DEPARTMENT OF PHYSICS

Revised Syllabus for

B.Sc. PHYSICS

With

CHOICE BASED CREDIT SYSTEM (CBCS)

(For students admitted from the academic year 2015-2016)

ETHIRAJ COLLEGE FOR WOMEN

(AUTONOMOUS)

CHENNAI 600 008

Department of Physics - Course Profile – 2015-16

CLASS	PART	COURSE CODE	COURSE TITLE	Hrs/Wk	Credits	MARKS		
						CA	SE	TOTAL
	Part I		Tamil/Hindi/French/Sanskrit	6	3	40	60	100
	Part II		English	4	3	40	60	100
	Part III	PH15/1C/PMS	Properties of Matter and Sound	7	5	40	60	100
	Part III	PH15/1C/MPR1	Major Practical I	3	0			
	Part III	MA15/1A/AM1	Allied Mathematics I	6	5	40	60	100
	Part IV		1a/1b/1c	2	2	NA	50	50
	Part IV		Soft Skill Subject*	2	3	NA	50	50
	Total W.Hrs/Credits			**30**	**21**			
			SEMESTER II					
	Part I		Tamil/Hindi/French/Sanskrit	6	3	40	60	100
	Part II		English	4	3	40	60	100
	Part III	PH15/2C/HTD	Heat &Thermodynamics	7	5	40	60	100
	Part III	PH15/2C/MPR1	Major Practical I	3	4	40	60	100
	Part III	MA15/1A/AM2	Allied Mathematics II	6	5	40	60	100
	Part IV		1a/1b/1c	2	2	NA	50	50
	Part IV		Soft Skill Subject*	2	3	NA	50	50
	Total W.Hrs/Credits			**30**	**25**			
	Total credits at the end of II sem				**46**			
	1a - Basic Tamil							
	1b - Advanced Tamil							

1c - Inter- Disciplinary NME Subject offered by the Department of Physics

PH15/1N/MSO// PH15/2N/MSO	Introduction to Microsoft office

CLASS	PART	COURSE CODE	COURSE TITLE	Hrs/Wk	Credits	MARKS		
						CA	SE	TOTAL
II YEAR			**SEMESTER III**					
	Part I		Tamil/Hindi/French/Sanskrit	6	3	40	60	100
	Part II		English	4	3	40	60	100
	Part III	PH15/3C/MCM	Mathematical Physics and Classical Mechanics	7	5	40	60	100
	Part III		Major Practical II	3	0	End of 4th semester		

	Part III	CH15/3A/PGC1	Allied Chemistry-General Chemistry 1	4	4	40	60	100
	Part III		Allied Chemistry Practical	2	0	End of 4th semester		
	Part IV		EVS	2	2	-	50	50
	Part IV		Soft Skill Subject*	2	3	-	50	50
	Total W.Hrs/Credits			**30**	**20**			
			SEMESTER IV					
	Part I		Tamil/Hindi/French/Sanskrit	6	3	40	60	100
	Part II		English	4	3	40	60	100
	Part III	PH15/4C/OPT	Optics	7	5	40	60	100
	Part III	PH15/4C/MPR2	Major Practical II	3	4	40	60	100
	Part III	CH15/4A/PGC2	Allied Chemistry-General Chemistry 2	4	4	40	60	100
	Part III	CH15/4A/PRA	Allied Chemistry Practical - Volumetric & Organic Analysis	2	2	40	60	100
	Part IV		Value Education	2	2	-	50	50
	Part IV		Soft Skill Subject*	2	3	-	50	50
	Total W.Hrs/Credits			**30**	**26**			
	Total credits at the end of IV sem				**46**			

***Soft Skill Subject offered by the Department of English**

CLASS	PART	COURSE CODE	COURSE TITLE	Hrs/Wk	Credits	MARKS		
						CA	SE	TOTAL
III YEAR			**SEMESTER V**					
	Part III	PH15/5C/NUP	Nuclear Physics	6	5	40	60	100
	Part III	PH15/5C/ETM	Electricity and Magnetism	6	5	40	60	100
	Part III	PH15/5C/ALP	Atomic and Laser Physics	6	5	40	60	100
	Part III	PH15/5E/EED	Basic Electronics and Electronic Devices	6	5	40	60	100
	Part III		Major General Practical III	3	0	End of 6th semester		
	Part III		Electronics Practical	3	0	End of 6th semester		
		Total W.Hrs/Credits		**30**	**20**			
			SEMESTER VI					
	Part III	PH15/6C/EMG	Electromagnetism	6	5	40	60	100

Part III	PH15/6E/DEM	Digital Electronics and Microprocessor	6	5	40	60	100
Part III	PH15/6C/RQM	Relativity and Quantum Mechanics	6	5	40	60	100
Part III	PH15/6E/MAS	Material Science	6	5	40	60	100
	or	or					
Part III	PH15/6E/ASP	Astrophysics	6	5	40	60	100
Part III	PH15/6C/MPR3	Major General Practical III	3	4	40	60	100
Part III	PH15/6C/EPR	Electronics Practical	3	3	40	60	100
Part V		NCC/NSS/CSS/Sports		1			
	Total W.Hrs/Credits		**30**	**28**			
	Total credits at the end of VI sem			**48**			
	Overall Total credits			140			

Allied Physics is offered for the students from the Department of Chemistry and Mathematics

CLASS	PART	CODE	SUBJECT	CREDITS
I B. Sc MATHS	Part III	PH15/1A/GP1	General Physics- 1	4
II B. Sc CHEMISTRY	Part III	PH15/3A/GP1	General Physics- 1	4
I B. Sc MATHS	Part III	PH15/2A/GP2	General Physics- 2	4
II B. Sc CHEMISTRY	Part III	PH15/4A/GP2	General Physics- 2	4
I B. Sc MATHS	Part III	PH15/2A/PPR	Allied Physics Practical	2
II B. Sc CHEMISTRY	Part III	PH15/4A/PPR	Allied Physics Practical	2

Department of Physics is revising syllabi with effect from the academic year 2015- 2016, under CBCS, Part – IV and Part – V components as specified by the Government of Tamil Nadu. Part – IV and Part –V components will seek to build the capacity of the students and provide inputs for their social service and social analysis capabilities.

Every academic year is divided into two semester sessions. Each semester will have a minimum of 90 working days and each day will have 5 working hours. Teaching is organized into a modular pattern of credit courses. Credit is normally related to the number of hours a teacher teaches a particular subject. It is also related to the number of hours a student spends learning a subject or carrying out an activity.

REGULATIONS

1. ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of B.Sc. Physics course shall be required to have passed the Higher Secondary Examinations conducted by the Government of Tamil Nadu or an Examination accepted as equivalent thereto by the Syndicate of the University of Madras.

2 ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study for a period of not less than three academic years, passed the examinations of all the Six Semesters prescribed and must have earned 140 credits.

3. COURSE OF STUDY:

The main subject of study for Bachelor Degree shall consist of the following:

PART – I : Foundation Courses exclusive for Languages.

PART – II : English

PART – III : Core courses

Allied Subjects I and II and Elective papers

PART – IV : Non Major Electives and Soft Skill Subjects

PART – V : Extension Activities / Sports / NCC

4. PASSING MINIMUM:

A candidate shall be declared to have passed in each paper / practical of the main subject of study wherever prescribed, if she secured NOT LESS THAN 40% of the marks prescribed for the examination.

5. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Part I, II, III & IV

Successful candidates passing the examination and securing the marks (i) 60 percent and above and (ii) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND class respectively. All other successful candidates shall be declared to have passed the examination in the THIRD class.

Candidates who pass all the examinations (Parts I, II, III and IV) prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for ranking.

Evaluation pattern

Continuous assessment - 40 marks

External examination - 60 marks (100 marks reduced to 60 marks)

Total - 100 marks

Scheme for Continuous assessment (Effective from 2015-2016)

Course Code	Course Title	Continuous Assessment				
		Test I	Test II	Quiz/Assignment Seminar	Participatory Learning	Total
ALL MAJOR AND ALLIED PAPERS		10	10	10	10	40

PRACTICALS

Course Code	Course Title	Continuous Assessment				
		Test I	Test II	Quiz/Assignment Seminar	Participatory Learning	Total
PRACTICAL PAPER		10	10	10	10	40

6. RUBRICS FOR CONTINUOUS ASSESSMENT EVALUATION:

Assignment: Appearance/ contents/ originality/ presentation/ schematic representation and diagram/ Bibliography

Seminar: organization/ subject knowledge/ visual aids/ confidence level/ presentation

Participatory learning: Answering questions/ clearing doubts/ participation in discussion/ attendance/ communication and language

SEMESTER – I

Properties of Matter and Sound

CORE – 1

COURSE CODE: PH15/1C/PMS **CREDITS: 5**

TEACHING HOURS: 15 X 7 = 105 HRS **L T P 4 3 0**

Objectives:

- To study the basic laws governing the behavior of matter and their application in specific systems.
- To give students a grounding in Acoustics and its applications.

COURSE OUTLINE:

UNIT I: Elasticity

Introduction-Hook's law-Elastic constants - relation connecting elastic constants - Poisson's ratio –Torsion: Twisting couple on a cylinder – Work done in twisting – Torsional oscillations – Rigidity modulus and moment of inertia by torsion pendulum - Rigidity modulus by static torsion.

20hrs

UNIT II: Bending of beams

Bending of beams – expression for bending moment – depression at the free end of a cantilever –Non-uniform bending – theory and experiment (microscope & telescope) – Uniform bending – theory and experiment (microscope and telescope) – I-form girders – non-uniform bending by Koenig's method. 20hrs

UNIT III: Fluids

Viscosity of liquids: Poiseulle's Formula – correction to the pressure head – determination of viscosity by capillary flow method – lubrication.

Surface Tension: Molecular theory of surface tension – surface energy - formation of drops - Relation between curvature, pressure and surface tension – it's application to spherical and cylindrical drops and bubbles – determination of surface tension and interfacial tension by drop weight method. 20hrs

UNIT IV: **Waves and Oscillations**

Simple Harmonic Motion (SHM) – energy of a particle executing SHM- composition of 2 SHM in a straight line and perpendicular to each other (periods in the ratio 1:1) -Newton Laplace's formula for the velocity of sound-effect of temperature, pressure & humidity. Laws of transverse vibration- velocity of tranverse wave along a stretched string –frequency determination- a.c. sonometer - Melde's experiment- Longitudinal waves in a rod- Kundt's tube. Doppler Effect: Definition - Expression for apparent frequency- observer at rest and source in motion, source at rest and observer in motion, both source and observer in motion.

25 hrs

UNIT V: Ultrasonics and Architectural Acoustics

Ultrasonics – definition - Production of ultrasonic waves - piezo–electric method, - Applications of ultrasonics.

Architectural Acoustics: Musical sound and noise – Characteristics of musical sound –Reverberation - Sabine's formula (Derivation not required) – Jaeger's method for finding reverberation time - Determination of absorption coefficient - Condition for good acoustics in auditoriums.

20 hrs

BOOKS FOR STUDY:

1. R.Murugesan, Properties of Matter and Acoustics, 2nd Edition, S.Chand & Co. Ltd. Reprint 2013.
2. R.KGaur and S.LGupta, Engineering Physics, Dhanpat and sons, 8th edition, New Delhi, 1993.
3. Brijlal and N.Subrahmanyam, Properties of Matter, 3rd Edition, S.Chand & Co., 2003.
4. Khanna and Bedi – A textbook of Sound, Atmaram & Sons, 1989
5. S.R.Govindarajan, T.Murugaiyan, T.Jayaraman – Sound, Rochouse & Sons, 1977.
6. N.Subrahmanyam and Brijlal - A textbook of Sound, Vikas publishing house Pvt. Ltd., 1985

BOOKS FOR REFERENCE:

1. D.S. Mathur, Properties of Matter, S.Chand & Co., Reprint 1987.
2. H. R.Gulati, Properties of Matter, S.Chand & Co, Delhi, 1994.
3. M.N.Srinivasan _ A textbook of Sound, Himalaya Publishing house, 1991.
4. D. Halliday, R. Resnick and J. Walker, Sixth edition Fundamentals of Physics, Wiley Eastern, 2001.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic
3. Hyperphysics

SEMESTER – I // III

Allied Paper - General Physics – I

ALLIED 1

COURSE CODE: PH15/1A/GP1 // PH15/3A/GP1 **CREDITS: 4**

TEACHING HOURS: 15 X 4 = 60HRS **LTP: 4 0 0**

Objectives:

- To expose the interdisciplinary areas of Physics
- To give broader idea about various areas of physics in a comprehensive manner.
- To prepare for various dimensions of problem solving.

UNIT I: **Simple harmonic motion**

Simple harmonic motion - composition of two simple harmonic motions at right angles (periods in the ratio 1:1) - lissajou's figures - Transverse vibration of stretched string - expression for the velocity of transverse waves - laws of transverse vibration of a string using sonometer - A.C. frequency measurement using sonometer (steel and Brass wires) - Ultrasonics – production - application and uses.

12 hrs

UNIT II: **Elasticity**

Elasticity - Elastic constants - bending of beams - depression of the cantilever- Young's modulus by non-uniform bending - energy stored in stretched wire - torsion of a wire -determination of rigidity modulus by torsional pendulum - Static torsion. 14 hrs

UNIT III: **Thermodynamics**

Laws of thermodynamics- zeroth law, first law and second law – Concept of Heat engine and its efficiency – Entropy - change of entropy in reversible and irreversible process 8 hrs

UNIT IV: **Electricity**

Current, current density, Ohm's law – calibraton of ammeter and voltmeter using potentiometer - Biot Savart's law - magnetic field along the axis of the circular coil – peak, average and RMS value of AC voltage and current – power factor in AC circuits. 12 hrs

UNIT V: **Geometrical Optics**

Refraction – refraction through narrow angled prism - dispersion through a thin prism – combination of two prisms to produce dispersion without deviation and deviation without dispersion – total internal reflection - principle of light propagation in optical fibers. 14 hrs

BOOKS FOR STUDY:

1. R.Murugesan, Allied Physics, S.Chand & Co, New Delhi, 1st edition, 2005.

2. R.Murugesan, Properties of Matter and Acoustics, 2nd Edition, Reprint 2013, S.Chand & Co. Ltd.

3. R.Murugeshan, Electricity and Magnetism, Chand & Company, reprint 2009.

BOOKS FOR REFERENCE:

1. Robert F.Kingsbury, Elements of Physics, 1st edition, Van Nostrand Company, Inc London, 1966.
2. Nelkon and Parker, Principles of Physics, Heinemann International literature and text books,7th revised edition, edition 1995.
3. R.Sen Gupta and H.L.Chatterjee J.N.Sen, A treatise on General properties of matter, 2nd edition, New Central Book Agency, Calcutta, 1988.
4. Brijlal and N.Subrahmanyam, Properties of Matter, 3rd Edition, S.Chand & Co., 2003.
5. Brijlal & Subramanium, Heat and Thermodynamics, S.Chand & Co.2002.
6. D.R. Kanna & R.S. Bedi, Textbook of Sound, Twelth edition, Atma Ram & Sons, New Delhi, 1980.
7. Brijlal and Subramanium,Text Book of Optics, S.Chand & Co, 2002.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic

SEMESTER – II

Heat and Thermodynamics

CORE- 2

COURSE CODE: PH15/2C/HTD **CREDITS: 5**

TEACHING HOURS: 15x7=105 Hrs **L T P: 4 3 0**

Objective:

To familiarize the students with the applications of heat energy and basic laws of thermodynamics and their applications in various fields.

UNIT I: Heat

Heat capacity - specific heat capacity- specific heat capacity of solids by Regnault's method of mixtures-specific heat of a liquid by Joule's electrical method-two specific heat capacities of a gas-Meyer's formula. Transmission of heat-propagation of heat waves in the earth's crust-conductivity of the earth's crust (K). Thermal radiation: application of heat radiation - solar constant-temperature of the sun-

sources of solar energy-the green house effect. 20hrs

UNIT II: Laws of Thermodynamics

Thermodynamic systems – Three class of System- Zeroth law of thermodynamics- Concept of heat-Work and Internal energy-first law of thermodynamics – significance and limitation of first law–application of first law - Mayer's relation- Isochoric, isobaric, isothermal and adiabatic processes- PVdiagrams. Second law of thermodynamics- Heat engine-reversible and irreversible processes- Statement and proof of Carnot's theorem - Carnot engine - internal combustion engine – petrol and diesel engines. 20hrs

UNIT III: Entropy

Concept of entropy – Physical concept of entropy - Entropy and second law of thermodynamics - entropy of an ideal gas – entropy change in reversible and irreversible processes - Temperature-entropy diagram – Physical significance of entropy - Thermodynamic scale of temperature and it's relation to perfect gas scale - Third law of thermodynamics – zero point energy – heat death of the universe.

20hrs

UNIT IV: Maxwell's thermo dynamical relations

Thermodynamic variables – Extensive and intensive variables – Maxwell's thermodynamical relations (general relationship) - Thermodynamic potentials - Internal energy - Gibb's, Helmholtz, Enthalpy functions – Significance of thermodynamic potentials - Derivation of Maxwell's equations from potentials – Application of Maxwell's thermodynamic equations – Specific heat relation (Meyer's relation) – First and second Latent heat equation – Joule Kelvin effect - First and second TdS equations –- Equilibrium between liquid and its vapour – First order phase transitions – Second order phase transitions (Ehrenfest's equations) 20hrs

UNIT V: Statistical Thermodynamics

Phase Space - Micro and Macro states – Ensembles - different types of ensembles Definition of probability – relation between entropy and probability - Degrees of freedom – statement of theorem of equipartition of energy - Classical statistics - Maxwell Boltzman statistics - expression for distribution of energy by Maxwell – Boltzman statistics – difficulty of classical statistics - Quantum statistics – Bose-Einstein statistics - expression for distribution of energy for Bose Einstein gas – Fermi-Dirac statistics – expression for energy of Fermi-Dirac gas - comparison of three statistics. 25hrs

BOOKS FOR STUDY:

1. Brijlal and N.Subramanyam, Heat Thermodynamics and Statistical Physics, S.Chand &

Co, Revised Edition 2012.

2. R.Murugesan &Kiruthiga Sivaprasath, Thermal, S.Chand & Co. Revised Edition 2012.
3. D.S. Mathur, Heat and Thermodyanamics, Sultan Chand & Sons, New Delhi, Reprint 2008.

4. D. Jayaraman and K. Illangovan, Thermal Physics and Statistical Mechanics, New Age International Publications.

5. B.K. Agarwal and M. Eisner, Statistical Mechanics, New Age International Publications.

6. Fundamentals of Statistical Mechanics by B.B. Laud, New Age International Publications, 2ed Edition, 2012.

BOOKS FOR REFERENCE:

1. Francis W.Sear and Gerhard S. Salinger, Thermodynamics, Kinetic Theory and statistical Thermodynamics, 3rd Edition, Narosa Publishing House, New Delhi, 1986.

2. Mark.W.Zemansky, Heat and Thermodynamics, 6th Edition, Mc Graw Hill Book Company Inc., Co., 1982.

3. C.L. Arora and Dr. P.S. Hemne, Physics for degree students, First Edition, S. Chand and Co., Ltd., New Delhi, 2012.

WEB REFERENCES

1. www.britannica.com/science/topic
2.en.wikipedia.org/wiki/topic
3. Hyperphysics

SEMESTER – II / IV

Allied Paper - General Physics -II

ALLIED - 2

COURSE CODE: PH15/2A/GP2// PH15/4A/GP2 **CREDITS: 4**

TEACHING HOURS: 15 X 4 = 60HRS **L T P: 4 0 0**

Objectives:

- To expose the students to the interdisciplinary areas of Physics
- To give broader idea about various areas of Physics in a comprehensive manner.
- To prepare the students for various dimensions of problem solving in Physics.

UNIT I: Physical Optics

Interference - Interference in thin films - Air wedge –-determination of diameter of a thin wire by air wedge - Newton's rings: expression for radii of the rings – determination of wavelength of sodium light - Diffraction - diffraction grating - theory of transmission grating - normal incidence - polarization - Double refraction - Nicol prism -Optical activity – Laurent's half shade polarimeter. 15 hrs

UNIT II: Atomic Physics

Vector atom model – spatial quantization, electronic configuration - Pauli's exclusion principle - various quantum numbers – photoelectric effect: definition and laws. 9 hrs

UNIT III: Nuclear Physics

Nuclear model - liquid drop model –- Nuclear energy - mass defect - Binding energy - Radiation Detectors: GM counters – Nuclear fission - controlled and uncontrolled chain reaction – nuclear reactor - Nuclear fusion - Thermonuclear reactions. 12 hrs

UNIT IV: Relativity

Postulates of theory of relativity - Lorentz transformation equation - derivation - length contraction - time dilation - mass energy equivalence. 10 hrs

UNIT V: Electronics

Introduction to semi conductors - Junction diode - characteristics – Zener diode - Voltage regulator - Junction transistor - CE mode – characteristics - Boolean algebra - AND,OR & NOT gates - construction using diodes – Demorgan's theorem – verification- NAND and NOR gates - universal building blocks.

BOOKS FOR STUDY

1. R.Murugesan, Allied Physics, first edition, S.Chand & Co, New Delhi, 2005.
2. Brijlal and Subramanium ,Text Book of Optics, S.Chand & Co Ltd., 2002.
3. R.Murugesan, Modern Physics, S.Chand & Co, 2002.
4. V.Vijayendran, Introduction to Integrated Electronics , S.Vishwathan Publishers Ltd., Chennai, 1st edition, 2005

BOOKS FOR REFERENCE

1. Nelkon and Parker, Principles of Physics, Heinemann International literature and text books,7th revised edition, edition 1995.
2. Malvino and Leach , Digital principles and application ,4th edition, Tata Mcgraw Hill, 1992

WEB REFERENCES

1. www.britannica.com/science/topic

2. en.wikipedia.org/wiki/ topic

MAJOR PRACTICAL - I

COURSE CODE: PH15/2C/MPR1 **CREDITS: 4**

TEACHING HOURS: 30 X 3=90 HRS

1. Orientation I – Learning screw gauge, vernier calipers & microscope.
2. Orientation II – Learning spectrometer and electric circuit connections.
3. Young's Modulus of the material of a beam- By non-uniform bending using Scale and Telescope (Graphical method to determine q and mass of the unknown body).
4. Young's Modulus q of the material of a beam- By uniform bending using Pin and Microscope (Graphical method to determine q and mass of the unknown body).
5. Rigidity Modulus n of the material of a wire -Torsion Pendulum. (Graphical method to determine n of the material of the wire).
6. Rigidity Modulus n of the material of a rod by static torsion. (Graphical method to determine n and mass of the unknown body).
7. Coefficient of viscosity of the given liquid by Poiseuille's method. (Measurement of radius by microscope method).
8. Surface Tension and Interfacial surface tension of a liquid by drop weight method.
9. Determination of acceleration due to gravity - Compound Pendulum.
10. Specific Heat Capacity of solid and hence the liquid – Method of mixtures. (Half time correction)
11. Frequency of a tuning fork – verification of laws using Sonometer.
12. Specific Gravity of solid and liquid - Sonometer (3sets of tuning forks given).
13. Frequency of AC mains - AC Sonometer using steel wire and electromagnet.
14. Velocity of longitudinal waves in a rod – Kundt's Tube.
15. To find the diameter of the given material - Air Wedge (2 sets).
16. Refractive index of a solid prism – Spectrometer.
17. Refractive index of a hollow prism Spectrometer.
18. Calibration of low range voltmeter - Potentiometer.

ALLIED PHYSICS PRACTICAL

ALLIED 3

COURSE CODE: PH15/2A/PPR & PH15/4A/PPR **CREDITS: 2**

TEACHING HOURS: 30 x 2 = 60HRS

1. 1.Orientation I – Learning screw gauge, Vernier calipers & microscope
2. 2.Orientation II – Learning spectrometer and electric circuit connections.
3. 3.Young's modulus of the material of a beam - non-uniform bending using pin and microscope.
4. Rigidity modulus of the material of a rod – using static torsion apparatus.
5. Rigidity modulus of the material of a wire - using torsional pendulum.
6. Characteristics of a Junction diode.
7. Determination of frequency of AC mains - using Sonometer, steel wire and electromagnet.
8. Frequency of a tuning fork - using Sonometer.
9. Thickness of a wire - Air Wedge.
10. Determination of radius of curvature of the lens - Newton's rings (Given - wavelength of sodium light).
11. Determination of wavelength of prominent lines of mercury spectrum - using Spectrometer and Grating by Normal incidence method.
12. Calibration of a low range voltmeter - using Potentiometer.
13. Calibration of an ammeter - using Potentiometer.
14. Determination of B_H using the field along the axis of a circular coil carrying current using deflection magnetometer.
15. Characteristics of a Zener diode.
16. Construction of AND, OR and NOT gates using junction diodes and using transistors.
17. Verification of De Morgan's theorem using ICs.
18. NAND & NOR gates as Universal building Blocks.

SEMESTER – I//II
Introduction to Microsoft Office
[ONLY PRACTICALS]

COURSE CODE: PH15/1S/MSO// PH15/2S/MSO **CREDITS: 3**

TEACHING HOURS: 15 X2 =30 HRS **LTP: 0 0 2**

UNIT – I

MS-WORD: Introduction-File Menu-Cut, Copy and Moving Text-Find and Replace-Formatting the document (Font, Paragraph, Bullets & Numbering)-Inserting Page breaks-Page numbers-Pictures-Header & Footer – Creating tables.

UNIT – II

MS-EXCEL: Introduction-Managing Workbooks-Editing data-Formatting cells-Insert row, Column-Creating a table for payroll program using Formulas-Aligning text & numbers-simple chart-Sorting records.

UNIT - III

MS-POWERPOINT: Introduction-Creating new presentation-Custom animation-Slide transition-Rehearse timing-Setup show.

TEXT BOOK:

Elements of Computer Applications by Anandhi Seshasayee.

SEMESTER- III

Mathematical Physics and Classical Mechanics

CORE – 3

COURSE CODE: PH15/3C/MCM **CREDITS: 5**

TEACHING HOURS: 15 X 7 = 105 HRS **L T P 4 3 0**

Objective:

To equip the students with the necessary mathematical skills required in the understanding of advanced Physics.

UNIT I: Vector analysis

Gradient of a scalar field- line, surface, volume integrals- Divergence of a vector function- expression for divergence in cartesian coordinates- Curl of a vector function- expression for curl in cartesian coordinates- physical significance of curl- Important Vector Identities-Gauss Divergence Theorem- Stoke's Theorem- Green's Theorem (Theorems only). 21hrs

UNIT II: Matrices

Matrices in Physics- Characteristic Equation of a Matrix- Cayley Hamilton Theorem- Special Types of Matrices and its Properties - square matrix- diagonal matrix- scalar matrix- identity matrix- null matrix- upper and lower triangular matrices- transpose of a matrix- hermitian matrix- symmetric and anti symmetric matrices- orthogonal matrix- adjoint of a matrix- inverse of a matrix. 21hrs

UNIT III: Special functions and Statistics

Special Functions- Beta and Gamma Functions- Definitions- fundamental properties of gamma functions- value of gamma ½- transformation of gamma function- Different forms of Beta function- relation between beta and gamma function- Bessel's Differential equation- bessel's functions of first kind- recurrence formula for J_n (x). 21hrs

UNIT IV: Classical Mechanics

Classical Mechanics- Mechanics of a system of Particles- Conservation theorem for Linear momentum, Conservation theorem for angular momentum, Conservation theorem for energy - Degrees of Freedom- Constraints- Generalised Coordinates- Generalised displacement, velocity, momentum, force, potential - Transformation Equations - Configuration Space - Principle of Virtual work - D'Alembert's Principle - derivation of Lagrange's equation from D'Alembert's principle for a conservative system. 21hrs

UNIT V: Applications

Applications of Lagrange's Equations - Atwood's machine - application to simple pendulum - Hamiltonian Formulation – derivation of Hamilton's equation from Lagrange equation and application of Hamiltonian equation to harmonic oscillator. 21hrs

BOOKS FOR STUDY:

1. R.Murugesan, Mechanics and Mathematical Methods, 2nd Edition S.Chand & Co.,1999.
2. B.D.Gupta, Mathematical Physics, 3rd Edition, Vikas Publishing House Pvt.Ltd.., 2002.
3. S.P.Gupta, Statistical Methods, 1st Edition, Sultan Chand & Sons.,2006.
4. H.Goldstein, Classical Mechanics, 3rd Edition, Pearson Education, New Delhi, 2003.

BOOKS FOR REFERENCE:

1. H.K.Dass, Gupta R.K. & Sharma H.C, Mathematical Physics, 4th Edition ,S. Chand & Co, 2003.
2. Sathya Prakash, Mathematical Physics, 4th Edition,S.Chand & Co., 2002.
3. W.W. Bell, Special functions for Scientists and Engineers, Dover Publications, 2004
4. Schaum Series, Fourier Analysis with Applications to Boundary Value Problems, McGraw Hill, 1974.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic
3. Hyperphysics
4. nptel.ac.in

SEMESTER – I // III

Allied Paper - General Physics – I

ALLIED 1

COURSE CODE: PH15/1A/GP1 // PH15/3A/GP1 **CREDITS: 4**

TEACHING HOURS: 15 X 4 = 60 HRS **LTP: 4 0 0**

Objectives:

- To expose the interdisciplinary areas of Physics
- To give broader idea about various areas of physics in a comprehensive manner.
- To prepare for various dimensions of problem solving.

UNIT I: **Simple harmonic motion**

Simple harmonic motion - composition of two simple harmonic motions at right angles (periods in the ratio 1:1) - lissajou's figures - Transverse vibration of stretched string - expression for the velocity of transverse waves - laws of transverse vibration of a string using sonometer - A.C. frequency measurement using sonometer (steel and Brass wires) - Ultrasonics – production - application and uses.
12 hrs

UNIT II: **Elasticity**

Elasticity - Elastic constants - bending of beams - depression of the cantilever- Young's modulus by non-uniform bending - energy stored in stretched wire - torsion of a wire -determination of rigidity modulus by torsional pendulum - Static torsion.

14 hrs

UNIT III: **Thermodynamics**

Laws of thermodynamics- zeroth law, first law and second law – Concept of Heat engine and its efficiency – Entropy - change of entropy in reversible and irreversible process

8 hrs

UNIT IV: **Electricity**

Current, current density, Ohm's law – calibraton of ammeter and voltmeter using potentiometer - Biot Savart's law - magnetic field along the axis of the circular coil – peak, average and RMS value of AC voltage and current – power factor in AC circuits. 12 hrs

UNIT V: **Geometrical Optics**

Refraction – refraction through narrow angled prism - dispersion through a thin prism – combination of two prisms to produce dispersion without deviation and deviation without dispersion – total internal reflection - principle of light propagation in optical fibers.

14 hrs

BOOKS FOR STUDY:

1. R.Murugesan, Allied Physics, S.Chand & Co, New Delhi, 1st edition, 2005.
2. R.Murugesan, Properties of Matter and Acoustics, 2nd Edition, Reprint 2013, S.Chand & Co. Ltd.
3. R.Murugeshan, Electricity and Magnetism, Chand & Company, reprint 2009.

BOOKS FOR REFERENCE:

1. Robert F.Kingsbury, Elements of Physics, 1st edition, Van Nostrand Company, Inc London, 1966.
2. Nelkon and Parker, Principles of Physics, Heinemann International literature and text books,7th revised edition, edition 1995.
3. R.Sen Gupta and H.L.Chatterjee J.N.Sen, A treatise on General properties of matter, 2nd edition, New Central Book Agency, Calcutta, 1988.
4. Brijlal and N.Subrahmanyam, Properties of Matter, 3rd Edition, S.Chand & Co., 2003.
5. Brijlal & Subramanium, Heat and Thermodynamics, S.Chand & Co.2002.

6.D.R. Kanna & R.S. Bedi, Textbook of Sound, Twelth edition, Atma Ram & Sons, New Delhi, 1980.

7. Brijlal and Subramanium,Text Book of Optics, S.Chand & Co, 2002.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic
3. nptel.ac.in
4. Hyperphysics

SEMESTER -IV

Optics

CORE – 4

COURSE CODE: PH15/4C/OPT **CREDITS: 5**

TEACHING HOURS: 15 X 7 = 105 HRS **L T P 4 3 0**

Objective:

To provide the foundation in physical optics and to provide basic ideas of fiber optic communications.

UNIT I: Interference

Introduction - Analytical treatment of interference – Expression for intensity - Theory of interference fringes - Interference by reflected light - wedge shaped film - Newton's rings- Determination of wavelength of sodium light - Determination of μ of a liquid- Michelson's Interferometer and applications : Determination of wavelength of light – Resolution of spectral lines.
22hrs

UNIT II: Diffraction

Introduction- Fresnel explanation of rectilinear propagation of light- zone plate- Fresnel diffraction at a circular aperture- straight edge- Fraunhoffer diffraction at a single slit- double slit - Plane transmission diffraction grating- dispersive power of grating- determination of wavelength of light using transmission grating.

22hrs

UNIT III: Resolving power

Definition - Rayleigh's criterion for resolution – Resolving power of Telescope – derivation , Relation between magnifying power and resolving power of a telescope - Resolving power of Microscope – derivation, Resolving power of Prism and Grating – Comparison of prism and grating spectra. 18hrs

UNIT IV: Polarization

Introduction - polarization by reflection - double refraction – Principle and Construction of Nicol prism – Polaroids and their uses - theory of the production of elliptical and circularly polarized light - Quarter wave plate - Half wave plate - production and detection of plane, circular and elliptically polarized light - optical activity - Biot's law - specific rotation – Laurent's half shade polarimeter – Faraday effect.
23hrs

UNIT V: Geometrical Optics and Fibre Optics

Refraction – refraction through narrow angled prism - dispersion through a thin prism – combination of two prisms to produce dispersion without deviation and deviation without dispersion – total internal reflection – introduction to the principle of light propagation in optical fibers.
20hrs

BOOKS FOR STUDY:

1. R.Murugeshan, Optics and Spectroscopy,6th edition ,S.Chand & Co., Pvt Ltd, New Delhi, Reprint 2008
2. N.Subrahmanyan & Brij Lal, A text book of optics, 22nd edition, S.Chand & Co., Pvt Ltd NewDelhi,2004.
3. Senthil Kumar, Engineering Physics, 6th Edition, VRB Publishers Pvt. Ltd.,

BOOK FOR REFERENCE:

1. Jenkins A Francis and White E Harvey, Fundamentals of Optics, McGraw Hill Inc., New Delhi, 1976.
2. Raj M.G, Fundamentals of Optics, Anmol Publication Pvt. Ltd, New Delhi, 1996.
3. Subir Kumar Sarkar, Optical fibres and fibre optic communication systems, Revised Edition, S.Chand & Co., 2007.
4. R.Murugesan, Allied Physics, S.Chand & Co, New Delhi, 1st edition, 2005.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic
3. Hyperphysics
4. nptel.ac.in

SEMESTER – II / IV

Allied Paper - General Physics -II

ALLIED - 2

COURSE CODE: PH15/2A/GP2// PH15/4A/GP2 **CREDITS: 4**

TEACHING HOURS: 15 X 4 = 60HRS **L T P: 4 0 0**

Objectives:

- To expose the students to the interdisciplinary areas of Physics
- To give broader idea about various areas of Physics in a comprehensive manner.
- To prepare the students for various dimensions of problem solving in Physics.

UNIT I: Physical Optics

Interference - Interference in thin films - Air wedge –-determination of diameter of a thin wire by air wedge - Newton's rings: expression for radii of the rings – determination of wavelength of sodium light - Diffraction - diffraction grating - theory of transmission grating - normal incidence - polarization - Double refraction - Nicol prism -Optical activity – Laurent's half shade polarimeter.
15 hrs

UNIT II: Atomic Physics

Vector atom model – spatial quantization, electronic configuration - Pauli's exclusion principle - various quantum numbers – photoelectric effect: definition and laws. 9 hrs

UNIT III: Nuclear Physics

Nuclear model - liquid drop model –- Nuclear energy - mass defect - Binding energy - Radiation Detectors: GM counters – Nuclear fission - controlled and uncontrolled chain reaction – nuclear reactor - Nuclear fusion - Thermonuclear reactions.
12 hrs

UNIT IV: Relativity

Postulates of theory of relativity - Lorentz transformation equation - derivation - length contraction - time dilation - mass energy equivalence.
10 hrs

UNIT V: Electronics

Introduction to semi conductors - Junction diode - characteristics – Zener diode - Voltage regulator - Junction transistor - CE mode – characteristics - Boolean algebra - AND,OR & NOT gates - construction using diodes – Demorgan's theorem – verification- NAND and NOR gates - universal building blocks.
14 hrs

BOOKS FOR STUDY:

1. R.Murugesan, Allied Physics, first edition, S.Chand & Co, New Delhi, 2005.
2. Brijlal and Subramanium ,Text Book of Optics, S.Chand & Co Ltd., 2002.
3. R.Murugesan, Modern Physics, S.Chand & Co, 2002.
4. V.Vijayendran, Introduction to Integrated Electronics , S.Vishwathan Publishers Ltd., Chennai, 1st edition, 2005

BOOKS FOR REFERENCE:

1. Nelkon and Parker, Principles of Physics, Heinemann International literature and text books,7th revised edition, edition 1995.
2. Malvino and Leach , Digital principles and application ,4th edition, Tata Mcgraw Hill, 1992

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/ topic
3. nptel.ac.in
4. Hyperphysics

MAJOR PRACTICAL - II

COURSE CODE: PH15/4C/MPR2 **CREDITS: 4**

TEACHING HOURS: 30 X 3=90 HRS

1. Young's Modulus of the material of a beam - By uniform bending using microscope. (Graphical method to determine q and mass of the unknown body).

2. Young's Modulus of the material of a beam - By uniform bending using scale and telescope. (Graphical method to determine q and mass of the unknown body).

3. Rigidity modulus of the material of a wire using torsion pendulum (with symmetrical masses).

4. Specific heat capacity of liquid (without voltmeter using Post Office Box) - Joule's Calorimeter.

5. Frequency of a.c mains (Using Brass wire and Horse shoe Magnet) - AC Sonometer.

6. Frequency by tranverse and longitudinal modes of vibration – Meldes Apparatus.

7. Field along the axis of a coil B_H – Deflection Magnetometer.

8. Specific resistance & verification of laws of resistance - Carey Foster's Bridge.

9. Verification of laws of resistance - P.O.Box.

10. Figure of Merit – B.G.

11. Charge sensitivity – B.G.

12. Comparison of Resistances and Specific Resistance of a wire - Potentiometer.

13. Refractive index of a lens - Newton's Rings.

14. Refractive index of the material of a prism - i-d curve - Spectrometer.

15. Determination of wavelength of prominent lines of mercury spectrum by Normal Incidence Method – Spectrometer.

16. Calibration of low range ammeter - Potentiometer.

ALLIED PHYSICS PRACTICAL

ALLIED 3

COURSE CODE: PH15/2A/PPR & PH15/4A/PPR Credits: 2

TEACHING HOURS: 30 x 2 = 60HRS

1. Orientation I – Learning screw gauge, Vernier calipers & microscope
2. Orientation II – Learning spectrometer and electric circuit connections.
3. Young's modulus of the material of a beam - non-uniform bending using pin and microscope.
4. Rigidity modulus of the material of a rod – using static torsion apparatus.
5. Rigidity modulus of the material of a wire - using torsional pendulum.
6. Characteristics of a Junction diode.
7. Determination of frequency of AC mains - using Sonometer, steel wire and electromagnet.
8. Frequency of a tuning fork - using Sonometer.
9. Thickness of a wire - Air Wedge.
10. Determination of radius of curvature of the lens - Newton's rings (Given - wavelength of sodium light).
11. Determination of wavelength of prominent lines of mercury spectrum - using Spectrometer and Grating by Normal incidence method.
12. Calibration of a low range voltmeter - using Potentiometer.
13. Calibration of an ammeter - using Potentiometer.

19. Determination of B_H using the field along the axis of a circular coil carrying current using deflection magnetometer.

20. Characteristics of a Zener diode.

21. Construction of AND, OR and NOT gates using junction diodes and using transistors.

22. Verification of De Morgan's theorem using ICs.

23. NAND & NOR gates as Universal building Blocks.

SEMESTER – V

Nuclear Physics

CORE – 5

COURSE CODE: PH15/5C/NUP CREDITS: 5

TEACHING HOURS: 15 x 6 = 90 HRS L T P 4 2 0

Objective:

- To give the students a theoretical grounding in nuclear and particle Physics

UNIT I: Introduction to the nucleus

Classification of nuclei - Properties of nucleus - nuclear size - charge- mass - density - Mass defect –Binding energy of a nucleus – Packing fraction – Nuclear models : liquid drop model – Weizacker's semi empirical mass formula – Shell model and magic numbers – Nuclear forces – Meson theory of nuclear forces.
15 hrs

UNIT II: Particle accelerators

Principle and working of accelerators - Linear accelerators – Cyclotron – Synchrocyclotron – Betatron – Synchrotrons: electron synchrotron and proton synchrotron.

15 hrs

UNIT III: Radioactivity

Alpha rays – Properties - Alpha ray spectra – Gamow's theory of alpha decay – Beta rays – Characteristics - Beta ray spectra – Neutrino theory of beta decay – k-electron capture - Gamma ray – Properties - Nuclear isomerism – lnternal conversion.

Radiation Hazards: Radiation Hazards - Radiation levels for safety - Radiation protection methods - Nuclear disasters - Nuclear waste disposal. 20 hrs

UNIT IV: Nuclear fission and fusion

Nuclear reaction – energy balance in nuclear reaction and Q-value – threshold energy – Laws of radioactivity: Soddy Fajan's Displacement Law – Half life period - Mean life - Nuclear fission –Chain reaction, critical mass and size, controlled chain reaction – nuclear reactor – fast breeder – Nuclear fusion – thermonuclear reactions – source of stellar energy.
20hrs

UNIT V: Elementary particles

Introduction to elementary particles – Particles and Anti-particles – Antimatter - Fundamental interactions (Gravitational, Electromagnetic, strong and weak) – Elementary

particle quantum numbers – Conservation laws and symmetry – The Quark Model. 20 hrs

BOOKS FOR STUDY:

1. R.Murugeshan, Modern Physics, Tenth Edition. S.Chand& Co, New Delhi, 2002.
2. Sehgal and Chopra, Modern Physics, Ninth Edition, Sultan Chand & Sons,
3. Tayal, Nuclear Physics, Himalaya Publishing House, Mumbai- 2002.
4. Irving Kaplan, Nuclear Physics, 2nd Edition, Oxford & IBH Publish & Co., NewDelhi, 1962.

BOOKS FOR REFERENCE:

1. S. M. Ghoshal, Atomic and Nuclear Physics, S.Chand & Company, 1997.
2. H.S.Mani, G.K. Metha, Introduction to Modern Physics, Affiliated East-West Pvt.Ltd., New Delhi, 1990.
3. Roy And Nigam, Nuclear Physics, First edition, Wiley Eastern Limited, New Delhi, 1967.
4. Blatt and Weisskopf, Theoretical Nuclear Physics, First Edition, John Wiley and Sons, New York, 1952.
5. Segre W.A.Benjamin , Nuclei & Particles, Second edition USA, 1965.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic
3. Hyperphysics
4. nptel.ac.in

SEMESTER – V

Electricity and Magnetism

CORE – 6

COURSE CODE: PH15/5C/ETM CREDITS: 5

TEACHING HOURS: 15 x 6 = 90 HRS L T P 4 2 0

Objective:

- To help students understand the basic concepts of electricity and realize their applications.

UNIT I: Electric charges

Permittivity of free space – relative permittivity – electric intensity – intensity due to a point charge – normal electric induction – Gauss theorem in electrostatics – its application to insulated conductor - uniformly charged sphere (conducting and non-conducting) and uniformly charged non-conducting cylinder – Coulomb's theorem – mechanical stress on unit area of a charged conductor – application to electrified soap bubble.

15 hrs

UNIT II: Electric potential & Capacitors

Definition for potential, potential difference, equipotential surface-Relation between potential and intensity – potential and intensity due to a uniformly charged sphere (conducting and non-conducting) – Electric dipole – potential and intensity due to a dipole.

Principle of a capacitor, capacitor in series and parallel, uses of capacitor-Capacity of a spherical - parallel and cylindrical condensers – Dielectric constant - effect of dielectric on capacity – change in energy of a parallel plate condenser on introduction of a dielectric slab – Energy of a charged condenser – loss of energy on sharing of charges.

20hrs

UNIT III: Network theorems

Kirchoff's laws – Thevenin's theorem – Norton's theorem – Superposition theorem – Maximum power transfer theorem – applications (simple problems). 15 hrs

UNIT IV: Electrical Measurements and Thermoelectricity

Principle of Wheatstone Bridge – Carey Foster's bridge and its applications – Potentiometer – principle – calibration of low range - high range voltmeter and ammeter – Thermoelectricity – Seebeck effect – Peltier and Thomson coefficients – Experiments to measure thermo e.m.f. using potentiometer – application of thermodynamics to a thermocouple – Peltier and Thomson coefficients – Thermo electric diagrams.

20 hrs

UNIT V: Magnetism

Introduction- Magnetic induction- Magnetization-Susceptibility–Permeability– Relation-Different types of magnetic materials– Properties of Dia, Para, Ferro, Antiferro and Ferri magnetic materials- Langevin's theory of dia and paramagnetism - Magnetic domain – Weiss's theory of ferromagnetism-Hysteresis-Experiment to draw M-H curve (horizontal model) – Energy loss due to hysteresis – Importance of hysteresis curves.

20 hrs

BOOKS FOR STUDY:

1. R.Murugeshan, Electricity and Magnetism, reprint 2009. S. Chand & Company

2. Brijlal & N.Subrahmanyam, Electricity and Magnetism, Revised Edition 2006, S. Chand & Company.
3. R.S. Sedha, A text book of Applied Electronics, reprint 2006, S. Chand & Company.

BOOKS FOR REFERENCE:

1. D.N.Vasudevan, Electricity and Magnetism, 12th Edition, S. Chand & Company.
2. D.C.Pandey, Electricity and Magentism, 2008, Arihant Prakashan.
3. Alan Giambattista, Richardson and Richardson, Fundamentals of Physics, 2008, Tata Mc Graw Hill Publishing Company.
4. John Bird,Electrical Principles and Technology for Engineering,1995, An imprint of Butterworth-Heinemann Ltd Linacre House, Jordan Hill, Oxford.

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2. en.wikipedia.org/wiki/topic
3. Hyperphysics
4. nptel.ac.in

SEMESTER –V

Atomic and Laser Physics

CORE – 7

COURSE CODE: PH15/5C/ALP **CREDITS: 5**

TEACHING HOURS: 15 X 6 = 90 HRS **L T P 4 2 0**

Objective:

- To gain the fundamental understanding of the interaction of atoms, molecules, and electromagnetic radiation.
- To understand the structure of matter and how matter evolves at the atomic and molecular level.

UNIT I: Structure of Atom

Atom model - vector atom model - spatial quantization - spinning electron - quantum numbers associated with the vector atom model - Coupling schemes - Pauli's exclusion principles - Periodic classification of elements - examples of electron configuration. 18 hrs

UNIT II: Application of Vector Atom Model

Magnetic dipole moments due to orbital motion and electron spin - Bohr magneton - experimental conformity of the vector atom model - Stern and Gerlach experiment - principle and experimental procedure - interpretation of the result – Spin-Orbit Coupling - Optical spectra- spectral terms and their notations – selection rules - Fine structure of sodium D - line.

18 hrs

UNIT III: Effect of atoms in electric and magnetic fields

Zeeman effect – experimental arrangement for the normal Zeeman effect- Lorentz classical theory of normal Zeeman effect- Larmor's theorem – quantum mechanical explanation of the normal Zeeman effect -anomalous Zeeman effect - Stark effect – derivation . 18 hrs

UNIT IV: X- rays

Introduction- Production of x-rays (Coolidge Tube) –diffraction of x-rays by crystals- Bragg's law in one dimensional – Bragg's spectrometer - verification of Bragg's law- powder crystal method.

X-Ray Spectra: Continuous and characteristic X-ray spectra - Moseley's law - its importance - Compton effect - experimental demonstration of Compton effect.
18hrs

UNIT V: Lasers

Stimulated and Induced Emission and Induced Absorption - Population inversion – Three level system - Ruby Laser - Four level Laser –Helium-Neon laser– Applications of Lasers in industry, medicine and communication.
18hrs

BOOKS FOR STUDY:

1. C.Kittel, An introduction to solid state Physics, 7th Edition, John Wiley and Sons, 2007
2. R.Murugesan, Modern Physics, 10th edition, S Chand and Co., 2002.
3. Laud B.B, Laser and Non-Linear Optics, 1st edition, Willey Eastern, Ltd, New York, 1985.
4. Avadhanulu, An Introduction to Laser Theory and Applications, 2nd Edition, S Chand & Co., New Delhi, 2001.
5. Richard S.Quimby , Photonics and Lasers, first edition, Wiley Publishers, March 2007.

BOOKS FOR REFERENCE:

1. J.B. Rajam, Atomic Physics, S Chand and Co, 1905
2. Arthur Beiser, Concepts of Modern Physics, 6th Edition, Mc Graw Hill, Inc, 2002

WEB REFERENCES

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2. en.wikipedia.org/wiki/topic
3. Hyperphysics
4. nptel.ac.in

SEMESTER – V

Basic Electronics and Electronic Devices

ELECTIVE – 1

COURSE CODE: PH15/5E/EED **CREDITS: 5**

TEACHING HOURS: 15 X 6 = 90 HRS **L T P 4 2 0**

Objective:

- To give a broad coverage on the study of diodes and transistors as a circuit element in different configurations
- To understand the performance of rectifier, amplifier and oscillator circuits.

UNIT I: Introduction to Semiconductors

Introduction – definition and properties- intrinsic, extrinsic semiconductors – n type and p type - PN junction - properties– biasing – current flow- V-I characteristics - important terms- limitations on the operating conditions - diode volt-ampere equation- Fermi level in a semiconductor - EBD of p - type and n-type semiconductors - EBD of PN junction under thermal equilibrium - EBD for a forward bias, reverse bias junction diode .

15 Hrs

UNIT II: Semiconductor devices

Crystal Diode as Rectifiers and its efficiency: Half wave rectifier –Full wave center tap rectifier –full wave bridge rectifier — nature of rectifier output - ripple factor – filter circuits –types. Voltage stabilization – Zener diode – equivalent circuit - Zener diode as a voltage regulator.

Junction Transistor - construction and working of a transistor – Transistor connections and Characteristics in CB, CE and CC mode - Comparative study of the parameters in different configuration. Transistor as an amplifier in CE arrangement - load line analysis - operating point -Biasing– voltage-divider bias. 20 Hrs

UNIT III: Special Devices

Field Effect Transistor (FET) – types-JFET- construction and working – parameters-characteristics-expression for saturation drain current- Uni Junction Transistor (UJT) – construction and working - equivalent circuit-characteristics- UJT as relaxation oscillator - Silicon Controlled Rectifier (SCR) – construction and working-equivalent circuit-important terms-characteristics- SCR as a half wave and full wave rectifier. 18 Hrs

UNIT IV: Oscillators using Transistors

Concept of feedback -negative and positive feedback- principles of negative voltage feedback in amplifiers – gain – advantages – feedback circuit – Sinusoidal oscillators: types – oscillatory circuit – undamped oscillations from tank circuit – positive feedback amplifier – essentials - Barkhausen condition for oscillation –Hartley and Colpitt's oscillator . 15 Hrs

UNIT V: Operational amplifier

Introduction to operational amplifier - Characteristics and parameters – Op-Amp circuits: comparator, Schmitt trigger, inverting and non-inverting amplifier, adder and subtractor, voltage follower, integrator- differentiator. Wave form generators: Phase Shift and Wein Bridge Oscillators

22 Hrs

BOOKS FOR STUDY:

1. V. K. Mehta, Principles of Electronics, Eleventh Edition , S Chand and Co,2012.
2. Bagde and Singh, Elements of Electronics, S. Chand and Co,1988.
3. R.S. Sedha, A text book of Applied Electronics, First Edition, S Chand and Co., 1990.
4. V.Vijayendran, Introduction to Integrated Electronics , S.Vishwathan Publishers Ltd.,Chennai, 1st edition, 2008.

BOOKS FOR REFERENCE:

1. Dennis Le Croissette, Transistors, 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.
2. Millman and Halkias, Integrated Electronics, Mc Graw Hill Book Co., 1987.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic
3. Hyperphysics
4. nptel.ac.in

SEMESTER – VI

Electromagnetism

CORE – 8

COURSE CODE: PH15/6C/EMG CREDITS: 5

TEACHING HOURS: 15 X 6 = 90 HRS L T P 4 2 0

Objectives:

- To expose the students to the various facets of electricity and magnetism and their applications

- To provide basic ideas about the electromagnetic theory and Maxwell's equations, which form the root of modern theory of electromagnetic wave propagation

UNIT I: Magnetic effect of Electric Current

Magnetic field around a current carrying conductor – Biot & Savart law - Magnetic field intensity at a point on the axis of a circular coil carrying current - Magnetic field intensity due to a solenoid carrying current - Effect of iron core in a solenoid - Force on a current carrying straight conductor placed in a magnetic field -Force between two current carrying infinitely long parallel conductors - Definition of ampere – Torque on a current loop in a uniform magnetic field - Moving coil ballistic galvanometer- Theory – Damping correction – current and voltage sensitivity of a moving coil ballistic galvanometer – Applications – Absolute capacitance of a capacitor – comparison of two capacitances using B.G.- Comparision of e.m.f's of two cells using B.G. 20 hrs

UNIT II: Electromagnetic Induction

Faraday's laws - Expression for self-induction – Self-inductance of a solenoid - Determination of self-inductance by Anderson method - Mutual induction – Experiment to determine mutual inductance between a pair of co-axial coils - Co-efficient of coupling – Eddy currents and its uses. 15 hrs

UNIT III: Transient Currents

Growth and decay of current in a circuit containing inductance L and resistance R with steady EMF - Growth and decay of charge in a CR circuit -Determination of high resistance by leakage - Growth and Decay of charge in a LCR circuit - Condition for the discharge to be oscillatory - Frequency of Oscillation. 15hrs

UNIT IV: Alternating Currents

EMF induced in a coil rotating in a magnetic field - Peak, average and RMS value of AC voltage and current - Power and power factor - Wattless current - reactance and impedance - Impedance of AC circuit containing L, C and R - series and parallel resonance circuits – j operator method and its applications to LR, CR and LCR circuits - Three phase AC – Star and delta connection – Skin effect. 20 hrs

UNIT V: Motion of particles

Motion of charged particles in (a) uniform electric field (Longitudinal, Transverse electric field) – (b) in alternating electric field –(c) in a uniform constant magnetic field – (d) in a crossed electric and magnetic fields.

Maxwell equations

Current density - equation of continuity - Maxwell's equations - Displacement currents –Magnitude of displacement current - Maxwell's equation in material media - Velocity of electromagnetic waves - Poynting vector. 20 hrs

BOOKS FOR STUDY:

1. Brijlal & N. Subramaniam, Electricity and Magnetism, S.Chand & Co., Revised Ed 2005.

2. R. Murugesan, Electricity and Magnetism, S.Chand & Co. Revised ed 2006.

BOOKS FOR REFERENCE:

1. Sehgal and Chopra Sehgal, Electricity and Magnetism, S.Chand & Co. Revised ed 2007

2. K.K. Tiwari, Electricity and Magnetism, S.Chand & Co, 2002.

3. B.D. Duggal and C.L. Chabra, Fundamentals of Electricity and Magnetism, Shobanlal Nagin Chand & Co, Fifth Edition, 2005.

WEB REFERENCES

1. www.britannica.com/science/topic
2.en.wikipedia.org/wiki/topic
3.Hyperphysics
4. nptel.ac.in

SEMESTER – VI

Digital Electronics and Microprocessor 8085

ELECTIVE – 2

COURSE CODE: PH15/6E/DEM **CREDITS: 5**

TEACHING HOURS: 15 x 6 = 90 HRS **L T P 4 2 0**

Objective:

- To give basic knowledge about digital electronics and different number systems, logic gates, Boolean algebra, logic families and ICs.

UNIT I: Digital Electronics

Binary, decimal and hexadecimal number system – inter conversion - binary addition, subtraction, Multiplication and Division – signed binary numbers – Binary Codes: Gray code and ASCII codes - logic gates - AND, OR, NOT and Exclusive OR gates - Boolean algebra - De Morgan's theorems - Universal logic gates - simplification of logical expressions using Boolean algebra and Karnaugh map method - pair, quad and octet - up to 4 variables. 18 Hrs

UNIT II: Counters and registers

Flip flops - RS Flip Flop - D Flip Flop - JK Flip Flop - JK Master slave Flip Flop – Asynchronous/Ripple counter: Mod 2, 4, 8, 16 counters, Mod 10/BCD counter using decoding gates- synchronous counter: Design, Mod 3,5 counters, Random sequence generator and BCD counter - Shift registers: Shift left, shift right and shift left- shift right registers. 18Hrs

UNIT III: D/A & A/D converters and ICs

D/A converter - binary weighted resister method – R-2R ladder method - A/D converter - Counter type- successive approximation techniques. Integrated circuits: IC classifications by structure and function - making monolithic IC - scale of integration - IC packings and symbols – advantages and disadvantages. 18 Hrs

UNIT IV: Architecture and pin configuration:

Introduction to Microprocessors - Intel 8085 - architecture of 8085 – registers - flags - address - data and control bus – Pin configuration and functions - Interrupts –overall interrupt structure – hardware and software interrupts- maskable and non maskable interupts - Priorities- RIM, SIM instructions. 18 Hrs

UNIT V: Instruction and programming:

Assembly language and machine language -Instruction set of 8085 - data transfer, arithmetic, logic, branching and machine control group of instructions- addressing modes – simple programming exercises for addition - subtraction, multiplication and division of two 8-bit numbers with carry - Arranging in Ascending order / descending order. 18 Hrs

BOOKS FOR STUDY:

1. V.Vijayendran, Introduction to Integrated Electronics , S.Vishwathan Publishers Ltd., Chennai, 1st edition, 2008.
2. V. K. Mehta , Principles of Electronics S.Chand & Co., Revised edition 2005.
3. R.S. Sedha, A text book of Applied Electronics, First Edition, S Chand and Co., Revised edition 2006.
4. Vijayendran, Fundamentals of Microprocessors 8085, 1st edition, S.Vishwathan Publishers Ltd., Chennai, , 2005
5. A.P. Godse & D.A. Godse, Microprocessors & Applications, First edition , Technical Publications pune- -2003

BOOKS FOR REFERENCE:

1. Thomas L.Floyd, Digital Fundamentals 3rd Ed, Universal Book Stall, New Delhi.
2. Albert Paul Malvino, Digital Computer Electronics, TMH, 1992.
3. Millman and Halkias, Integrated Electronics, Mc Graw Hill Book Co., 1987.
4. R.S.Goenkar, Penram, Microprocessor architecture, programming and applications with the 8085/8080, 5th Edition

WEB REFERENCES

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2.en.wikipedia.org/wiki/topic
3.Hyperphysics
4. nptel.ac.in

SEMESTER – VI

Relativity and Quantum Mechanics

CORE – 9

COURSE CODE: PH15/6C/RQM **CREDITS: 5**

TEACHING HOURS: 15 x 6 = 90 HRS **L T P 4 2 0**

Objectives:

- To introduce the basic ideas of special theory and general theory of relativity.

- An introduction to the fundamental concepts, mathematical formalism of Quantum Mechanics**.**

UNIT I: Special Theory of Relativity:

Galilean Transformation - Ether Hypothesis – Michelson Morley experiment - Significance of the results - Postulates of special theory of relativity – Lorentz transformation – simultaneity- length contraction – time dilation – relativistic addition of velocities - Relativistic mass – mass energy equivalence.
18hrs

UNIT II: General Theory of Relativity:

Geometric representation of space and time - Space – time diagrams – simultaneity – contraction – dilation - Time order and space separation of events – General relativity - Principle of equivalence – gravitational red shift – fundamental ideas of general relativity.
18 hrs

UNIT III: Origin of quantum mechanics:

Failure of classical physics - Black body radiation -Planck's Quantum theory- Photo electric effect- Einstein's explanation of the photoelectric effect- Compton effect- the Ritz combination principle in spectra- Stability of an atom- Bohr's Quantization of angular momentum and its application to the hydrogen atom.
18hrs

UNIT IV: **Wave properties of matter**:

Wave particle duality- De-Broglie's Hypothesis for matter waves- concept of wave velocity and group velocity- velocity of de -Broglie wave- diffraction of particles- Interference of electrons- consequences of de- Broglie's concepts- wave packet- Heisenberg's uncertainty principle-Its illustration by thought- experiments- consequences of the uncertainty relation. 18hrs

UNIT V: Schrodinger's wave equation and its application:

Postulates of Quantum Mechanics- physical interpretation of the wave function Ψ- operators in quantum mechanics, Eigen function, Eigen value and Eigen value equation- expectation values- transition probability-Schrodinger's one dimensional time-dependent, time -independent wave equation.

Application of Schrodinger equation: Particle in one dimensional box- Simple harmonic oscillator.
18hrs

BOOKS FOR STUDY:

1. Robert Resnick, Introduction to special theory of relativity, John Wiley Eastern Ltd., 1998.
2. Kamal singh, S.P.Singh ,Elements of Quantum Mechanics , First Edition, S.Chand & co Ltd, New Delhi-110055, 2005.
3. R.Murugeshan, Kiruthiga Siva Prasath , Modern Physics, 13th edition ,S.Chand& Co., New Delhi 110005, 2007.
4. Gupta. Kumar. Sharma, Quantum mechanics, 25th edition, Jai Prakash Nath & Co. Meerut,2005.
5. Mathews and Venkatesan, Text book on quantum mechanics , 20th reprint,,Tata Mc Graw Hill, New Delhi.1995.

REFERENCE BOOKS:

1. Ghatak and Loganathan, Quantum Mechanics, Macmillan India Pvt Ltd.1984.
2. Beiser, Concepts of modern Physics, 1997 Fifth edition A,Tata MC Graw Hill, New Delhi.
3. V. Devanathan, Quantum Mechanics, Narosa Publications, New Delhi, 2006.

WEB REFERENCES

5. www.britannica.com/science/topic
6. en.wikipedia.org/wiki/topic
7. Hyperphysics
8. nptel.ac.in

SEMESTER – VI

Material Science

ELECTIVE – 3
CREDITS: 5

COURSE CODE: PH15/6E/MAS **L T P : 4 2 0**

TEACHING HOURS: 15 X 6 = 90 HRS.

Objective:

- To educate the students in the areas of advanced materials and processes which are essential for the higher studies in the field of material science and Nano technology.

UNIT I: Interatomic Forces and Bonding in Solids

Forces between atoms – Cohesion of atoms and Cohesive energy – Calculation of Cohesive energy - – Different types of chemical bonds: Ionic bond- Bond energy of NaCl molecule - Covalent bond – Metallic bond – Dispersion bond – Dipole bond – Hydrogen bond – Properties – Lattice energy of ionic crystals – The compressibility and modulus of elasticity. 18 hrs

UNIT II: Crystal Growth and Characterization

Introduction to crystal growth – Spontaneous nucleation - Methods of crystallization - Solution growth - Slow cooling - Slow evaporation - Temperature gradient method - Gel growth - Crystal growth from melt - Czochralski technique and floating zone method - Hydrothermal growth (qualitative analysis). - Introduction to UV and IR spectroscopy – Instrumental techniques of UV and IR. 18 hrs

UNIT III: Ceramics and Polymers

Introduction to Ceramics – Classification of ceramics – Properties: mechanical, thermal and electrical properties – Applications – Introduction to Polymers – Types of Polymers – Mechanism of polymerization – Classification of Polymers - mechanical, physical and chemical properties - Applications. 18 hrs

UNIT IV: Dielectric properties of materials

Introduction – Fundamental definitions – Different types of electric polarization: Electronic polarization – Ionic polarization – Orientational polarization – Space –charge polarization – Frequency and Temperature effects on polarization – Dielectric loss – Clausius Mossotti relation – Determination of dielectric constant of a dielectric material – Different types of dielectric materials – Active dielectrics – Passive dielectrics. 18 hrs

UNIT V: Nano materials

Introduction to Nano materials – Types of Nano materials: zero dimensional, one dimensional, two dimensional nanomaterials - Production methodology of nanomaterials: Chemical vapour deposition (sol-gel method), Physical vapour deposition (high energy ball milling method) - Thermal evaporation – Properties of nanomaterials - Advantages of Nano materials - Application of nanomateials in photovoltaics . 18 hrs

BOOKS FOR STUDY:

1. Dr.M.Arumugam, Material science, 3rd edition, Anuradha Publication, 2004.
2. V. Ragavan, Material Science and Engineering, 3rd edition, Prentice Hall India, New Delhi. 1993.
3. Santhana Raghavan and Dr.P. Ramaswamy, Crystal growth process and methods, 1st edition KRU publications, 2000.
4. K. G. Aswani, Material Science, 2nd edition, S. Chand & Company, New Delhi, 2001.

5. William D. Callister & David G. Rethwisch ,Materials Science and Engineering, 8th edition,Wiley Publications, 2009
6. J.C. Anderson,K.D.Leaver ,P.Leevers,R.D.Rawlings, Material science for engineers , 5th edition, Nelson Thornes Publications, 2003.
7. G.K.Narula, K.S.Narula, V.K. Gupta, Materials Science, Tata McGraw Hill Publishing Company Limited, 27th reprint in 2007.

BOOKS FOR REFERENCE:

1. D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 6th edition, John Wiley and Sons., 2001.
2. Charles Kittle, An Introduction to Solid State Physics, 7th Edition, John Wiley and Sons, 2003.
3. C.M. Srivastava, C. Srinivasan, Science of Engineering Materials, 2nd Edition, New Age International., 2005.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic
3. Hyperphysics
4. nptel.ac.in

SEMESTER – VI

Astrophysics

ELECTIVE – 3

COURSE CODE: PH15/6E/ASP **CREDITS: 5**

TEACHING HOURS: 15 X 6 = 90 HRS **L T P 4 2 0**

Objectives:

- To study the mysteries of the universe using modern technological skills
- To introduce the fundamental concepts of the Astrophysics and Cosmology
- To understand the origin and evolution of the physical universe

Unit I: General Astronomy

Systems of coordinates- horizon system – equatorial system – ecliptic system – galactic system- Time - solar time – sidereal time - universal time – ephemeris time- stellar parallaxes. 18 hrs

Unit II: Optical Techniques

Optical telescopes – magnifying power- brightness of image-f/a ratio- types of reflecting telescopes- refracting telescopes-radio telescopes- Hubble space telescope-astronomical spectrographs- parts and resolving power-Detectors and image processing. 18 hrs

Unit III: Stellar Physics

Spectral classification of stars-Harvard classification system- Hertzsprung – Russel diagram – Luminosity of stars – Stellar evolution –Radii, mass and density of stars-Gravitational potential energy of a star- Internal temperature and pressure of a star - equations of state - stellar energy generation - White dwarfs – electrons in a white dwarf star -

Chandrasekharan limit – Neutron stars- Binary stars- Novae and Supernovae- Black holes.

18 hrs

Unit IV: Galactic Physics & Cosmology

Clusters and association of stars- galactic clusters- globular clusters- classification of galaxies - evolution of galaxies - dark matter in galaxies - Our galaxy – size and shape- rotation and mass

Cosmology- Redshift and expansion of Universe- Hubble's law –Models of the Universe -Big bang theory – cosmic showers – cosmic microwave background - Steady state theory.

18 hrs

Unit V: Sun & Solar System

Measurement of solar distances- Size, mass and surface temperature of planets - Physics of planetary atmospheres – Individual planets, comets, asteroids - The sun – surface temperature – composition – source of energy - sun spots and solar activity- solar cycle.

18 hrs

BOOKS FOR STUDY:

1. Brijlal and N.Subrahmanyam, Properties of Matter, 3rd Edition, S.Chand & Co., 2004.
2. Murugeshan.R & Kiruthiga Sivaprasath , Modern Physics, S.Chand & Co., 14th edition,2009
3. Baidyanath Basu, An introduction to Astrophysics, 4th edition, Prentice Hall of India Pvt.Ltd., 2004

BOOKS FOR REFERENCE:

1. Chandrasekhar , An Introduction to the Study of Stellar Structure, 1st edition, S Dover Publications, 1967.
2. Clayton, D.D , Principles of Stellar Evolution and Nucleosynthesis, 1st edition, University of Chicago Press, 1983.
3. K.D.Abhyankar , Astrophysics of the Solar system, 1st edition ,Universities Press Pvt.Ltd.,1999.
4. Kenneth S.Krane, Modern Physics, 2nd edition, Wiley India Pvt. Ltd., New Delhi,1996.
5. K.D.Abhayankar, Astronomical Physics : Stars and Galaxies, 1st edition ,Universities Press Pvt.Ltd., 1999
6. V.B.Bhatia , Textbook of astronomy and astrophysics with elements of Cosmology, 1st edition, Narosa Publishing House, New Delhi, 2001.

WEB REFERENCES

1. www.britannica.com/science/topic
2. en.wikipedia.org/wiki/topic
3. Hyperphysics
4. nptel.ac.in

MAJOR GENERAL PRACTICAL - III

COURSE CODE: PH15/6C/MPR3 **CREDITS: 4**

TEACHING HOURS: 30 X 3=90 HRS

1. Young's Modulus of the material of a beam - By non- uniform bending - Koenig's Method. (Graphical method to determine q and mass of the unknown body).
2. M and B_H by Deflection Magnetometer and Vibration Magnetometer.
3. Temperature Co-efficient of a coil - Carey Foster Bridge.
4. E.M.F of a thermocouple - Potentiometer.
5. Calibration of high range voltmeter - Potentiometer.
6. Absolute determination of mutual inductance of a coil - B.G.
7. Comparison of mutual inductances - B.G.
8. E.M.F of a thermocouple - B.G.
9. Self Inductance of a coil – B.G.
10. Absolute determination of Capacitance – B.G.
11. Comparison of Capacitances – B.G.
12. Conversion of a galvanometer into a voltmeter, ammeter and ohmmeter.
13. i - i' curve – Spectrometer.
14. Dispersive power of a prism - Spectrometer.
15. Refractive index of the material of a narrow angled prism - Spectrometer.
16. Determination of wavelength of prominent lines of mercury spectrum by Minimum Deviation Method – Spectrometer.

ELECTRONICS PRACTICAL

COURSE CODE: PH15/6E/EPR **CREDITS: 3**

TEACHING HOURS: 30 X 3=90 HRS

1. UJT - Characteristics and Relaxation oscillator.

2. Sine wave oscillator -Wein's Bridge Oscillator and Phase shift Oscillator- using IC 741.

3. Characteristics of a transistor in CE mode and determination of parameters.

4. Regulated power supply - 2 diodes. (Using Zener diode and IC.

5. Characteristics of Junction diode and Zener diode.

6. Construction of Basic Logic Gates – AND, OR and NOT using Diodes and Transistors.

7. Single stage amplifier-Frequency response curve to study the variation of gain with load.

8. Inverting and non-inverting amplifier - OP-AMP.

9. Current follower and voltage follower - OP-AMP.

10. NAND and NOR gate - Universal building block and verification of De Morgan's theorems using IC.

11. OP-Amp Amplifier as an a) adder and subtractor b) differentiator & an integrator.

12. Hartley Oscillator using transistor.

13. Microprocessor 8085- Addition and subtraction, Multiplication and division (8 bit numbers).

14. Microprocessor 8085 - Sort the numbers in ascending and descending order.

15. Microprocessor 8085 – Data Conversion – Binary to ASCII and ASCII to Binary, BCD to ASCII and ASCII to BCD.

16. Microprocessor 8085 – Largest and Smallest number in an array.

TEMPLATE IS COMMON TO ALL SUBJECT PAPERS (CORE AND ALLIED)
TEMPLATE FOR QUESTION PAPER (2015-2016)

Time: 3 hours **Maximum marks: 100**

Section – A (10x 2= 20 marks)

1. All the questions are compulsory.
2. Two questions to be taken from each unit.
3. Questions can be based on definitions, basic principles and laws.

Section – B (5x8=40 marks)

1. 5 out of 8 questions to be answered.
2. Three questions should be problems.

3. All the units should be covered while preparing the questions.

Section – C (2x20=40 marks)

1. 2 out of 4 questions to be answered.
2. All the units should be covered while preparing the questions not exceeding one from each unit.
3. Each question can have sub divisions.

Nature of the question: application, analysis, experimental description (with diagrams/circuits), theoretical derivation and discussion.

Numbering of questions: Section A – (1 to 10)
Section B – (11 to 18)
Section C – (19 to 22)