Board of Studies in Physics

FACULTY OF SCIENCE

GONDWANA UNIVERSITY, GADCHIROLI

Syllabus of

B.Sc. First Year (Semester pattern) (Choice Based Credit System)

SUBJECT - PHYSICS

Semester I & Semester II

Semester I & Semester II

SUBJECT - PHYSICS

Teaching and Semester Examination Scheme for B.Sc(First Year) .

Class	Semester	Paper	Teaching Scheme Per Week (workload)			Examination Scheme			
			Theory	Total	Practical	Theory Marks		Practical Marks	Total Marks
						Paper	Internal Assessment		
B. Sc. I	I	USPHT 01	3	6 + 1T	6	50	10	30	150
		USPHT 02	3			50	10		
	II	USPHT 03	3	6 + 1T	6	50	10	30	150
		USPHT 04	3			50	10		

B.Sc.Semester CBCS Pattern Examination Scheme

1. There shall be total six semesters.
2. Each semester shall comprise of 90 teaching days.
3. Each Semester I to VI shall be of 150 marks.
4. Distribution of marks will be as follows

i.	Paper I Theory	----	50 marks
	Internal Assessment	----	10 marks
ii.	Paper II Theory	----	50 marks
	Internal Assessment	----	10 marks
iii.	Practical	----	30 marks
Total	(i+ii+iii)	----	150 marks

5. The marks on internal assessment of the student shall be compounded with the theory Paper. The passing marks will be **35%** marks .

6. A student will have to perform at least Ten (**10**) experiments per semester. At the time of Practical examination every student has to perform two experiment, each of three hours duration.

7. The distribution of marks for practical examination is as follows.

Record Book	----	6
Viva-voce	----	6
Experiment	----	18
TOTAL	**----**	**30**

8. Evaluation of the student during the semester for internal assessment:-

i) For Theory internal

S.N.	Work Assigned	Marks	Marks Obtained
1	Assignment	**02**	
2	Class Test	**05**	
3	Active Participation/Seminar/Routine Activity etc.	**03**	

Signature of teacher in-charge Head of Department

9. The internal assessment shall be done by respective college and the marks shall be sent to the university one month prior to the final examination of each semester.

10. All theory papers shall be divided into four units. Each unit shall be cover in 15 periods of 48 minutes.

11. The theory question paper shall be of 3 hours duration and comprise of 5 questions with internal choice and with equal weightage to all units. The pattern of question paper shall be as follows.

Pattern of Question Paper

Subject – Physics

Time: 3 Hours **Maximum marks :50**

Question No.		**Marks Allotted**
Qu. 1		
Either		
	From Unit - I	10
	O	
	r	
	From Unit - I	10
Qu. 2		
Either		
	From Unit - II	10
	O	
	r	
	From Unit - II	10
Qu. 3		
Either		
	From Unit – III	10
	O	
	r	
	From Unit - III	10
Qu. 4		
Either		
	From Unit - IV	10
	O	
	r	
	From Unit - IV	10
Qu. 5 Attempt any 10 questions from the following.		
(a)	Unit - I	1
(b)	Unit - I	1
(c)	Unit - I	1
(d)	Unit – II	1
(e)	Unit – II	1
(f)	Unit – II	1
(g)	Unit – III	1
(h)	Unit – III	1
(i)	Unit – III	1
(j)	Unit – IV	1
(k)	Unit – IV	1
(l)	Unit – IV	1

The above pattern is for all two papers of each semester of B.Sc. I w.e.f. **2017-18** & B.Sc. II and B.Sc. III from next subsequent years.

Proposed Syllabus for B.Sc. I CBCS (Semester Pattern)Subject – Physics

The syllabus of Physics as per semester system for the B.Sc. I will be implemented from the Academic year **2017-2018**.

Name of Programme	Duration	Semester	Subject :- Physics	Code	Title
B.Sc. I	Two semesters	I	Theory	USPHT01	Mechanics and Relativity
				USPHT02	Gravitation, Oscillation and Properties of Matter
			Practical	USPHP01	10 experiments
		II	Theory	USPHT03	Vector Analysis and Electrostatics
				USPHT04	Magnetostatics and Electromagnetic Waves
			Practical	USPHP02	10 experiments

USPHT01: MECHANICS AND RELATIVITY

Aim: To make the students understand the basic concepts of Mechanics and Relativity as core part of the subject.

Unit I:

Laws of Motion: Newton's laws of motion and its limitations, Components of velocity and Acceleration (radial and transverse), Frame of reference, inertial and non-inertial frame of reference, uniformly rotating frame, Centripetal force,

Centre of Mass: Centre of mass**,** Linear momentum about centre of mass, equation of motion of centre of mass.

Numericals.

Unit II:

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.(Single stage and multistage)

Collision: Perfectly elastic and inelastic collision in one dimension, velocities of particles in elastic collision, application of elastic collision,

Numericals

Unit III:

Dynamics of rigid body: Moment of inertia, radius of gyration, physical significance of Moment of inertia, Principle of perpendicular and parallel axis (no derivations), Moment of inertia of a ring, rod, solid sphere and rectangular lamina.

Numericals.

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. Isotropy and rotation invariance of space, angular impulse, homogeneity and isotropy of time. Conservation of energy (from homogeneity of time and Newton's laws of motion) Numericals.

Unit IV:

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation, variation of mass with velocity. Relativistic addition of velocities. Mass energy equivalence.

Numericals.

USPHT02: Gravitation, Oscillation and Properties of Matter

Aim : Students should understand the concept related with Gravitation and Properties of Matter.

Unit I:

Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Gravitational Field and Gravitational potential. Gravitational potential due to spherical shell.

Gravitation: Gravitational self-Energy of a body, Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

Numericals.

Unit II:

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages.

Free, Damped and Forced harmonic Oscillations, Differential equation of a damped oscillator and its solutions, Energy equation of damped oscillations, Power dissipation, Power absorption, Resonance, Quality factor and band width.

Numericals.

Unit III:

Elasticity: Hooke's law , Stress-strain diagram , Elastic moduli-Relation between elastic constants Poisson's Ratio, Expression for Poisson's ratio in terms of elastic constants, Work done in stretching and in twisting a wire. Twisting couple on a cylinder, Determination of Rigidity modulus by static torsion , Torsional pendulum, Determination of Rigidity modulus.

Numericals.

Unit IV:

Viscosity: Streamline and Turbulent flow, Coefficient of viscosity, Reynold's number, equation of continuity, Bernoulli's theorem and its applications (Lift of an Aeroplane and Atomizer), Poiseulle's equation.

Surface tension: Surface tension and its molecular interpretation, Angle of contact, Excess of pressure inside a liquid drop, bubble in air and liquid, wetting and spreading,

Numericals.

USPHP01 : (Practical)

Every student will have to perform at least five (05) experiments from each group. This odd semester practical examination shall be conducted by **Internal Examiner.**

Group A

1. To determine height of building using Sexant.
2. Moment of inertia of flywheel.
3. Study of conservation of momenta in two dimensional collisions.
4. Study of compound pendulum.
5. To determine '**g**' by Kater's Pendulum.
6. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g
7. Study of oscillations of mass under different combinations of spring.
8. To determine '**g'** and velocity for a freely falling body using Digital Timing Technique.
9. Calculation of percentage error of diameter of orifice of capillary.

Group B

1. Young's modulus by Cantilever.
2. Modulus of rigidity by statistical method.
3. Coefficient of viscosity by Poiseulle's flow method.
4. Determination of surface tension by Quinke's method.
5. Determination of surface tension by capillary rise method.
6. Modulus of rigidity by Tortional Pendulum.
7. Young's modulus by bending of beam.
8. Young's modulus by Vibration method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

Reference Books: Semester I

1. Fundamentals of Physics – Halliday and Resnick (6^{th} edition)
2. Concepts of Physics Vol. I and II - H.C. Verma
3. Properties of Matter – Brijlal
4. Waves and Oscillations – Chaudhari R.N.
5. Berkely Physics Course – Vol. I
6. Physics for degree students B.Sc. First Year – C.L. Arora, Dr P.S. Hemne
7. Mechanics – D.S. Mathur , Dr. P.S. Hemne
8. B.Sc. Practical Physics – Dr. P.S. Hemne, Harnam Singh
9. University Physics- FW Sears, MW Zemansky and HD Young
10. Engineering Mechanics- Basudeb Bhattacharya
11. University Physics- Ronald Lane Reese

USPHT03 : Vector Analysis and Electrostatics

Aim : To make the students understand the basic concepts vectors and vector analysis and its applications in electostatics as core part of the subject.

Unit I: Vector Analysis:

Scalar and Vector, Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).
Numericals.

Unit II: Electrostatics- I

Definitions of electric field, electric field intensity, electric potential, electric dipole, electric dipole moment, electric quadrupole. Electric field intensity due to electric dipole, quadrupole, electric field as a negative gradient of potential, conservative nature of electric field, torque on a dipole in a uniform electric field. Potential energy of an electric dipole, electrostatics field energy. Flux of electric field.
Numericals

Unit III: Electrostatics- II

Gauss's theorem of electrostatics(no derivation), applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor.
Electric potential due to a point charge, electric dipole (along axial line and equatorial line), uniformly charged spherical shell and solid sphere.
Numericals,

Unit IV: Electric field in dielectric:

Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Parallel plate capacitor completely filled with dielectric.
Numericals.

USPHT04: Magnetostatics and Electromagnetic Waves

Aim : To make the students understand the basic concepts of Magnetostatics and Elecrtomagnetic Waves as core part of the subject.

Unit I: Magnetostatics

Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.
Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of diamagnetic, paramagnetic, and ferromagnetic materials.
Numericals.

Unit II: Electromagnetic Induction:

Faraday's laws of electromagnetic induction, Lenz's law, self(L) and mutual inductance(M), L of single coil, M of two coils. Energy stored in magnetic field.
Transformer – Construction and working, Energy losses, parameters and application .
Numericals

Unit III: Maxwell`s equations and Electromagnetic Wave Propagation:

Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector and Poynting theorem, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves.
Numericals

Unit IV: Steady Electric current:

Kirchoff’s laws and its applications, Rise and decay of current in LR, CR circuits, time Constants, Decay of charge in LCR circuits.

Alternating electric current: AC circuits, Complex numbers, j-operator and applications to LR and CR circuits.
Numericals

USPHP02 :(Practical)

Every student will have to perform at least five (05) experiments from each group. This even semester practical examination shall be conducted by**Internal and External Examiners** both.

Group A

1. Use of vibration magnetometers to study a field.
2. To compare capacitance using De'Sauty's bridge .
3. Measurement of inductance using impedance at different frequencies.
4. Measurement of capacitance using impedance at different frequencies.
5. Study of decay of currents in LR circuits.
6. Response curve of LCR circuit, resonance frequency and quality factor.
7. Study of Transformer.
8. Characteristic of Choke.
9. Determination of high resistance by Leakage method.

Group B

1. To determine a Low Resistance by Carey -Foster's Bridge.
2. To verify the Thevenin's theorem.
3. To verify the Norton'sTheorem.
4. To verify the Superposition electrical network.
5. To verify the Maximum Power Transfer Theorem.
6. To verify the Milliman's Theorem.
7. Calibration of ammeter by Potentiometer.
8. Determination of resistance of Galvanometer by half deflection method.
9. Low resistance by Potentiometer.

Reference Books: Semester II

1. Electricity and Magnetism -- Edward M. Purcell
2. Electricity and Magnetism -- J.H. Fewkes & J. Yarwood
3. B.Sc. Practical Physics -- Dr P.S. Hemne, Harnam Singh
4. Electricity and Magnetism--D C Tayal
5. Physics for degree students B.Sc. First Year – C.L. Arora, Dr P.S. Hemne
6. Electromagnetic waves and radiating systems – E.C. Jordan
7. Electricity and Magnetism – S.S. Atwood
8. Electricity and Magnetism – A.S. Mahajan and A.A. Rangwala
9. Electricity and Magnetism - Brijlal and Subramanyam
10. Electricity and Magnetism – D.N. Wasudeva
11. Electrodynamics – S.L. Gupta and R. Singh
12. Mechanics and Electrodynamics – Brijlal and Subramanyam
13. Introduction to electrodynamics - D.J. Griffiths
14. Fundamentals of Physics – Halliday and Resnick

Board of Studies in Physics

FACULTY OF SCIENCE

GONDWANA UNIVERSITY, GADCHIROLI

Syllabus of

B. Sc. Second Year (Semester pattern)

(Choice Based Credit System)

SUBJECT - PHYSICS

Semester III & Semester IV

Semester III & Semester IV
SUBJECT - PHYSICS

Teaching and Semester Examination Scheme for B.Sc(Second Year) .

Class	Semester	Paper	Teaching Scheme Per Week (Workload)			Examination Scheme			
			Theory	Total	Practical	Theory Marks		Practical Marks	Total Marks
						Paper	Internal Assesment		
B. Sc. II	III	USPHT05	3	6 + 2T	6	50	10	30	150
		USPHT06	3			50	10		
	IV	USPHT07	3	6 + 2T	6	50	10	30	150
		USPHT08	3			50	10		

B. Sc. Semester CBCS Pattern Examination Scheme :

1. There shall be total six semesters.
2. Each semester shall comprise of 90 teaching days.
3. Each Semester I to VI shall be of 150 marks.
4. Distribution of marks will be as follows

i.	Paper I	Theory	50 Marks
		Internal Assessment	10 Marks
ii.	Paper II	Theory	50 Marks
		Internal Assessment	10 Marks
iii.	Practical (section A and B)		30 Marks
Total	(i + ii + iii)		**150 Marks**

5. The marks on internal assessment of the student shall be compounded with the theory Paper. The passing marks will be **40 %** marks.

6. A student will have to perform at least five experiments from each section (Total **10** experiments) per semester. At the time of Practical examination every student has to perform two experiments (one from each section), each of three hours duration.

7. The distribution of marks for practical examination is as follows.

Record Book	----	6
Viva-voce	----	6
Experiment (A + B)	----	18
TOTAL	**----**	**30**

8. Evaluation of the student during the semester for internal assessment:-

For Theory internal:

Sr. No.	Work Assigned	Marks	Marks Obtained
1.	Assignment	02	
2.	Class Test	05	
3.	Active Participation Seminar/Routine Activity etc.	03	
Total		**10**	

Signature of teacher in-charge Head of Department

9. The internal assessment shall be done by respective college and the marks shall be sent to the university one month prior to the final examination of each semester.
10. All theory papers shall be divided into four units. Each unit shall be cover in 15 periods of 48 minutes.
11. The theory question paper shall be of 3 hours duration and comprise of 5 questions with internal choice and with equal weightage to all units. The pattern of question paper shall be as follows.

Pattern of Question Paper
Subject – Physics

Time: 3 Hours **Maximum marks :50**

Question No. **Marks Allotted**

Qu. 1 EITHER

A (From Unit – I) (i, ii, iii, two or three bits including numerical) **10**

OR

B (From Unit – I) [Four bits (a),(b), (c), (d) including numerical] **4 x 2½**

Qu. 2 EITHER

A (From Unit – II) (i, ii, iii, two or three bits including numerical) **10**

OR

B (From Unit – II) [Four bits (a),(b), (c), (d) including numerical] **4 x 2½**

Qu. 3 EITHER

A (From Unit – III) (i, ii, iii, two or three bits including numerical) **10**

OR

B (From Unit – III) [Four bits (a),(b), (c), (d) including numerical] **4 x 2½**

Qu. 4 EITHER

A (From Unit – IV) (i, ii, iii, two or three bits including numerical) **10**

OR

B (From Unit – IV) [Four bits (a),(b), (c), (d) including numerical] **4 x 2½**

Qu. 5 Attempt any TEN questions from the following.

a) From Unit I **1**
b) From Unit I **1**
c) From Unit I **1**
d) From Unit II **1**
e) From Unit II **1**
f) From Unit II **1**
g) From Unit III **1**
h) From Unit III **1**
i) From Unit III **1**
j) From Unit IV **1**
k) From Unit IV **1**
l) From Unit IV **1**

The above pattern is for all two papers of each semester of B.Sc. I (CBCS pattern) & B.Sc. II (CBCS pattern) w.e.f. **2018-19** and B.Sc. III from next subsequent years.

Proposed Syllabus for B.Sc. II CBCS (Semester Pattern)Subject – Physics

The syllabus of Physics as per semester system for the B.Sc. II will be implemented from the Academic year **2018-2019**.

Name of programme	**Duration**	**Semester**	**Subject: Physics**	**Code**	**Title**
B. Sc. II	**Two Semester**	**Sem- III**	**Theory**	USPHT05	**Thermal Physics**
				USPHT06	**Radiation & Statistical Physics**
			Practical	USPHP03	10 experiments
		Sem- IV	**Theory**	USPHT07	**Waves, Acoustic & Laser**
				USPHT08	**Optical Physics**
			Practical	USPHP04	10 experiments

Syllabus of B. Sc. Second year (Semester pattern)
(Choice Based Credit System) Subject- PHYSICS (Sem-III and Sem-IV)

Sem-III Paper-I (Thermal Physics)
USPHT05: THERMAL PHYSICS (Paper I)

Aim: To make the students to understand the basic concepts of Thermal physics as core part of the subject.

Unit- I (Kinetic Theory of Gases & Transport Phenomena):

Assumptions of Kinetic theory of gases, Pressure exerted by gas (no derivation), Derivation of Maxwell's law of distribution of velocities and its experimental verification, Degree of Freedom (Mono, Di and Polyatomic gases), Law of equipartition of energy, Mean free path, Expression for mean free path and its dependency on temperature and pressure.

Transport of momentum & viscosity of gas(η), Transport of energy & thermal conductivity (K), interrelationship between η & K, dependency η & K on temperature and pressure, Transport of mass (diffusion). *Numericals.*

Unit- II (Concept of Thermodynamics):

Thermodynamic system, Thermodynamic variables (Intensive and Extensive), Thermodynamic equilibrium, Thermodynamic process (Isothermal, Adiabatic, Isobaric, Isochoric), Zeroth law of thermodynamics and its importance.

Concept of Internal Energy, First law of Thermodynamics and its applications and limitations, Derivation of Work done during isothermal and adiabatic process, Adiabatic relations between P, V and T, Specific heat (Definition), General relation between C_P and C_V, Thermal expansion and Compressibility. *Numericals.*

Unit- III (Second and Third laws of Thermodynamics):

Reversible and irreversible process, Second law of Thermodynamics (Statements), Heat Engine and its efficiency, Carnot's Ideal heat engine, Carnot's cycle, Carnot's Theorem (Only statement).

Concept of entropy, Second law of Thermodynamics in terms of entropy, Entropy changes in reversible and irreversible process, T-S diagram and derivation of Work done and efficiency, Third law of Thermodynamics. *Numericals*.

Unit- IV (Thermodynamics Functions):

Internal energy function, Enthalpy function, Gibb's function, Helmholtz function, Derivations of Maxwell's thermodynamics relations, First and second Tds equations.

Latent heat (definition), First latent heat equation (Clausius-Clapeyron equation), Second latent heat equation (Clausius equation), Joule – Thomson effect, Porus-Plug experiment and its application (To show enthalpy constant). *Numericals*.

Sem-III Paper-II (Radiation and Statistical Physics)

USPHT06: RADIATION AND STATISTICAL PHYSICS

Aim: To make the students to understand the Thermal radiation laws and basic concepts of statistical analysis and as core part of the subject.

Unit- I (Theory of Radiation):

Black body radiation, Spectral distribution, Concept of energy density, Derivation of Planck's law, Wien's distribution law, Rayleigh-Jeans law, Stefan's Boltzmann law and Wien's displacement law from Planck's law. *Numericals*.

Unit- II (Statistical basis of thermodynamics):

Probability and thermodynamic probability, Principle of equal priori probabilities, Mu- space, Phase space, macrostate and microstate, Constraint, Accessible and inaccessible states, Entropy and thermodynamic probability, Equilibrium between two system in thermal contact. *Numericals.*

Unit- III (M-B Statistics):

Fundamental postulates of statistical mechanics, M-B statistics applicable to ideal gas, Maxwell- Boltzmann energy distribution law, Most probable speed, Average speed and root mean square speed, Maxwell- Boltzmann law of distribution of velocity. *Numericals*.

Unit- IV (B-E and F-D Statistics):

Fundamental postulates of B-E statistics, Bose- Einstein's energy distribution law, Photon gas, Planck's radiation law.

Postulates of Fermi- Dirac statistics, F-D energy distribution law, Fermi energy, Expression for Fermi energy of electrons in metal, Fermi energy for electron at absolute zero (E_{F_0}), Comparison between M-B, B-E and F-D statistics. *Numericals*.

Reference Books:

1. Fundamentals of Physics – Halliday and Resnick (6th edition).
2. Concepts of Physics Vol. I and II - H.C. Verma.
3. Properties of Matter – Brijlal.
4. Waves and Oscillations – Chaudhari R.N.
5. Berkely Physics Course – Vol. I.
6. Physics for degree students B.Sc. First Year – C.L. Arora, Dr P.S. Hemne.
7. Physics for degree students B.Sc. Second Year – C.L. Arora, Dr P.S. Hemne.
8. Mechanics – D.S. Mathur , Dr. P.S. Hemne.
9. A Text Book of First year Physics, M. K. Bagde, S. Chand Publication.
10. University Physics- FW Sears, MW Zemansky and HD Young.
11. Engineering Mechanics- Basudeb Bhattacharya.
12. University Physics- Ronald Lane Reese.

USPHP03 : (Practical)

Every student will have to perform at least five (05) experiments from each group. This odd semester practical examination shall be conducted by **Internal Examiner.**

Group A:

1. To determine the coefficient of thermal conductivity of copper. (by Searle's Apparatus or other method).
2. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
4. To study the variation of thermo-emf across two junctions of a thermocouple with temperature.
5. To determine heating efficiency of electrical kettle using voltages.
6. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge.
7. To determine Mechanical Equivalent of Heat (J). (by Callender and Barne's constant flow method or other method).
8. To determine Mechanical Equivalent of Heat (J) by Joule's Calorimeter.

Group B:

1. Measurement of Planck's constant using black body radiation.
2. To determine Stefan's Constant.
3. To verify the Stefan's law of variation by using an incandenscent lamp
4. To verify the laws of probability distribution throwing one coin, tow coin and ten coins.
5. To show the deviation of probability from theoretical value decrease with increase in the number of event.
6. Study of statistical distribution from the given data and to find most probable, average and rms value.
7. Study of random decay of nuclear disintegration and determination of decay constant using dices.
8. To record and analyze the cooling temperature of an hot object as a function of time.(cooling law)

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
5. B.Sc. Practical Physics – Dr. P.S. Hemne, Harnam Singh, S. Chand Publication.

Sem-IV Paper-I (Waves, Acoustics & Laser)

USPHT07: WAVES, ACOUSTICS & LASER (Paper I)

Aim: To make the students to understand the basic concepts Sound Waves, Acoustics and Laser as core part of the subject.

Unit- I (Superposition of two Harmonic Oscillations):

Super position of two SHMs having slightly different frequencies along same line (Beats), Lissajous's Figures, Super position of two Perpendicular Harmonic Oscillations-Graphical and Analytical Methods with equal (1:1) frequencies and unequal (1:2) frequencies, Formation of Lissajous's Figures by CRO and optical method. Application of Lissajous's Figures. *Numericals*.

Unit- II (Wave Motion and Fourier's Theorem):

Transverse waves on a string, Progressive and standing waves on a string, Normal Modes of a vibration of string, Group velocity, Phase velocity and their relations, Wave intensity.

Fourier's Theorem-statement, evaluation of Fourier coefficients, Its application to saw tooth wave and square wave, Limitations. *Numericals*.

Unit- III (Ultrasonic and Acoustics):

Ultrasonic waves and its properties, Production by piezoelectric effect, detection, applications (depth of sea, signalling & medical uses).

Noise and music, characteristics of musical sound, Intensity and loudness of sound, Bel and Decibels, musical notes, musical scale, Echo, Reverberation and time of reverberation, Absorption coefficient, Sabine's formula, Requirements of good auditorium. *Numericals*.

Unit- IV (Laser):

Coherence, spatial and temporal coherence, Einstein's coefficients (absorption, spontaneous and stimulated emission), population inversion, optical pumping, characteristics of laser beam, Ruby laser, Semiconductor laser, He-Ne Laser, applications of lasers. *Numericals.*

Sem-IV Paper-II (Optical Physics)

USPHT08: OPTICAL PHYSICS (Paper II)

Aim: To make the students to understand the basic concepts of Light Waves and properties of light waves as core part of the subject.

Unit I (Interference of Light):

Definition and Properties of wave front, Huygens Principle of propagation of wave front, Principle of superposition and interference of light, Division of amplitude and division of wave front, Fresnel's Biprism, Phase change on Reflection- Stokes' treatment, Interference in Thin Films: due to reflected and transmitted light in parallel film, Fringes of equal inclination (Haidinger Fringes), Interference in wedge-shaped film, Fringes of equal thickness(Fizeau Fringes). *Numericals*.

Unit II (Newton's Rings & Michelson's Interferometer):

Newton's Rings: Experimental setup & theory, application of Newton's ring for measurement of wavelength and refractive index.

Michelson's Interferometer- construction and working, types of fringes (circular and localised), Determination of wavelength and Wavelength difference, Refractive index and Visibility of fringes. *Numericals*.

Unit III (Diffraction):

Basic concept of diffraction, types of diffraction, Fresnel's Diffraction: Definition, Half-period zones, Zone plate, Diffraction due to straight edge and narrow slit. Fraunhofer's diffraction: Definition, Single slit, Double Slit, Diffraction Grating-construction, theory, its application to determine wavelength. *Numericals*.

Unit IV (Polarization):

Concept of polarisation, Plane polarized light(PPL), production of PPL by reflection, double refraction, Brewster's law, Uniaxial and biaxial crystal, positive and negative crystal, Nicol's prism- construction and working, Nicol as a polariser and analyser, Circular and elliptical polarization, phase retardation (quarter and half wave plate). *Numericals*.

Reference Books:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill.
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing.
3. Fundamentals of Optics, H. R. Gulati and D.R. Khanna, 1991, R. Chand Publication.
4. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley.
5. A Text Book of Optics, N. Subramanyam and Brijlal, S. Chand Publication.
6. A Text Book of First year Physics, M. K. Bagde and S. P. Singh, S. Chand Publication.
7. Optics and spectroscopy, R. Murugeshan, S. Chand Publication.
8. Physics for degree students, B. Sc. Second Year, C. L. Arora and Dr. P. S. Hemne, S. Chand Publications

USPHP04 : (Practicals)

Every student will have to perform at least five (05) experiments from each group. This even semester practical examination shall be conducted by **Internal and external examiner both.**

Group A:

1. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.
2. To study Lissajous Figures by using CRO.
3. To determine the frequency of a tuning fork using sonometer.
4. To determine the velocity of transverse wave on stretched string using sonometer.
5. To determine the velocity of sound by using resonance tube.
6. To determine the unknown frequency by using Helmholtz resonator.
7. To determine velocity of ultrasonic waves in a given liquid.
8. To determine the wavelength of Laser beam.
9. To study the divergence of Laser beam.
10. To study the mono-chromaticity of Laser beam.
11. To study the characteristics of loudspeaker.

Group B:

1. Familiarization with Schuster`s focussing; determination of angle of prism.
2. Determination of angle of minimum deviation of prism using different colour.
3. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
4. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
5. To determine the value of Cauchy Constants of a material of a prism.
6. To determine the Resolving Power of a Prism.
7. To determine wavelength of sodium light using Fresnel Biprism.
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine the wavelength of Laser light using Diffraction of Single Slit.
10. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating.
11. To determine the Resolving Power of a Plane Diffraction Grating.
12. To determine the Resolving power of telescope.
13. To determine focal length of long focus convex lens using short focus convex lens.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. B.Sc. Practical Physics – Dr. P.S. Hemne, Harnam Singh, S. Chand Publication.

Board of Studies in Physics

FACULTY OF SCIENCE& TECHNOLOGY

GONDWANA UNIVERSITY, GADCHIROLI

Syllabus of

B.Sc. Third Year (Semester Pattern)

(Choice Based Credit System)

SUBJECT - PHYSICS

Semester V& Semester VI

From academic session- 2019-20

Semester V& Semester VI

SUBJECT - PHYSICS

Teaching and Semester Examination Scheme for B.Sc.(Third Year) .

Class	Semester	DSE Paper (Any two)	Teaching Scheme Per Week (Workload)			Examination Scheme				
			Theory	Total	Practical	Theory Marks		Practical Marks	Total Marks	Credits
						Paper	Internal Assessment			
B. Sc. III	V	DSE P-I	3	6 + 2T	6	50	10	30	150	06
		DSE P-II	3			50	10			
		SEC								02
	VI	DSE P-I	3	6 + 2T	6	50	10	30	150	06
		DSE P-II	3			50	10			
		SEC								02

B. Sc. Semester CBCS Pattern Examination Scheme :

1. There shall be total six semesters.
2. Each semester shall comprise of 90 teaching days.
3. Each semester I to VI shall be of 150 marks.
4. Distribution of marks will be as follows

i.	Paper I	Theory	50 Marks
		Internal Assessment	10 Marks
ii.	Paper II	Theory	50 Marks
		Internal Assessment	10 Marks
iii.	Practical (section A and B)		30 Marks
Total	(i + ii + iii)		**150 Marks**

5. The marks on internal assessment of the student shall be compounded with the theory Paper. The passing marks will be **40 %** marks.
6. A student will have to perform at least five experiments from each section per semester. At the time of practical examination every student has to perform two experiments(one from each section), each of three hours duration.
7. The distribution of marks for practical examination is as follows.

Record Book	----	6
Viva-voce	----	6
Experiment (A + B)	----	18
TOTAL	**----**	**30**

8. Evaluation of the student during the semester for internal assessment:-

For Theory internal:

Sr. No.	Work Assigned	Marks
1.	Assignment	02
2.	Class Test	05
3.	Active Participation Seminar/Routine Activity etc.	03
Total		**10**

9.The internal assessment shall be done by respective college and the marks shall be sent to the university one month prior to the final examination of each semester.

10. All theory papers shall be divided into four units. Each unit shall be cover in 12 periods of 48 minutes.

11. The theory question paper shall be of 3 hours duration and comprise of 5 questions with internal choice and with equal weightages to all units. The pattern of question paper shall be as follows.

12. In B. Sc. Third year (Sem V & VI) student have to opt any two DSE course from the given four courses (for theory & practical) in each semester.

13. **INSTRUCTION FOR SKILL ENHANCEMENT COURSES (SEC):**

i. There should be two skill enhance courses in each semester V and VI. The student should opt any one out of two as per their choice in each semester.

ii. Total marks for SEC is 50.

iii. For SEC 70% weightage is given to practical work and 30% weightage to theory paper.

iv. Theory paper should be of MCQ type.

v. The distribution of marks for SEC practical work will be as follows-

SEC practical	Project Work	20 Marks
	Project Record	08 Marks
	Viva-Voce	07 Marks
Total		35 Marks

vi. The examination should be conducted and evaluated at college level for each semester and equivalent grade obtained by student should be submitted to the university prior to the final exam of each semester.

Pattern of Question Paper
Subject – Physics

Time: 3 Hours **Maximum Marks :50**

Question No.	**Marks Allotted**
Qu. 1 EITHER	
A (From Unit – I) (i, ii, iii, two or three bits including numerical)	**10**
OR	
B (From Unit – I) [Four bits (a),(b), (c), (d) including numerical]	**4 x 2½**
Qu. 2 EITHER	
A (From Unit – II) (i, ii, iii, two or three bits including numerical)	**10**
OR	
B (From Unit – II) [Four bits (a),(b), (c), (d) including numerical]	**4 x 2½**
Qu. 3 EITHER	
A (From Unit – III) (i, ii, iii, two or three bits including numerical)	**10**
OR	
B (From Unit – III) [Four bits (a),(b), (c), (d) including numerical]	**4 x 2½**
Qu. 4 EITHER	
A (From Unit – IV) (i, ii, iii, two or three bits including numerical)	**10**
OR	
B (From Unit – IV) [Four bits (a),(b), (c), (d) including numerical]	**4 x 2½**
Qu. 5 Attempt any TEN questions from the following.	
a) From Unit I	**1**
b) From Unit I	**1**
c) From Unit I	**1**
d) From Unit II	**1**
e) From Unit II	**1**
f) From Unit II	**1**
g) From Unit III	**1**
h) From Unit III	**1**
i) From Unit III	**1**
j) From Unit IV	**1**
k) From Unit IV	**1**
l) From Unit IV	**1**

The above pattern is for all papers of each semester of B.Sc. I (CBCS pattern)w.e.f. 2017-18, B.Sc. II (CBCS pattern) w.e.f. **2018-19** and **B.Sc. III (CBCS)** w.e.f. **2019-20.**

Proposed Syllabus for B.Sc. III CBCS (Semester Pattern)

Subject – Physics

The syllabus of Physics as per semester system for the B.Sc. III will be implemented from the Academic year **2019-2020**.

Name of programme	Duration	Semester	Subject: Physics	Code	Title
22B. Sc. III	**Two Semester**	**Sem V**	**Theory**	USDSEPHT09	Elements of Modern Physics
				USDSEPHT10	Solid State Physics
				USDSEPHT11	Medical Physics
				USDSEPHT12	Mathematical Physics
			Practical	USDSEPHP05	10 experiments
			Skill Enhancement Courses	USSECPH01	Physics Workshop Skill
				USSECPH02	Electrical Circuits and Network Skills
		Sem VI	**Theory**	USDSEPHT13	Nuclear and Particle Physics
				USDSEPHT14	Digital & Analog Circuits and Instrumentation
				USDSEPHT15	Embedded system: Introduction to Microcontrollers
				USDSEPHT16	Quantum Mechanics
			Practical	USDSEPHP06	10 experiments
			Skill Enhancement Courses	USSECPH03	Basic Instrumentation Skills
				USSECPH04	Renewable Energy and Energy Harvesting

Scheme and Syllabus under Choice Based Credit System (CBCS)
for B.Sc. Physics

Semester	Core Course (DSC) (12)	Ability Enhancement Compulsory Courses AECC(2)	Skill Enhancement (Foundation) Courses SEC(2)	Discipline Specific Elective (DSE)
I	DSC 01–Physics P -I DSC 02–Physics P -II	English (1) Marathi/Hindi/Sup. English (1)		
II	DSC 03–Physics P -I DSC 04–Physics P -II	English (1) Marathi/Hindi/Sup. English (1)		
III	DSC 05–Physics P -I DSC 06–Physics P -II		Environmental Studies	
IV	DSC 07- Physics P -I DSC 08- Physics P -II		Democracy, Elections and Good Governance	
V	DSE 01- Physics P -I DSE 02- Physics P -II		(Any one) 1.Physics Workshop Skill 2.Electrical Circuits and Network Skills	**DSE-Physics** (Any Two) 1.Elements of Modern Physics 2.Solid State Physics 3. Medical Physics 4.Mathematical Physics
VI	DSE 03- Physics P -I DSE 04- Physics P -II		1. Basic Instrumentation Skill 2. Renewable Energy and Energy Harvesting	**DSE- Physics** (Any Two) 1.Nuclear and Particle Physics 2.Digital & Analog Circuits and Instrumentation 3. Quantum Mechanics 4. Embedded system: Introduction to Microcontroller

B.Sc. Physics

Discipline Specific Core (DSC):

Semester I: Core Papers: Physics (Credits : 02 each)

1. Mechanics and relativity
2. Gravitation, Oscillations and Properties of Matter
3. **Practical - I** (10 Experiments)

Semester II: Core Papers: Physics (Credits : 02 each)

1. Vector Analysis and Electrostatics
2. Magnetostatics and Electromagnetic Waves
3. **Practical - II** (10 Experiments)

Semester III Core Papers: Physics (Credits : 02 each)

1. Thermal Physics
2. Radiation and Statistical Physics
3. **Practical III** (10 Experiments)

Semester IV: Core Papers :Physics (Credits : 02 each)

1. Waves, Acoustics and Laser
2. Optical Physics
3. **Practical IV**(10 Experiments)

Semester V: Discipline Specific Electives (DSE): Physics(Credit : 02 each)

(Any two from four DSE course papers)

1. Elements of Modern Physics
2. Solid State Physics
3. Medical Physics
4. Mathematical Physics
5. **Practical V** (10 Experiments related to opted papers)

Skill Enhancement Courses (SEC): Physics (Credit : 02 each)

(Any one from two SEC course papers)

1.Physics Workshop Skill

2. Electrical Circuits and Network Skills

Semester VI:Discipline Specific Electives (DSE): Physics(Credit:02 each)

(Any two from four DSE course papers)

1. Nuclear and Particle Physics
2. Digital & Analog Circuits and Instrumentation
3. Quantum Mechanics
4. Embedded system: Introduction to Microcontrollers
5. **Practical VI** (10 Experiments related to opted papers)

Skill Enhancement Courses (SEC): Physics (Credit : 02 each)

(Any one from two SEC course papers)

1. Basic instrumentation skill
2. Renewable energy and energy harvesting

SEM- V

Discipline Specific Elective (DSE) Course (Any Two)

Paper I (USDSEPHT09): ELEMENTS OF MODERN PHYSICS

(Credits: Theory-04, Practicals-02) Theory: 48 Lectures

UNIT- I (12L) Introduction to Quantum theory: Failures of Classical theories (w. r. t. Black body radiations and photoelectric effect), Planck's constant and light as a collection of photons; De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Position measurement; Energy-time uncertainty principle**,** applications of uncertainty principle (Impossibility of an electron being in the nucleus), gamma ray microscope thought experiment**.**

Numerical

UNIT- II (12L)

Schrodinger's wave equations: Schrodinger equation for non-relativistic particles (time dependent and time independent equation); Physical significance of psi; Eigen values and Eigen functions; Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Applications of Schrodinger's equation: One dimensional infinitely rigid box; Quantum mechanical scattering and tunneling in one dimension - across a step potential and barrier potential.

Numerical

UNIT- III (12L)

Nucleus and its stability: Size and structure of atomic nucleus and its relation with atomic weight; Nature of nuclear force, NZ graph & stability, semi-empirical mass formula and binding energy (BE); Average BE and its variation with mass number.

Radioactivity: Radioactivity and emission of α, β and ϒ-rays; Law of radioactive decay; Mean life & half-life; Range of α-particle and its experimental measurements; Gamow's theory of α-decay.

Numerical

UNIT- IV (12L)

β and ϒ-rays emission: β decay- energy released, spectrum and Pauli's prediction of neutrino; Origin of γ-ray emission, Geiger-Nuttle law, Nuclear isomerism, Massbouer effect.

Fission and fusion: Fission-Liquid drop model, energy release, fission fragments & emission of neutrons. Chain reaction with Uranium 235; Nuclear reactor; Fusion- Stellar energy and thermonuclear energy reactions. *Numerical*

Reference Books:

1. Physics for Degree students B. Sc. III yr Harnath Singh and Dr. P. S. Hemne, S. Chand Publication
2. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
3. Modern Physics, John R.Taylor, Chris D.Zafiratos, Michael A.Dubson,2009, PHI Learning
4. Six Ideas that Shaped Physics:Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
5. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
6. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning.
7. Atomic and Nuclear Physics, Dr. V. W. Kulkarni, Himalaya Publication.
8. Modern Physics, R. Murugashen, S, Chand Publications.

PRACTICAL: ELEMENTS OF MODERN PHYSICS

1. To determine value of Boltzmann constant using V-I characteristic of PN diode (or other method).
2. To determine work function of material of filament of directly heated vacuum diode.
3. To determine value of Planck's constant.
4. To determine the ionization potential of mercury.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source.
8. Measurement of intensity variation using Photo sensor and compare with incoherent source – Na light.
9. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light.
10. To determine the value of e/m.
11. To setup the Millikan oil drop apparatus and determine the charge of an electron.
12. To determine the lattice parameter of unit cell by x-ray diffraction film.
13. Identification of unknown element from line emission spectra.
14. To determine the electronic charge (e) and work function (Φo) of cathode by using photocell

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi
4. B. Sc. Practical Physics H. Singh and Dr. P. S. Hemne, S. Chand Publication.

Paper II (USDSEPHT10): SOLID STATE PHYSICS

(Credits: Theory-04, Practicals-02) Theory: 48 Lectures

UNIT-I (12L)

Crystal Structure: Solids- Amorphous and Crystalline Material, Lattice Translation Vector, Lattice with a Basis, Periodicity in crystal. Unit Cell, Miller Indices, Reciprocal Lattice, Types of Lattices, Brillouin Zones. **Diffraction of Crystal:** Diffraction of X-rays by Crystals, Bragg's Law, Bragg,s X-ray spectrometer.

Numerical

UNIT-II (12L)

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin theory of Dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism, Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains, Discussion of B-H Curve, Hysteresis and Energy Loss**.**

Numerical

UNIT-III (12L)

Dielectric Properties of Materials: Three electric vectors E, D and P; Polarization, Local Electric Field at an Atom, Depolarization Field. Electric Susceptibility, Polarisability, Claussius-Mossotti Equation, its molecular interpretation and limitations.

Classical Theory of Electric Polarizability, Normal and Anomalous Dispersion, Cauchy and Sellmeir relations, Langevin-Debye equation, Complex Dielectric Constant, Optical Phenomena.

Numerical

UNIT-IV (12L)

Elementary band theory: Energy band picture of conductor, semiconductors and insulators, Kroning Penny model, Hall Effect, Fermi level and Fermi energy. **Superconductivity:** Theory of superconductivity, Type-I and Type-II super conductor, Effect of external electric field on superconductors, Critical Temperature, Critical magnetic field, Meissner effect.

Numerical

Reference Books:

1. Physics for Degree students B. Sc. III yr Harnath Singh and Dr. P. S. Hemne, S. Chand Publication.
2. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
3. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
4. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill.
5. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning.
6. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India.
7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.
8. Atomic and Nuclear Physics, Dr. V. W. Kulkarni, Himalaya Publication.
9. Modern Physics, R. Murugashen, S, Chand Publications.

PRACTICALS: SOLID STATE PHYSICS

1. Determination of various parameters of crystal models.
2. Construction and study of various crystal structure using ball and spokes.

3. To determine the lattice parameter ‘a’ of unit cell by x-ray photograph.
4. Identification of unknown element from given spectra.
5. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method).
6. To measure the Magnetic susceptibility of Solids.
7. To determine the Coupling Coefficient of a Piezoelectric crystal.
8. To measure the Dielectric Constant of a dielectric Materials with frequency.
9. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR).
10. To determine the refractive index of a dielectric layer using SPR.
11. To study the PE Hysteresis loop of a Ferroelectric Crystal.
12. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
13. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four probe method (from room temperature to 150^{o}C) and to determine its band gap.
14. To determine the Hall coefficient of a semiconductor sample.
15. Study of NTC/PTC thermister.
16. To determine the band gap energy of semiconductor using junction diode.

Reference Books:

1. Physics for Degree students B. Sc. III yr Harnath Singh and Dr. P. S. Hemne, S. Chand Publication.
2. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi
5. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

Paper III (USDSEPHT11): MEDICAL PHYSICS

(Credits: Theory-04, Practicals-02) Theory: 48 Lectures

UNIT-I (12L)

Physics of the body–I: Mechanics of the body - Skeleton, forces, and body stability, Muscles and the dynamics of body movement Physics of body crashing, Energy household of the body, Energy balance in the body, Energy consumption of the body, Heat losses of the body, Pressure system of the body, Physics of breathing, Physics of the cardiovascular system.

UNIT-II (12L)

Physics of the body–II: Acoustics of the body- Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound Optical system of the body, Physics of the eye, Electrical system of the body, Physics of the nervous system, Electrical signals and information transfer.

UNIT-III **(12L)**

Physics of diagnostic and therapeutic systems-I:

X-RAYS- Electromagnetic spectrum, production of x-rays, x-ray spectra, Brehmsstrahlung Characteristic x-ray , X-ray tubes, Coolidge tube, x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating, quality and intensity of x-ray, X-ray generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit, high frequency generator, exposure timer, HT cables.

RADIATION PHYSICS- Radiation units – exposure, absorbed dose, units- rad, gray, relative biological effectiveness, effective dose, inverse square law, interaction of radiation with matter, linear attenuation coefficient.

UNIT-IV **(12L)**

Radiation Detectors: Thimble chamber, condenser chambers, Geiger counter, Scintillation counter, ionization chamber, Dosimeters, survey methods, area monitors, TLD and semiconductor detectors.

Medical Imaging Physics: X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR), NMR imaging, MRI Radiological imaging, Radiography, Filters, grids, cassette, X-ray film, film processing, fluoroscopy, computed tomography scanner, principle function, display, generations, mammography. Ultrasound imaging, magnetic resonance imaging, thyroid uptake system, Gamma camera (Only Principle, function and display).

References:

1. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978).
2. Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003).
3. Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990).
4. Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition (2003).
5. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002).
6. The Physics of Radiology-H E Johns and Cunningham.

PRACTICALS: MEDICAL PHYSICS

1. Understanding the working of a manual Hg Blood Pressure monitor and measure the Blood Pressure.
2. Understanding the working of a manual optical eye-testing machine and to learn eye-testing.
3. Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard.
4. Correction of Hypermetropia/Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard.
5. To learn working of Thermoluminescent dosimeter (TLD) badges and measure the background radiation.
6. Familiarization with Geiger-Muller (GM) Counter and to measure background

radiation.

7. Familiarization with Radiation meter and to measure background radiation.
8. Familiarization with the construction of speaker-receiver system and to design a speaker-receiver system of given specification.

References:

1. Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
2. Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
3. Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition (2003)
4. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
5. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

Paper IV (USDSEPHT12): MATHEMATICAL PHYSICS

(Credits: Theory-04, Practicals-02) Theory: 48 Lectures

UNIT I: (12L)

Fourier series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series.

Numerical

UNIT II: (12 L)

Frobenius Method and Special Functions: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations .

Numerical

UNIT III: (12 L)

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical symmetry.

Numerical

UNIT IV: (12 L)

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables.

Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable.

Numerical

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. An Introduction to Ordinary Differential Equations, Earl A Coddington, 1961, PHI Learning.
5. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
6. Partial Differential Equations for Scientists and Engineers, S.J. Farlow, 1993, Dover Publications.
7. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Books.

PRACTICALS: MATHEMATICAL PHYSICS

1. Highlights the use of computational methods to solve physical problems
2. Use of computer language as a tool in solving physics problems (applications)
3. The course will consist of lectures (both theory and practical) in the Computer Lab
4. Evaluation done not on the programming but on the basis of formulating the problem
5. Aim at teaching students to construct the computational problem to be solved
6. Students can use anyone operating system Linux or Microsoft Windows
7. Introduction and Overview Computer architecture and organization memory and Input/output devices Basics of scientific computing.
8. Errors and error Analysis .
9. Review of C & C++ Programming fundamentals.
10. Program using C / C++ Programming language.

Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5thEdn., 2012, PHI Learning Pvt. Ltd.
2. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw---Hill Publications.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal., 3rdEdn., 2007, Cambridge University Press.
4. A first course in Numerical Methods, Uri M. Ascher and Chen Greif, 2012, PHI Learning
5. Elementary Numerical Analysis, K.E.Atkinson,3rdEdn., 2007, Wiley India Edition.
6. Numerical Methods for Scientists and Engineers, R.W. Hamming, 1973, Courier Dover Pub.
7. An Introduction to Computational Physics, T.Pang, 2ndEdn., 2006, Cambridge Univ. Press

Skill Enhancement Course (SEC): (any one)

Paper I(USSECPH01): PHYSICS WORKSHOP SKILL
(Credits: 02) 24 Lectures

AIM : *The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode.*

UNIT I (6L)

Introduction of Measurement: Measuring units. Conversion into SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains etc.

UNIT II (6L)

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode etc) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

UNIT III (6L)

Introduction to prime movers(Machines): Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

UNIT IV (6L)

Uses of Bread Board: Designing of circuits like Half wave rectifires, Full wave rectifires, Bridge rectifires with L- section , π- section filters and measurement of output voltage.

Designing of basic gates: AND , OR, NOT, NAND and NOR gates and verifications of their truth tables.

Practical:

1. To determine diameter of thin wire using screw gauge.
2. To determine thickness of thick iron sheet by using vernier caliper.
3. To design Half wave & full wave rectifier using diode.
4. To design L-Section and , π - section filter.
5. To design basic gates.
6. To determine the volume of cylindrical body.

Reference Books:

1. A text book in Electrical Technology - B L Theraja – S. Chand and Company.
2. Performance and design of AC machines – M.G. Say, ELBS Edn.
3. Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes
5. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland

Paper II(USSECPH02): ELECTRICAL CIRCUIT NETWORK SKILLS

(Credits: 02) Theory: 24 Lectures

AIM :*The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode*

UNIT I (6L)

Basic Electricity Principles: Introduction to Voltage, Current, Resistance, and Power. Ohm's law. series-parallel combinations of resistance and capacitances. AC Electricity and DC Electricity. Familiarization with galvanometer, voltmeter, ammeter and multimeter.

Understanding Electrical Circuits: Main electric circuit elements and their combination. Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources.

UNIT II (6L)

Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

Generators and Transformers: DC Power sources. AC/DC generators. Concepts of Inductance, capacitance and impedance. Operation of transformers.

UNIT III (6L)

Electric Motors: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

Solid-State Devices: Diodes, Transistors, Thermisters and LED, Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

UNIT IV (6L)

Electrical Protection: Relays. Fuses and disconnecting switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Interfacing DC or AC sources to control elements(relay protection device).

Practical:

1. To determine total capacitance when three capacitors connected in series.
2. To determine total capacitance when three capacitors connected in parallel.
3. To obtain the value of three resistances using colour codes.
4. To design and verify Ohm’s law.
5. To draw symbols of, capacitors, inductors, diode and transistor (NPN and PNP).

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn

SEM- VI

Discipline Specific Elective (DSE) Course(Any Two)

Paper I(USDSEPHT13): NUCLEAR & PARTICLE PHYSICS

(Credits: Theory-04, Tutorials-02) Theory: 48 Lectures

UNIT-I (12L)

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, atomic mass unit, mass defect, packing fraction & its variation with mass number.

Angular momentum (spin, orbital and total), magnetic moment of nucleus, electric moments, magnetic moment of an atom and Bohr magneton**.**

Numerical

UNIT-II (12L)

Nuclear Models: Liquid drop model approach, total binding energy of nucleus, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas).

Shell model and evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of nuclear force**.**

Numerical

UNIT-III (12L)

Nuclear Reactions: Types of Reactions (scattering, radioactive capture, disintegration, high energy reaction), Conservation Laws, Endoergic and exoergic reactions, Q-value, reaction rate, reaction cross section.

Interaction of Nuclear Radiation with matter: Energy loss due to ionization, Neil-Bohr's formula and Bethe-Block formula with their limitations, Range and straggling of charge particle, energy loss of electrons, Cerenkov radiation, Absorption of ϒ-ray by matter, Gamma ray interaction through matter, photoelectric absorption, Compton scattering, pair production, plot of absorption coefficient with photo energy, neutron interaction with matter & neutron detection.

Numerical

UNIT-IV (12L)

Detector for Nuclear Radiations: Principle and working of Wilson chamber, Ionisation chamber, Proportional counter and GM counter. Basic principle & working of Scintillation counter, construction & operation of photo-multiplier tube (PMT).

Particle Accelerators: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchro-cyclotrons**.**

Numerical

Reference Books:

1. Atomic and Nuclear Physics by Dr. V. W. Kulkarni, Himalaya publication.

2. Physics for degree students, B. Sc. Third year by C. L. Arora & Dr. P. S. Hemane, S. Chand publications.
3. Introductory nuclear Physics by Kenneth S.Krane (Wiley India Pvt. Ltd., 2008)
4. Concepts of nuclear physics by Bernard L.Cohen. (Tata Mcgraw Hill, 1998).
5. Introduction to the physics of nuclei & particles, R.A.Dunlap. (Thomson Asia, 2004)
6. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
7. Quarks and Leptons, F. Halzen and A.D.Martin, Wiley India, New Delhi
8. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
9. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
10. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)

Paper II(USDSEPHT14): DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION

(Credits: Theory-04, Practicals-02) **Theory: 48 Lectures**

UNIT-I **(12L)**

Digital Circuits: Difference between Analog and Digital Circuits. Binary, decimal, Hexadecimal number system, and their inter conversion. Binary Addition, Binary Subtraction using 1's and 2's Complement Method. Binary codes 8421 and EX-3 code, Logic gates- AND, OR and NOT Gate, NAND and NOR Gates as Universal Gates, XOR and XNOR Gates.

De Morgan's Theorems, Boolean Laws, Implementation of Boolean equation to logic circuits, Simplification of Logic Circuit using Boolean Algebra, Half and Full Adders, Half and Full Subtractor.

Numerical

UNIT-II **(12 L)**

Semiconductor Devices and Applications: P and N-type semiconductors. Formation of Potential Barrier in PN junction diode, Current flow mechanism in forward and reverse biased diode, PN junction and its characteristics, Static and Dynamic Resistance, LED and Photocell.

Power Supply: Half-wave Rectifiers, Full-wave Rectifiers and bridge Rectifires, Calculation of Rectification Efficiency, Ripple Factor and Regulation. Basic idea about L-section and π-section filter, Zener diode, its characteristics and Voltage Regulation

Numerical

UNIT-III **(12 L)**

Bipolar Junction transistors: Construction and working of n-p-n and p-n-p Transistors. Characteristics of transistor in CB and CE configuration, Current gains α and β. Relation between α and β. Transistor as an CE amplifier, Graphical analysis of CE amplifier with DC Load line and Q-point. Explanation of active, cut-off and saturation regions.

Voltage Amplifiers: Classification of amplifier as Class-A, Class-B and Class-C amplifier.

Cascaded amplifier, RC coupled amplifier.

Numerical

UNIT-IV **(12 L)**

Operational Amplifiers: Difference amplifier, Characteristics of an Ideal OPAMP- Input bias current, input offset current, input offset voltage, Open-loop & Closed-loop Gain, CMRR, slew rate, concept of Virtual ground. Practical OPAMP IC-741.

Applications of Op-Amps: (i) Inverting and Non-inverting Amplifiers, ii) Adder, (iii) Subtractor, (iv) Differentiator, (v) Integrator, (vi) Zero Crossing Detector.

Numerical

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronic devices and circuits, S. Salivahanan and N.Suresh Kumar, 2012, Tata Mc-Graw Hill.
3. Elements of Electronics- Bagde and Singh, S. Chand Publication.
4. Digital and Analogue Technique- Navneet, Kale, Gokhale, Kitab Mahal Publication.
5. Microelectronic Circuits, M.H. Rashid, 2ndEdn., 2011, Cengage Learning.
6. Modern Electronic Instrumentation & Measurement Tech.,Helfrick&Cooper,1990, PHI Learning
7. Digital Principles & Applications, A.P.Malvino, D.P.Leach & Saha, 7th Ed.,2011, Tata McGraw Hill
8. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
9. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.

PRACTICALS: DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTS

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To verify and design AND, OR, NOT and XOR gates using NOR gates.
3. To minimize a given logic circuit and verification of their truth table.
4. Half adder, Full adder and 4-bit Binary Adder.
5. Adder-Subtractor using Full Adder I.C.
6. To study astable multivibrator using 555 Timer/transistor circuit.
7. To study I-V characteristics of PN junction diode and Zener diode.
8. To study the characteristics of a Transistor in CE configuration.
9. To design and study the CE amplifier.
10. To design and study OPAMP as an inverting amplifier of given gain using Op-amp IC741.
11. To design and study OPAMP as non-inverting amplifier of given gain using Op-amp IC741.
12. To design and study OPAMP as an Adder.
13. To study OPAMP as a subtractor.
14. To study a precision Differential Amplifier of given I/O specification using Op-Amp.

15. To investigate the use of an op-amp as a Differentiator.
16. To study the various flip-flops using NAND & NOR gates.

Reference Books:

1. Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
5. B. Sc. Practical Physics- Harnath Singh and Dr. P. S. Hemne, S. Chand Publication.

Paper III(USDSEPHT15) : QUANTUM MECHANICS

(Credits: Theory-04, Practicals-02) **Theory: 48 Lectures**

UNIT-I **(12L)**

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum.

Time independent Schrodinger equation: Time independent Schrodinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wavepacket for a free particle in one dimension; wave packets.*Numerical*

UNIT-II **(12L)**

General discussion of bound states in an arbitrary potential : continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method.

Numerical

UNIT-III **(12L)**

Quantum theory of hydrogen-like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wavefunctions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells (idea only)*Numerical*

UNIT-IV **(12L)**

Atoms in Electric and Magnetic Fields: Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton. **Atoms in External**

Magnetic Fields: Normal and Anomalous Zeeman Effect.

Reference Books:

1. A Text book of Quantum Mechanics, P.M.Mathews & K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEdn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
4. Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
6. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press Additional Books for Reference
7. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
8. Introduction to Quantum Mechanics, David J. Griffith, 2nd Ed. 2005, Pearson Education
9. Quantum Mechanics, Walter Greiner, 4thEdn., 2001, Springer

PRACTICAL: QUANTUM MECHANICS

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like-

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom.
2. Obtain the energy eigen values and plot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 (eVÅ)1/2, ħc = 1973 (eVÅ) and m = 0.511x106eV/c2.
3. Solve the s-wave radial Schrodinger equation for an atom.
4. Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 (eVÅ)1/2, m = 0.511x106eV/c2 , and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ).
5. The ground state energy is expected to be above -12 eV in all three cases.
6. Solve the s-wave radial Schrodinger equation for a particle of mass m.
7. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule.
8. Find the lo west vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function. Take: m = 940x106eV/C2, D = 0.755501 eV, α = 1.44, ro = 0.131349 Å

Laboratory based experiments:

1. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency.
2. Study of Zeeman effect: with external magnetic field; Hyperfine splitting.
3. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.

Reference Books:

1. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw---Hill Publications.
2. Numerical Recipes in C: The Art of Scientific Computing, W.H.Press et al., 3rdEdn., 2007, Cambridge University Press.
3. Elementary Numerical Analysis, K.E.Atkinson, 3rdEdn., 2007, Wiley India Edition.
4. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández.2014 Springer ISBN: 978-3319067896.
5. Scilab by example: M. Affouf2012ISBN: 978-1479203444.
6. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand and Company, New Delhi ISBN: 978-8121939706.
7. Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 9786133459274A.
8. Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
9. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.

PaperIV(USDSEPHT16): EMBEDDED SYSTEM- INTRODUCTION TO MICROCONTROLLERS

(Credits: Theory-04, Practicals-02) **Theory: 48 Lectures**

UNIT-I **(12 L)**

Embedded system introduction: Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems, challenges and design issues in embedded systems, operational and non-operational quality attributes of embedded systems, elemental description of embedded processors and microcontrollers.

Review of microprocessors: Organization of Microprocessor based system, 8085µp pin diagram and architecture, concept of data bus and address bus, 8085 programming model, instruction classification, subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts.

Numerical

UNIT-II **(12 L)**

8051 microcontroller: Introduction and block diagram of 8051 microcontroller, architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions.

Numerical

UNIT-III **(12 L)**

8051 I/O port programming: Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description and their functions, I/O port programming in 8051, (Using Assembly Language), I/O programming: Bit manipulation.

Programming of 8051: 8051addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic & logic instructions. *Numerical*

UNIT-IV **(12 L)Programming**

Embedded Systems: Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging.

Embedded system design and development: Embedded system design and development environment, file types generated after cross compilation, disassemble / decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry. *Numerical*

Reference Books:

1. Embedded Systems: Architecture, Programming & Design, R. Kamal, 2008, Tata McGraw Hill
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A.Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
3. Embedded Microcomputor System: Real Time Interfacing, J.W. Valvano, 2000, Brooks/Cole
4. Microcontrollers in practice, I.Susnea and M.Mitescu, 2005, Springer.
5. Embedded Systems: Design & applications, 1/e S.F. Barrett, 2008, Pearson Education India
6. Embedded Microcomputer systems: Real time interfacing, J.W.Valvano 2011,Cengage Learning

PRACTICALS: EMBEDDED SYSTEM-INTRODUCTION TO MICROCONTROLLERS

Following experiments should be perform using 8051:

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
5. Program to glow first four LED then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle '1234' as '1324' in the seven segment LED.
10. Interface stepper motor with 8051 and write a program to move the motor through

a given angle in clock wise or counter clockwise direction.

11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.

Reference Books:

1. Embedded Systems: Architecture, Programming & Design, R. Kamal, 2008, Tata McGraw Hill
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A.Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
3. Embedded Microcomputor System: Real Time Interfacing, J.W. Valvano, 2000, Brooks/Cole
4. Embedded System, B.K. Rao, 2011, PHI Learning Pvt. Ltd.
5. Embedded Microcomputer systems: Real time interfacing, J.W.Valvano 2011,Cengage Learning.

Skill Enhancement Course (SEC): (any one)

Paper I (USSECPH03): BASIC INSTRUMENTATION SKILLS
(Credits: 02) Theory: 24 Lectures

AIM:*This course is to get exposure with various aspects of instruments and their usagethrough hands-on mode. Experiments listed below are to be done in continuation of the topics.*

UNIT I (6L)

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Error in measurements and loading effects.

Multimeter: Principles of measurement of dc voltage, dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

UNIT II (6L)

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier- rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

UNIT III (6L)

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

UNIT IV (6L)

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

Practical:

1. Use of an oscilloscope to measure the frequency, time period and amplitude.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment.
4. Use of Digital multimeter/VTVM for measuring voltages.
5. Circuit tracing of Laboratory electronic equipment.
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit.
9. Balancing of bridges.

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter. 6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
7. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer

Paper II(USSECPH04) : RENEWABLE ENERGY AND ENERGY HARVESTING

(Credits: 02) Theory: 24 Lectures

AIM :*The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible*

UNIT I (6L)

Fossil fuels and Alternate Sources of energy: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

UNIT II (6L)

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning.

UNIT III (6L)

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

UNIT IV (6L)

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Practical:

1. To design solar green house.
2. To design solar heater.
3. To design model of a bio-gas plant.
4. Write drawbacks of conventional energy sources and importance of renewable energy sources.

Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J. Balfour, M. Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA)