AC 11-02-2017

Item No. 4.222

UNIVERSITY OF MUMBAI

Essential Elements of the Syllabus

Title : Syllabus for the B.Sc. Course in Physics (from academic year 2017-18) for Semester III & IV

Course Code : **USPH**

Preamble :

This is a revised part of the undergraduate programme (Six Semesters) in Physics, to be taught in Semester III & IV from the academic year 2017-18 onwards.

Developing Curriculum that is progressive and purposeful to create positive improvement in the education system is the logic behind this revision.

Out of the three courses in each Semester, **two** courses are devoted to core Physics, catering to Mechanics, Thermodynamics, Optics , Electrodynamics, Quantum Mechanics, Mathematical Physics and Digital and Analog Electronics. These have been tailored to fit in with the existing FYBSc syllabus (Sem I and Sem II) in terms of continuity and to ensure delivery of quality content to the learner.

The science of Physics has diversified immensely in recent times and numerous new fields in Physics, such as Biophysics, Geo-Physics, Radio-Physics, Physics of metals and materials, etc. have come into existence. The fundamentals and the generality of many principles of Physics are common to all these specialized diverse fields. Most problems in applied areas have been discussed

intensely in academic conferences and journals, but have not found their place in curricula or in text books.

The **third** course in each semester offers interdisciplinary application- oriented topics . It will be offered as a **choice** to all learners across various combinations. This course will seek to foster a spirit of multidisciplinary approach in learning.

The 'practical' component in the applied course will be seen as a combination of laboratory sessions , a visit to a Research Institute/Industry, mini project, an assignment on a relevant topic etc.

For the various units, experts will guide as '**Resource Persons**' and their laboratories/ departments could serve as **Resource Centers**. Faculty members/Teachers can avail of their expertise to train themselves in the delivery of these courses whenever required.

Objective :

Upon completion of the course, students should have acquired the following knowledge and skills:

1. a thorough quantitative and conceptual understanding of the core areas of physics, including mechanics, , thermodynamics, quantum mechanics, electronics at a level compatible with graduate programs in physics at peer institutions.
2. the ability to analyze and interpret quantitative results, both in the core areas of physics and interdisciplinary areas.
3. the ability to use contemporary experimental apparatus and analysis tools to acquire, analyze and interpret scientific data.
4. the ability to apply the principles of physics to solve new and unfamiliar problems.
5. the ability to communicate scientific results effectively in presentations or posters.

Eligibility : Passed semester 1 and Semester II **;** as per rules of passing

Question paper pattern : Paper of 100marks ; 3 hours duration.

(pattern as per guidelines)

Revised Syllabus in Physics (Theory and Practical)

as per Choice based Credit and Grading system

Second year B.Sc. 2017-2018

The revised syllabus in Physics as per credit based system (with choice) of the Second Year B.Sc course will be implemented from the academic year 2017-2018.

Objectives:

- To develop analytical abilities towards real world problems
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem solving hands on activities, study visits, projects etc.

Semester	Paper	Title	Credits
III	USPH301	Mechanics and thermodynamics	2
III	USPH302	Vector calculus ,Analog Electronics	2
III	USPH303	Applied Physics -I	2
III	USPHP3	Practical course -3 (Group A,B,C and Skill)	3
		Total	**9**
IV	USPH401	Optics and Digital Electronics	2
IV	USPH402	Quantum Mechanics	2
IV	USPH403	Applied Physics-II	2
IV	USPHP4	Practical course -4 (Group A,B,C and Demo)	3
		Total	**9**

Proposed syllabus of SYBSc (2017-18)

USPH301 : Mechanics and thermodynamics

Learning Outcomes :

On successful completion of this course, students will be able to :

i) Understand the concepts of mechanics & properties of matter & to apply them to problems.

ii) Comprehend the basic concepts of thermodynamics & its applications in physical situation.

iii) Learn about situations in low temperature.

iv) Demonstrate tentative problem solving skills in all above areas.

UNIT – I **15 Lectures**

I Compound pendulum :
Expression for period, maximum and minimum time period, centres of suspension and oscillations , reversible compound pendulum. Kater's reversible pendulum , compound pendulum and simple pendulum- a relative study.

Ii Center of Mass , .Motion of the Center of Mass , Linear momentum of a Particle Linear momentum of a System of Particles , Linear momentum wrt CM coordinate (i.e shift of origin from Lab to CM), Conservation of Linear Momentum , Some Applications of the Momentum Principle , System of Variable Mass
Torque Acting on a Particle , Angular Momentum of a Particle , Angular Momentum of System of Particles , Total angular momentum wrt CM coordinate. Conservation of Angular Momentum

iii Oscillations **,** The Simple Harmonic Oscillator , Relation between Simple Harmonic Motion and Uniform Circular Motion , Two Body Oscillations, Damped Harmonic Motion , Forced Oscillations and Resonance.

UNIT –II **15 Lectures**

(Review of zeroth and first law of thermodynamics)

I Conversion of heat into work, heat engine, Carnot's cycle: its efficiency.

Ii Second law of thermodynamics, Statements, Equivalence of Kelvin and Plank statement, Carnot's theorem, Reversible and irreversible process, Absolute scale of temperature.

iii Clausius theorem, Entropy, Entropy of a cyclic process, Reversible process, Entropy change, Reversible heat transfer, Principle of increase in entropy, generalized form of first and second law, entropy change of an ideal gas, entropy of steam, entropy and unavailable energy, entropy and disorder, absolute entropy.

UNIT –III **15 Lectures**

i Third law of thermodynamics, Nernst heat theorem, Consequences of the third law, Maxwell's thermodynamic relations, Clausius – Clapeyron equation, Thermal Expansion.

ii Steam engine, Rankine cycle, Otto engine, Efficiency of Otto cycle, Diesel cycle, Efficiency of Diesel cycle, Otto and diesel comparison

iii Low temp Physics: Different methods of liquefaction of gases, methods of freezing, Cooling by evaporation, cooling by adiabatic expansion
Joule - Thompson effect, JT effect of Van der Waal's gas, Liquefaction of helium, properties and uses of liquid Helium

References:

Resnick and Halliday : Physics – I

Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2_{nd} ED.)

Thermal Physics, AB Gupta and H. Roy, Book and Allied (P) Ltd, Reprint 2008, 2009.

Heat thermodynamics and Statistical Physics, Brijlal, N.Subramanyam, P. S. Hemne, S. Chand, edition 2007.

Additional reference:

1. KRS: Mechanics by K.R Symon.
2. Classical Dynamics of particles and systems by Thornton and Marian, (CENGAGE Learning)
3. Basic Thermodynamics : Evelyn Guha (Narosa Publications)
4. Classical mechanics by Kleppener , Kollenkov
5. A treatise on heat : Meghanad Saha and BN Srivastava , 1969, India Press.
6. Mechanics and Electrodynamics Rev Edn. 2005 by Brijlal and Subramanyan and Jeevan Seshan.

USPH302 : Vector calculus, Analog Electronics

Learning Outcomes:

On successful completion of this course students will be able to :

1) Understand the basic concepts of mathematical physics and their applications in physical situations.

2) Understand the basic laws of electrodynamics and be able to perform calculations using them.

3) Understand the basics of transistor biasing, operational amplifiers, their applications

4) Understand the basic concepts of oscillators and be able to perform calculations using them.

5) Demonstrate quantitative problem solving skill in all the topics covered.

Unit I: Vector Calculus: 15 Lectures

1. Line, Surface and Volume Integrals, The Fundamental Theorem of Calculus, The Fundamental Theorem of Gradient, The Fundamental Theorem of Divergence , The Fundamental Theorem of Curl (Statement and Geometrical interpretation is included, Proof of these theorems are omitted). Problems based on these theorems are required to be done.

2. Curvilinear Coordinates: Cylindrical Coordinates, Spherical Coordinates

Unit II: Analog Electronics **15 Lectures**

1.Transistor Biasing, Inherent Variations of Transistor Parameters, Stabilisation, Essentials of a Transistor Biasing Circuit, Stability Factor, Methods of Transistor Biasing, Base Resistor Method, Emitter Bias Circuit, Circuit analysis of Emitter Bias, Biasing with Collector Feedback Resistor, Voltage Divider Bias Method, Stability factor for Potential Divider Bias.

2.General amplifier characteristics: Concept of amplification, amplifier notations, current gain, Voltage gain, power gain, input resistance, output resistance, general theory of feedback, reasons for negative feedback, loop gain.

3.Practical circuit of transistor amplifier, phase reversal, frequency response, Decibel gain and Band width.

Unit III: Analog Electronics **15 Lectures**

1. Oscillators: Introduction, effect of positive feedback. Requirements for oscillations, phase shift oscillator, Wien Bridge Oscillator, Colpitt's oscillator, Hartley oscillator

2. Operational Amplifiers: Introduction, Schematic symbol of OPAMP, Output voltage from OPAMP, AC analysis, Bandwidth of an OPAMP, Slew rate, Frequency Response of an OPAMP, OPAMP with Negative feedback, Inverting Amplifier, Non-Inverting Amplifier, Voltage Follower, Summing Amplifier, Applications of Summing amplifier, OPAMP Integrator and Differentiator, Critical frequency of Integrator, Comparator

References:

Introduction to Electrodynamics 3rd Ed by D.J. Griffith

Principles of Electronics – V. K. Mehta and Rohit Mehta. (S. Chand – Multicoloured illustrative edition)

Electronic devices and circuits – An introduction Allan Mottershead (PHI Pvt. Ltd.– EEE – Reprint – 2013)

USPH303 : Applied Physics - I

This paper consists of three modules (units) designed in a way so as to offer interdisciplinary & application oriented learning.

Learning Outcomes :

On completion of this, it is expected that

i) Students will be exposed to contextual real life situations.

ii) Students will appreciate the role of Physics in 'interdisciplinary areas related to materials, Bio Physics, Acoustics etc.

iii) The learner will understand the scope of the subject in Industry & Research.

iv) Experimental learning opportunities will faster creative thinking & a spirit of inquiry.

Unit 1 : Acoustics , Lasers and fibre optics 15 Lectures

1)Acoustics of Buildings: Reverberation, Sabine's formula (without derivation) Absorption coefficient, Acoustics of Buildings, factors affecting Acoustics of Buildings, Sound distribution in an auditorium.

2)Laser : Introduction, transition between Atomic energy states (without derivation), Principle of Laser, Properties of Laser, Helium–Neon Laser, Application of Laser, Holography

3) Fibre Optics : Light propagation through Fibres, Fibre Geometry, Internal reflection, Numerical Aperture, Step-Index and Graded-Index Fibres, Applications of Fibres.

References:

Modern Physics Concept and Applications – Sanjeev Puri, Narosa Publication.

Properties of matter and Acoustics – R Murugeshan and K. Shivaprasath, S Chand & Co.Ltd. (2005-Ed)

Unit II : Biophysics **15 Lectures**

Introduction, definition, History & scope of biophysics, biological fluids, physico-chemical properties, viscosity, surface tension, pH, osmosis, osmotic pressure. Diffusion, Ficks' laws of diffusion, dialysis, Cell is unit of life, fundamental understanding prokaryotic and eukaryotic cell structure and function, eukaryotic cell membrane, Fundamentals of transport process through biological membrane, membrane channels. electrical properties of cell, Action potential, propagation of action potential, methods of measurement of action potential, Nernst equation, Golman equation, The Hodgkin-Huxely model of action potential, voltage clamp technique, Patch clamp technique, cell impedance and capacitance .

References:

1. Cellular and Molecular Biology: Concept and Experiment by Gerald Karp
2. The Cell: A Molecular Approach by Geoffery Cooper
3. Introductory Biophysics: Perspective on living state by James Claycomb
4. Medical Physiology by Guyton
5. Molecular Biology of Cell by Bruce Albert
6. Text Book of Biophysics by R N Roy

Unit III : Materials – properties and applications **15 Lectures**

<u>Introduction to Materials</u>

Classification of Materials based on structures (Crystalline and Amorphous, single crystal, polycrystalline and nanomaterials) and Functionality (Conducting, insulating, superconducting, reflecting, transmitting etc)
Types of Materials: Metals and alloys, Ceramics, Polymers and Composites, Thin Films, Nanomaterials; Some Physical and Chemical methods of materials synthesis (5L)

<u>Properties of materials</u>

Electrical Properties: Review of energy band diagram for materials - conductors, semiconductors and insulators, Electrical conductivity in metals, semiconductors and insulators (dielectrics), effect of temperature on conductivity

Optical Properties: Reflection, refraction, absorption and transmission of electromagnetic radiation in solids.
Magnetic Properties: Origin of magnetism in solids (basic idea), Types of magnetic order (paramagnetism, diamagnetism, antiferro magnetism, ferromagnetism, ferrimagnetism), magnetic hysteresis (6L)

Applications
Optical materials: LEDs, OLEDs, LCDs, Flat Panel Displays, optical fibers
Dielectric materials: Piezoelectric, ferroelectric and pyroelectric materials
Magnetic Materials: Soft magnets (Transformer steels), Hard magnets for permanent magnets, Magnetic Recording and Storage (4L)

References:

1. Electronic Properties of Materials, Rolf E Hummel
2. Materials Science and Engineering: A First Course by V. Raghavan

USPHP3: Practical course -3

Instructions:

i) All the measurements and readings should be written with proper units in SI system only.
ii) After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
iii) While evaluating practical, weight age should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
iv) Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Learning outcomes :

On successful completion of this course students will be able to :

i) Understand & practice the skills while performing experiments.
ii) Understand the use of apparatus and their use without fear & hesitation.
iii) Correlate the physics theory concepts to practical application.
iv) Understand the concept of errors and their estimation.

Note: Exemption of two experiments from section A and / or B and / or C may be given if student carries out any one of the following activity.

1) Collect the information of at least five Physicists with their work or any three events on physics, report that in journal.
2) Execute a mini project to the satisfaction of teacher in-charge of practical.
3) Participate in a study tour or visit & submit a study tour report.

For practical examinations, the learner will be examined in three experiments (one from each group) .
Each experiment will be of three hours' duration .
A Minimum 3 from each group and in all minimum 12 experiments must be reported in journal.
All the skill experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments.

A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Physics or a certificate that the learner has completed the practical course of Physics Semester III as per the minimum requirements.

Group A

1 Y by bending.
2 Kater’s pendulum
3 Searle’s experiment: determination of Y and □.
4 Flat spiral spring (Y)
5 Flat spiral spring (n)
6 Young’s modulus by Koenig’s method.
7 Determination of thermal conductivity of bad conductor by Lee’s Method.
8 Helmholtz resonator- determination of unknown frequency.

9 Moment of Inertia of compound pendulum by method of coincidence.
8. Verification of Stefan's law (electrical method)
9. Temperature coefficient of resistance of conducting material,
10. e/m by Thomson's method
11. Charging and discharging of capacitor.
12. LCR parallel resonance.
13. Figure of merit of a mirror galvanometer.
14. Determination of absolute capacitance using BG
15. Measurement of resistance of galvanometer (G by shunting)

Group B

1. Passive low pass filter
2. Passive high pass filters.
3. Passive band pass filter.
4. Opamp: Inverting amplifier with different gains
5. Opamp: Non-inverting amplifier with different gains and voltage follower
6. Opamp: Integrator and Differentiator
7. CE amplifier: determination of bandwidth
8. CE amplifier: variation of gain with load
9. Lissajous figures using CRO.
10. Phase shift oscillator
11. Wien bridge oscillator
12. UJT characteristics
13. UJT relaxation oscillator
14. Colpitt's oscillator
15. Hartley oscillator

Group C

1. Laser experiments: straight edge, single slit, ruler grating
2. Optical fibre: transmission of signal
3. Concept of beats
4. Coupled oscillations and resonance
5. Standardization of pH meter & acid-base titration.
6. Determination of Isoelectric point of Amino Acids/protein.
7. Understanding uv visible spectra of protein/Nucleic Acids.
8. Surface tension of Biological fluid.
9. Microscopic examination of Red blood Cells & White blood Cells.
10. Synthesis of materials - mini project - thin film/nano materials/bulk powders using different routes etc.
11. Visit to research institutes (equivalent to three practical sessions).

12. Assignment & literature survey (equivalent to 2 practical sessions).

Skill experiments

1. Soldering technique
2. Wiring of a simple circuit using bread board
3. Use of DMM
4. Use of oscilloscope
5. Travelling microscope (radius of capillary)
6. Spectrometer: mean μ of yellow doublet of mercury source.
7. Spectrometer: optical leveling and Shuster's method
8. Component testing, colour code of resistors, capacitors etc.
9. Drawing of graph on semi logarithmic / logarithmic scale.
10. Radius of ball bearings (single pan balance)

References:

1) Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6^{th} Edition) Book and Allied Pvt.Ltd.
2) B.Sc Practical Physics – Harnam Singh S.Chand & Co. Ld. 2001
3) A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3^{rd} edition)
4) B.Sc. Practical Physics – CL Arora (1^{st} Edition) -2001 S.Chand and Co Ltd.
5) Practical Physics CL Squires (3^{rd} Edition) Cambridge University
6) University Practical Physics – DC Tayal. Himalaya Publication
7) Advanced Practical Physics – Worsnop &Flint.

USPH401 : Optics and Digital Electronics

Learning Outcomes:

On successful completion of this course students will be able to :

1) Understand the diffraction and polarization processes and applications of them in physical situations.
2) Understand the applications of interference in design and working of interferometers.
3) Understand the resolving power of different optical instruments.\
4) Understand the working of digital circuits
5) Use IC 555 time for various timing applications.
6) Demonstrate quantitative problem solving skills in all the topics covered.

UNIT I: (15 Lectures)

Background knowledge (devote one lecture at commencement):

i. Introduction, Huygens's - Fresnel theory, Distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction.
ii. Introduction of Polarization, Natural light is unpolarized, Unpolarized and Polarized light
iii. Brewster's law , Polaroid sheets
iv. Prism and grating spectra , Cornu's spiral, Fresnel's integrals.

Diffraction:

Fresnel's Diffraction: Fresnel's assumptions, Rectilinear propagation (Half period zones) of light, Diffraction pattern due to straight edge, Positions of maxima and minima in intensity, Intensity at a point inside the geometrical shadow(straight edge), Diffraction due to a narrow slit, Diffraction due to a narrow wire

Fraunhoffer Diffraction : Introduction, Fraunhoffer diffraction at a single slit, Intensity distribution in diffraction pattern due to a single slit, Fraunhoffer diffraction at a double slit, Distinction between single slit and double slit diffraction pattern and missing orders, Plane diffraction Grating, Theory of plane transmission grating, Width of principal maxima .

Unit II **(15 Lectures)**

Polarization: Types of polarization, Plane polarized light, Circularly polarized light, Elliptically polarized light, Partially polarized light, Production of Plane polarized light, Polarization by reflection from dielectric surface, Polarization by refraction –pile of plates, Polarization by scattering, Polarization by selective Absorption, Polarization by double refraction, Polarizer and Analyzer, Malus' Law, Anisotropic crystal, Calcite crystal, Optic Axis, Double refraction in calcite crystal, Huygens' explanation of double refraction, Ordinary and Extra ordinary rays, Positive and Negative crystals, Superposition of waves linearly polarized at right angles, Superposition of e-Ray and o-Ray, Retarders, Quarter wave plate, Half wave plate, Production of linearly polarized light,Production of elliptically polarized light, Production of circularly polarized light, Analysis of polarized light, Applications of polarized light.

Unit – III

Digital Electronics: **(15 Lectures)**

Background knowledge (devote one lecture at commencement):

i. Binary number system , Arithmetic building blocks , Types of registers

Digital IC signal levels, Binary to Decimal ,Decimal to binary , Hexadecimal number, Hexadecimal to decimal Conversion, Decimal to hexadecimal conversion, Hexadecimal to binary conversion, Binary to hexadecimal conversion, Binary addition, Unsigned binary numbers, Sign magnitude numbers , 1's complement , 2's complement , Converting to and from 2's complement representation , 2's complement arithmetic, The adder-subtractor (ignore IC specific diagrams)

RS Flip-Flops (only NOR gate latch, NAND gate latch) , Gated Flip-Flops, Edge-Triggered RS Flip-Flop, Edge- Triggered D Flip-Flop, Edge-Triggered J-K Flip-Flop, JK Master- Slave Flip-Flops, Bounce elimination switch

Types of registers : SISO , SIPO, PISO , PIPO [in this chapter the teacher should make all IC specific diagrams into general diagrams ie. Ignore pin numbers and IC numbers]

Asynchronous counter -3 bit (ignore IC specific diagrams), Synchronous counter only mod 8, Decade Counters Mod5 and Mod10

A Text Book Of Optics By: Dr.N.Subrahmanyam, Brijlal, Dr M.N. Avadhaanulu (S.Chand, 25th Revised edition2012 Reprint 2013)

AJOY GHATAK: OPTICS (5thEdition)

LMS – Digital Principles and Aplications By Leach, Malvino, Saha 6th edn.

TF – Digital Fundamentals by Thomas L Floyd 10th edn. (Additional Reading)

RPJ – Modern Digital Electronics by R P Jain 4th edn. (Additional Reading)

USPH402: QUANTUM PHYSICS

Learning Outcomes :

On successful completion of this course students will be able to :

1) Understand the postulates of quantum mechanics and to understand its importance in explaining significant phenomena in Physics.

2) Demonstrate quantitative problem solving skills in all the topics covered.

Background Reading (Review):

Origin of Quantum Mechanics:
1) Review of Black body radiation, b) Review of photoelectric effects.
2) Matter waves-De Broglie hypothesis. Davisson and Germer experiment.
3. Wave particle duality
5. Concept of wave packet, phase velocity, group velocity and relation between them
6. Heisenberg's uncertainty principle with thought experiment, different forms of uncertainty.

Unit –I: The Schrodinger wave equation: 15 Lectures

1. Concept of wave function, Born interpretation of wave function.
2. Concepts of operator in quantum mechanics examples – position, momentum and energy operators.
3. Eigenvalue equations, expectation values of operators.
4. Schrodinger equation.

5. Postulates of Quantum Mechanics.
6. Analogy between Wave equation and Schrodinger equation.
7. Time dependent and time independent (Steady State) Schrodinger equation, Stationary State
8. Superposition principle.
9. Probability current density, Equation of continuity and its physical significance.

Unit-II: Applications of Schrodinger steady state equation- 15 Lectures

1. Free particle.
2. Particle in infinitely deep potential well (one - dimension).
3. Particle in finitely deep potential well (one - dimension).
4. Step potential.
5. Particle in three dimension rigid box, degeneracy of energy state.

Unit-III: Applications of Schrodinger steady state equation –II 15 Lectures

1. Potential barrier (Finite height and width) penetration and tunneling effect (derivation of approximate transmission probability)
2. Theory of alpha particle decay from radioactive nucleus.
3. Harmonic oscillator (one-dimension), correspondence principle.

[Note: A good number of numerical examples are expected to be covered during the prescribed lectures].

Reference Books:

1. Concepts of Modern Physics – A. Beiser (6th Ed.) Tata McGraw Hill.
2. Quantum Mechanics – S P Singh, M K Bagade, Kamal Singh, - S. Chand : 2004 Ed.
3. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles. - By R. Eisberg and R. Resnik Published by Wiley.
5. Introduction to Quantum Mechanics. - By D. Griffiths Published by Prentice Hall.
6. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.
7. Quantum Mechanics. - By L. I. Schiff.
8. Quantum Mechanics. - By Powell and Crasemann, Addison-Wesley Pub. Co.

USPH403 : Applied Physics II

Learning Outcomes :

On successful completion of this course, students will be able to :

i) Understand the concepts of mechanics & properties of matter & to apply them to problems.

ii) Comprehend the basic concepts of thermodynamics & its applications in physical situation.

iii) Learn about situations in low temperature.

iv) Demonstrate tentative problem solving skills in all above areas.

Unit 1 : Introduction to Geophysics 15 Lectures

CHAPTER 1 : GEOLOGY AND GEOPHYSICS

1.1 Introduction to Geophysics its branches and relationship with other sciences.

1.2 Earth and solar system: Meteorites and other extra-terrestrial materials.

1.3 Age of Earth and various methods of determination. Planetary evolution of the Earth and its internal structure: Elastic waves and variation of physical and chemical properties in the interior of Earth.

1.4 Major tectonic features of the ocean oceanic and continental crust.

1.5 Continental drift – geological and geophysical evidence: mechanisms, objections and present status.

1.6 Gravity and magnetic anomalies at Mid-ocean ridges: deep sea trenches, continental shield areas and mountain chains.

1.7 Geomagnetism, elements of Earth's magnetism: Internal, external fields and their causes, Palaeomagnetism, Polar wandering paths and reversals, Seafloor spreading and Plate tectonics.

1.8 Seismic belts of the Earth: Seismicity and plate movements.

1.9 Geodynamics of the Indian plate.

1.10 Utility of the different geophysical techniques (discussed above) in exploration for academic as well as for harnessing resources. Geophysical potential fields: Principles of Gravity and Magnetic methods.

1.11 Instrumentation, field procedures used in geophysical studies.

1.12 Case studies

1.13 Problems.

Suggested Textbooks and References

1. *Geomagnetism: Solid Earth and Upper Atmosphere Perspectives.* Nathani Basavaiah, Springer (2011).
2. *Introduction to Applied Geophysics: Exploring the Shallow Subsurface.* H.R. Burger, A.F. Sheehan and C.H. Jones. W.W. Norton, New York (2006).
3. *Earth Science.* E.J. Tarbuck, F.K. Lutgens and D. Tasa, Prentice & Hall (2005).
4. *Mantle Plumes and Their Record in Earth History.* K.C. Condie, Cambridge University Press, Cambridge, UK (2001)
5. *The Magnetic Field of the Earth: Paleomagnetism, the Core, and the Deep Mantle.* R.T. Merrill, M.W. McElhinny and P.L. McFadden, International Geophysical Series 63, Academic Press (1996).
6. *Applied Geophysics (Paperback).* W.M. Telford, L.P. Geldart and R.E. Sheriff, Cambridge University Press, Cambridge (1990).

CHAPTER 2 : GEO-ENVIRONMENTAL SCIENCES

2.1 Environmental Magnetic Analysis relating to magnetic minerals and environmental systems, soil magnetism, mineral magnetic studies of lake and marine sediments and magnetic monitoring of air-, land- and water-pollution.

2.2 Geo-Environmental Studies relating to mining, urban, industrial, coastal and desert management, palaeoclimate, palaeoenvironment, medical geology, climate change and studies related to their impact on ecosystem.

2.3 Natural Hazard Investigations including scientific studies related to natural hazards such as earthquakes, landslides, floods and tsunamis.

2.4 Impact Assessment of Anthropogenic Activities such as heavy metal pollution in Mumbai aquatic system with industries and thermal power plants, urbanization, disposal of industrial and radio-active waste, excessive withdrawal of ground water and use of fertilizers.

Problems.

Suggested Textbooks and References

1. *Energy and Environment, 3rd Edition.* Robert A. Ristinen and Jack P. Kraushaar, John Wiley and Sons, Inc. (2015).
2. *Geomagnetism: Solid Earth and Upper Atmosphere Perspectives.* Nathani Basavaiah, Springer (2011).
3. *Textbook of Environmental Chemistry.* Balaram Pani, I.K. International Publishing House (2007).

4. *A Textbook of Environmental Studies, 1/e*. D.K. Asthana and Meera Asthana, S. Chand and Co. Publishing (2006).
5. *Environment: Problems and Solutions, 2/e*. D.K. Asthana and Meera Asthana, S. Chand and Co. Publishing (2006).
6. *Environmental magnetism.* R. Thompson and F. Oldfield F, Allen & Unwin (1986).

Unit II : Microprocessors (15 Lectures)

8085 Microprocessor and Basic Assembly Language Programming *(15 lectures)*

Introduction, Historical Perspective, Organization of a Microprocessor Based system, how does
the Microprocessor works, Machine Language, Assembly Language, High Level Languages,
Writing and executing an Assembly Language Program.

8085 Bus Organization, 8085 Programming Model, The 8085 Microprocessor, Pin connection
diagram and function of each pin, A detailed look at 8085 Microprocessor.

Basic definitions: Instruction, Opcode, operand. Instruction word Size, instruction Format, data format **,**Addressing Modes, The 8085 Instruction Set(Classification) Data transfer Operations, Arithmetic Operations, Logical Operations Branch Operations ,
Introduction to Advanced I nstructions Flowchart

Main References:

1. G: Microprocessor Architecture, programming and Applications with the 8085 by Ramesh Gaonkar, 5th Edition, Prentice Hall of India.
Additional references:
1) Microprocessor and Applications by Vibhute and Borole, Technova Publications, Pune.
2) Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH

Unit III : **15 Lectures**

A)Radiation Physics

1**: Basics of Radiation Science** 3L

Electromagnetic Spectrum, Introduction to radioactivity, Sources of radiation: Alpha, beta and gamma radiation, high energy electron radiation and X-rays, Radiation units, Sources of radiation: natural and man-made, Radiation protection

2: **Radiation Detectors and Beam Calibration** 4L

Types of radiation detectors, Ionization detectors, scintillation detectors, particle detectors, TLD, thin film detectors, Radiation field analyzer, Basic principles of beam profile measurement

Recommended Books:

1. Course in DRP by Dept of Atomic Energy

B) Radio communication :

1: Basics of Communication 3L

Block diagram of communication system, types of communication system: simplex, duplex, analog and digital communication,

Electromagnetic spectrum, base band and broad band communication. Noise

concept and types, signal to noise ratio, noise figure, noise temperature.

2: Amplitude Modulation 2 L

Need of modulation, concept of modulation, AM waveform, mathematical expression of AM, concept of sideband, demodulation principles. AM Receiver: TRF and super-heterodyne receiver,

3: Frequency Modulation 2 L

FM modulation: definition, mathematical representation, frequency spectrum, bandwidth and modulation index.

4.Concept of ASK, PSK, FSK, PAM, PWM, PPM, PCM. 1 L

Recommended Books:

1. Communication Electronics: Principles and applications by Louis E Frenzel 3rd edition TMH Publications.

2. Electronics Communication Systems by Kennedy

3. Telecommunication Switching Systems and Network by Vishwanathan and Thiagarajan, PHI publication.

4. Electronics Communication Systems by Denis Roddy and John Coolen, PHI publication.

USPHP4: Practical course -4

Instructions:

i. All the measurements and readings should be written with proper units in SI system only.

ii. After completing all the Required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.

iii. While evaluating practical, weight age should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.

iv. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Learning Outcomes :

On successful completion of this course students will be able to :

i) Understand & practise the skills while performing experiments.
ii) Understand the use of apparatus and their use without fear & hesitation.
iii) Correlate their physics theory concepts to practical application.
iv) Understand the concept of errors and their estimation.

For practical examination the learner will be examined in the experiments (one from each group) . Each experiment will be of three hour duration;
Minimum 3 from each group and in all minimum 12 experiments and all the demonstration experiments are required to be completed compulsorily.
Students are required to report all these experiments in the journal. Evaluation in viva voce will be based on regular experiments and skill experiments.

A learner will be allowed to appear for the semester and practical examination only if he submits a certified journal of Physics or a certificate that the learner has completed the practical course of Physics Semester III as per the minimum requirements.

Group A

1. Optical lever: determination of μ
2. Cylindrical obstacle: determination of λ
3. Single slit diffraction
4. Fresnel's bi-prism: determination of λ
5. Determination of Couchy's constants.
6. R.P. of telescope.
7. R.P. of grating
8. R. P. of prism
9. Brewster's law: determination of μ
10. Double refraction
11. Polarimeter
12. Laser beam profile
13. Determination of wavelength of laser using grating
14. Determination of R.I. of liquid by laser
15. μ by total internal reflection

Group B

1. Square wave oscillator using gates.
2. Half adder and full adder (7486, 7408)
3. Study of MS-JK flip flop
4. Study of Latch (74LS373)
5. Study of 3:8 Decoder (74LS138)
6. Study of 8:3 Priority Encoder (74LS148)
7. Counters mod 2,5 and 10
8. Shift registers
9. Transistorized Astable multivibrator
10. Transistorized Monostable multivibrator
11. Transistorized Bistable multivibrator
12. Op-Amp as Astable multivibrator
13. IC 555 timer as Astable multivibrator
14. IC 555 timer as Monostable multivibrator
15. IC 555 timer as a Ramp generator

Group C

1. Study of 8085 microprocessor kit and commands.
2. 8 -bit addition, subtraction, multiplication
3. Two digit Decimal addition, subtraction.
4. Memory block transfer from one location to another.
5. Find largest/smallest number in given block.
6. Find number of positive/negative, odd/even elements in given block.
7. Arrange given number in ascending/descending order
   (**Note**: Use 8085 kit or any 8085 simulator to perform practicals)
8. Use of initial magnetization curve to find flux in core
9. Project on a topic (equivalent to three practical sessions)
10. Visit to research institutes (equivalent to three practical sessions)
11. Assignment & literature survey (equivalent to 2 practical sessions).
12. Visit to Hospital with medical diagnostic equipment.
13. Plotting and analysis of detector data (from University /research institutions)
14. Design, Build and test Amplitude Modulator and/or Frequency Modulator
15. Time Division Multiplexing circuit.
16 Frequency Shift Keying(FSK) using IC 555 or XR 2206
17. Demonstration of PAM, PPM and PWM.

Demonstration experiments

1. Error analysis of a given experiment
2. Wave form generator using Op-amp
3. PC simulations: graph, curve fitting etc.
4. Straight edge Fresnel diffraction
5. First order active filter.
6. DAD instruction.

References:

1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6^{th} Edition) Book and Allied Pvt.Ltd.
2. B.Sc PRACTICAL Physics – Harnam Singh S.Chand & Co. Ld. 2001
3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3^{rd} edition)
4. B.Sc. Practical Physics – CL Arora (1^{st} Edition) -2001 S.Chand and Co Ltd.
5. Practical Physics CL Squires (3^{rd} Edition) Cambridge University
6. University Practical Physics – DC Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop &Flint.