UNIVERSITY OF MUMBAI
No. UG/ 69 of 2016-17

CIRCULAR:-

A reference is invited to the Syllabi relating to the B.Sc. degree course , **vide** this office Circular No. UG/131 of 2011, dated 13th June, 2011 and the Principals of affiliated Colleges in Science are hereby informed that the recommendation made by Board Studies in Physics at its meeting held on 24th May, 2016 has been accepted by the Academic Council meeting held on 24th June, 2016 **vide** item No. 4.50 and that in accordance therewith, the revised syllabus as per the Credit Based Semester and Grading System for F.Y. B.Sc. Physics (Sem.I & II), which are available on the University's web site (www.mu.ac.in) and that the same has been brought into force with effect from the academic year 2016-17.

19/9/16

(Dr.M.A.Khan)
REGISTRAR

MUMBAI – 400 032
21st September, 2016

To,

The Principals of the affiliated Colleges in Science.

A.C/4.50/24.06.2016

****

No. UG/69-A of 2016 MUMBAI-400 032 21st September, 2016

Copy forwarded with Compliments for information to:-

1) The Deans, faculties of Science,
2) The Chairman, Board of Studies in Physics,
3) The Professor-cum-Director, Institute of Distance & Open Learning (IDOL)
4) The Director, Board of College and University Development,
5) The Co-Ordinator, University Computerization Centre,
6) The Controller of Examinations.

19/9/16

(Dr.M.A.Khan)
REGISTRAR

PTO..

UNIVERSITY OF MUMBAI

Syllabus for Sem I & II
Program: B.Sc.
Course: Physics

(Credit Based Semester and Grading System for Academic year 2016-17)

Syllabusfor B.Sc. Physics(Theory&Practical)
Aspercreditbasedsystem
FirstYearB.Sc.2016–2017.

TherevisedsyllabusinPhysicsasper creditbasedsystemfortheFirstYearB.Sc.Course willbeimplementedfromtheacademicyear**2016–2017.**

Preamble:

The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics.

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.

Course code	Title	Credits
	Semester I	
USPH101	Classical Physics	2
USPH102	Modern Physics	2
USPHP1	Practical I	2
		Total= 06
	Semester II	
USPH201	Mathematical Physics	2
USPH202	Electricity and Electronics	2
USPHP2	Practical II	2
		Total=06

SEMESTER-I

Name of the Programme	Duration	Semester	Subject
B.Sc.inPhysics	Sixsemesters	I	Physics
CourseCode	Title	Credits	
USPH101	**Classical Physics**	2for USPH101	

Learning Outcomes:

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

1. Understand Newton's laws and apply them in calculations of the motion of simple systems.
2. Use the free body diagrams to analyzetheforces on the object.
3. Understand the concepts of friction and the concepts of elasticity, fluid mechanics and be able to perform calculations using them.
4. Understand the concepts of lens system and interference.
5. Apply the laws of thermodynamics to formulate the relations necessary toanalyze athermodynamic process.
6. Demonstrate quantitative problem solving skills in all the topics covered

Unit:I **15lectures**

1. Newton’s Laws**:**

Newton’s first, second and third laws of motion, interpretation and applications, pseudo forces, Inertial and non-inertial frames of reference.Worked out examples (with friction present)

2. Elasticity:

Review of Elastic constants Y, K, η and σ;Equivalence of shear strain to compression and extension strains. Relations between elastic constants, Couple for twist in cylinder.

3. Fluid Dynamics**:**

Equation of continuity, Bernoulli’s equation, applications of Bernoulli’s equation, streamline and turbulent flow, lines of flow in airfoil, Poiseuille’s equation.

Unit:II **15lectures**

1. Lens Maker's Formula (Review), Newton’s lens equation,magnification-lateral, longitudinal and angular.

2. Equivalent focal length of two thin lenses, thick lens, cardinal points of thick lens, Ramsdenand Huygens eyepiece.
3. Aberration: Spherical Aberration, Reduction of Spherical Aberration, Chromatic aberration and condition for achromatic aberration.
3. Interference: Interference in thin films, Fringes in Wedge shaped films, Newton's Rings (Reflective).

UNIT III **15 lectures**

1. Behavior of real gases and real gas equation, Van der Waal equation
2.Thermodynamic Systems, Zeroth law of thermodynamics, Concept of Heat, The first law, Non Adiabatic process and Heat as a path function, Internal energy, , Heat Capacity and specific heat, Applications of first law to simple processes, general relations from the first law, Indicator diagrams, Work done during isothermal and adiabatic processes, Worked examples, Problems.

Note:Agoodnumberofnumericalexamplesareexpectedtobecoveredduringthe prescribed lectures.

References:

1. Halliday, Resnick and Walker, Fundamental of Physics (extended) – (6th Ed.), John Wiley and Sons.
2. H. C. Verma, Concepts of Physics – (Part–I), 2002 Ed. BharatiBhavan Publishers.
3. Iradov
4. Brijlal,Subramanyam and Avadhanulu A Textbook of Optics, 25th revised ed.(2012) S. Chand
5. Brijlal, Subramanyam and Hemne, Heat Thermodynamics and Statistical Physics, S Chand, Revised, Multi-coloured,2007 Ed.
6. Jenkins and White, Fundamentals of Optics by (4th Ed.), McGraw Hill International.

Additional References :

1. Thornton and Marion, Classical Dynamics – (5th Ed)
2. D S Mathur, Element of Properties of Matter, S Chand & Co.
3. R Murugeshan and K Shivprasath, Properties of Matter and Acoustics S Chand.
4. M W Zemansky and R H Dittman, Heat and Thermodynamics, McGraw Hill.
5. D K Chakrabarti, Theory and Experiments on Thermal Physics, (2006 Ed) Central books.
6. C L Arora, Optics, S Chand.
7. Hans and Puri, Mechanics –, 2nd Ed. Tata McGraw Hill

SEMESTER-I

Nameofthe Programme	Duration	Semester	Subject
B.Sc.inPhysics	Sixsemesters	I	Physics
CourseCode	Title	Credits	
USPH102	**Modern Physics**	2for USPH102	

Learning Outcomes:

After successful completion of this course students will be able to

1. Understand nuclear properties and nuclear behavior.
2. Understand the type isotopes and their applications.
3. Demonstrate and understand the quantum mechanical concepts.
4. Demonstrate quantitative problem solving skills in all the topics covered.

Unit I **15lectures**

1. Structure of Nuclei:Basic properties of nuclei, Composition, Charge, Size, Rutherford's expt. for estimation of nuclear size, density of nucleus, Mass defect and Binding energy, Packing fraction, BE/A vs A plot, stability of nuclei (N Vs Z plot) and problems.
2. Radioactivity: Radioactive disintegration concept of natural and artificial radioactivity, Properties of α, β, γ-rays, laws of radioactive decay, half-life, mean life (derivation not required), units of radioactivity, successive disintegration and equilibriums, radioisotopes. Numerical Problems.
3. Carbon dating and other applications of radioactive isotopes (Agricultural, Medical, Industrial, Archaeological -information from net).

Unit II **15 lectures**

Interaction between particles and matter, Ionization chamber, Proportional counter and GM counter, problems

Nuclear Reactions: Types of Reactions and Conservation Laws. Concept of Compound and Direct Reaction, Q value equation and solution of the Q equation, problems.

Fusion and fission definitions and qualitative discussion with examples.

Unit III **15 lectures**

1. Origin of Quantum theory, Black body (definition), Black Body spectrum, Wien's displacement law, Matter waves, wave particle duality, Heisenberg's uncertainty Principle. Davisson-Germer experiment, G. P. Thompson experiment.
2. X-Rays production and properties. Continuous and characteristic X-Ray spectra, X-Ray Diffraction, Bragg's Law, Applications of X-Rays.
3. Compton Effect, Pair production, Photons and Gravity, Gravitational Red Shift.

Note: Agoodnumberofnumericalexamplesareexpectedtobecoveredduringthe prescribed lectures

References:

1. Kaplan: Nuclear Physics, Irving Kaplan, 2nd Ed. Narosa Publishing House
2. SBP: Dr. S. B. Patel, Nuclear Physics Reprint 2009, New Age International
3.BSS: N Subrahmanyam, Brijlal and Seshan, Atomic and Nuclear Physics Revised Ed. Reprint 2012, S. Chand
4. Arthur Beiser, Perspectives ofModernPhysics : Tata McGraw Hill

Additional References:

1 S N Ghosal, Atomic Physics S Chand
2 S N Ghosal, Nuclear Physics 2nd ed. S Chand

SEMESTER-I

Name of the Programme	Duration	Semester	Subject
B.Sc.inPhysics	Sixsemesters	I	Physics
CourseCode	Title	Credits	
USPHP1	**Practical I**	2	

Leaning Outcome:

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

i) To demonstrate their practical skills.
ii) To understand and practice the skills while doing physics practical.
iii) To understand the use of apparatus and their use without fear.
iv) To correlate their physics theory concepts through practical.
v) Understand the concepts of errors and their estimation.

A. <u>Regularexperiments:</u>

1	J by Electrical Method: To determine mechanical equivalent of heat (Radiation correction by graph method)
2	Torsional Oscillation: To determine modulus of rigidity η of a material of wire by torsional oscillations
3	Bifilar Pendulum
4	Spectrometer: To determine of angle of Prism.
5	Y by vibrations: To determine Y Young's Modulus of a wire material by method of vibrations- Flat spiral Spring
6	To determine Coefficient of Viscosity (η) of a given liquid by Poisseuli's Method
7	Surface Tension/ Angle of contact
8	Combination of Lenses To determine equivalent focal length of a lens system by magnification method.
9	Spectrometer: To determine refractive index μ of the material of prism
10	To study Thermistor characteristic Resistance vs Temperature
11	Constant volume/constant pressure
12	Newton's Rings To determine radius of curvature of a given convex lens using Newton's rings.
13	Wedge Shaped Film

B. Skill Experiments:

1.	Use of Verniercalipers, Micrometer Screw Gauge, Travelling Microscope
2.	Graph Plotting : Experimental, Straight Line with intercept, Resonance Curve etc.
3.	Spectrometer: Schuster's Method
4.	Use of DMM
5	Absolute and relative errors calculation.

C) Any one out of following isequivalent to two experiments from section A and/ or B

1. Students should collect the information of at least five Physicists with their work. Report that in journal.
2. Students should carry out mini-project upto the satisfaction of professor In-charge of practical.
3. Study tour. Students participated in study tour must submit a study tour report.

Minimum 8experimentsfrom the listshouldbecompletedinthe first semester. Any four skill experimentsaretobereportedinjournalCertifiedjournalis a must tobeeligibletoappearforthesemesterendpractical.

Theschemeofexaminationfortherevisedcoursein Physicsat theFirstYearB.Sc.Semester endexaminationwillbeasfollows.

SemesterEnd Practical Examination:
Schemeof examination:

There will be no internal assessment for practical.
Acandidatewillbeallowedtoappearforthesemester end practical examinationonlyifthecandidatesubmits aCertified journalatthetimeofpracticalexaminationofthe semester oracertificatefrom theHeadoftheDepartment /Institute totheeffectthathecandidate hascompleted the practicalcourseofthatsemesterofF.Y.B.Sc.Physicsasperthe minimumrequirement. The duration of the practical examination will be two hours per experiment. There will be two experiments through which the candidate will be examined in practical. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics.

SEMESTER II

Nameofthe Programme	Duration	Semester	Subject
B.Sc.inPhysics	Sixsemesters	II	Physics
CourseCode	Title	Credits	
USPH201	**Mathematical Physics**	2for USPH201	

Learning Outcomes:

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

1. Understand the basic mathematical concepts and applications of them in physical situations.
2. Demonstrate quantitative problem solving skills in all the topics covered.

Unit I **15 lectures**

1. Vector Algebra :

Vectors, Scalars, Vector algebra, Laws of Vector algebra, Unit vector, Rectangular unit vectors, Components of a vector, Scalar fields, Vector fields, Problems based on Vector algebra.

Dot or Scalar product, Cross or Vector product, Commutative and Distributive Laws, Scalar Triple product, Vector Triple product (Omit proofs). Problems and applications based on Dot, Cross and Triple products.

2. Gradient, divergence and curl:

The ∇ operator, Definitions and physical significance of Gradient, Divergence and Curl; Distributive Laws for Gradient, Divergence and Curl (Omit proofs); Problems based on Gradient, Divergence and Curl.

Unit: II **15lectures**

1. Differential equations**:**

Introduction, Ordinary differential equations, First order homogeneous and non- homogeneous equations with variable coefficients, Exact differentials, General first order Linear Differential Equation, Second-order homogeneous equations with constant coefficients. Problems depicting physical situations like LC and LR circuits, Simple Harmonic motion (spring mass system).

2. Transient response of circuits: Series LR, CR, LCR circuits. Growth and decay of currents/charge.

Unit:III **15lectures**

1. Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats).

2. Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses
3. Wave Motion: Transverse waves on string, Travelling and standing waves on a string. Normal modes of a string, Group velocity, Phase velocity, Plane waves, Spherical waves, Wave intensity.

Note: Agoodnumberofnumericalexamplesareexpectedtobecoveredduringthe prescribed lectures

References:

1.MS:Murray R Spiegel, Schaum's outline of Theory and problems of Vector Analysis, Asian Student Edition

2. CH**:** Charlie Harper, Introduction to Mathematical Physics , 2009 (EEE) PHI Learning Pvt. Ltd.

3. CR: D. Chattopadhyay, P C Rakshit , Electricity and Magnetism 7th Ed. New Central Book agency.

4. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.

5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.

6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

Additional References:

1. BrijLal**,N.** Subrahmanyam **,** JivanSeshan, Mechanics and Electrodynamics, , (S. Chand) (Revised & Enlarged ED. 2005)
2. A K Ghatak, Chua, Mathematical Physics, 1995, Macmillan India Ltd.
3. Ken Riley**, Michael** Hobson **and Stephen** Bence, Mathematical Methods for Physics and Engineering, Cambridge (Indian edition).
4. H. K. Dass, Mathematical Physics, S. Chand & Co.
5. Jon Mathews & R. L. Walker, Mathematical Methods of Physics: W A Benjamin Inc.

SEMESTER II

Nameofthe Programme	Duration	Semester	Subject
B.Sc.inPhysics	Sixsemesters	II	Physics
CourseCode	Title	Credits	
USPH202	**Electricity and Electronics**	2for USPH202	

Unit I : 15 lectures

1. Alternating current theory:(Concept of L, R, and C: Review)

AC circuit containing pure R, pure L and pure C, representation of sinusoids by complex numbers, Series L-R, C-R and LCR circuits. Resonance in LCR circuit (both series and parallel), Power in ac circuit. Q-factor.

2. AC bridges: AC-bridges: General AC bridge, Maxwell,de-Sauty, Wien Bridge , Hay Bridge.

Unit II: Electronics 15 lectures

1.Circuit theorems: (Review: ohm's law, Kirchhoff's laws)
Superposition Theorem, Thevenin's Theorem, Ideal Current Sources, Norton's Theorem, Reciprocity Theorem, Maximum Power Transfer Theorem.
Numericals related to circuit analysis using the above theorems.
2.DC power supply:Half wave rectifier , Full wave rectifier, Bridge rectifier, PIV and Ripple factor of full wave rectifier, Clipper and Clampers(Basic circuits only), Capacitor Filter.
Zener diode as voltage stabilizer.
3.Digital electronics : Logic gates(Review), NAND and NOR as universal building blocks. EXOR gate: logic expression, logic symbol, truth table, Implementation using basic gates and its applications, Boolean algebra, Boolean theorems. De-Morgan theorems, Half adder and Full adder

Unit III : Electrostatics and Magnetostatics 15 lectures

1.The Electric Field : Introduction, Coulomb's Law, The Electric Field, Continuous charge Distribution, Electric Potential, Introduction to Potential, Comments on Potential,
The Potential of a Localized Charge Distribution
2.Work and Energy in Electrostatics**:** The Work Done to Move a charge, The Energy of a Point Charge Distribution
3.Magnetostatics**:** Magnetic Fields
4.TheBiotSavart Law**:** Steady Currents,The Magnetic Field of a Steady Current

Helmholtz coil and solenoid.

Note: Agoodnumberofnumericalexamplesareexpectedtobecoveredduringthe prescribed lectures

References :

CR: D. Chattopadhyay, P C Rakshit , Electricity and Magnetism 7th Ed. New Central Book agency.

TT :B.L. Theraja and A.K. Theraja , A Textbook of Electrical Technology Vol. I , S. Chand Publication

BN :Boylestad and Nashelsky, Electronic devices and Circuit Theory: 7th edition, Prentice Hall of India.

VKM: V K Mehta and R Mehta Electronics Principals, MulticolouredRevised 11th Ed. reprint in 2012 ,S Chand.

David J. Griffiths : Introduction to Electrodynamics, Prentice Hall India (EEE) 3rd Ed.

A B Bhattacharya, Electronics Principlesand Applications, Central publisher.

A P Malvino, Digital Principles and Applications: Tata McGraw Hill

Tokhiem, Digital electronics, 4thed, McGraw Hill International Edition.

SEMESTER II

Name of the Programme	Duration	Semester	Subject
B.Sc.inPhysics	Sixsemesters	II	Physics
CourseCode	Title	Credits	
USPHP2	**Practical II**	2	

Leaning Outcome:

i) To understand and practice the skills while doing physics practical.
ii) To understand the use of apparatus and their use without fear.
iii) To correlate their physics theory concepts through practical.
iv) Understand the concepts of errors and their estimation.

A) Regular experiments:

1	Flywheel
2	To study Zener Diode as Regulator
3	To study load regulation of a Bridge Rectifier
4	LR Circuit: To determine the value of given inductance and phase angle
5	CR Circuit: To determine value of given capacitor and Phase angle
6	Frequency of AC Mains: To determine frequency of AC mains.
7	LCR series Resonance: To determine resonance frequency of LCR series circuit.
8	To study NAND and NOR gates as Universal Building Blocks
9	To study EX-OR Gate, half adder and full adder and verify their truth tables.
10	To verify De Morgan's Theorems
11	Thevenin's Theorem: To verify Thevenin's theorem for DC circuits
12	Norton's Theorem: To verify Norton's Theorem for DC circuits
13	LDR Characteristics: To study the dependence of LDR resistance on intensity of light.

B) List of Demo-experiments: (Min. four)

1.	Angular Momentum conservation (Rotating Platform)
2.	Light dependent switch
3.	Laser beam divergence, Intensity
4.	Use of Oscilloscope
5	Charging and discharging of a capacitor

6	Use of PC for graph plotting
7	Clipper and Clamper circuits.

C) Any one out of following isequivalentto two experiments from section A and/ or B

1. Students should collect the information of at least fourPhysics events and their outcome. Report that in journal.
2. Students should carry out mini-project up to the satisfaction of professor In-charge of practical
3. Study tour. Students participated in study tour must submit a study tour report.

Minimum 8experimentsfrom the listshouldbecompletedinthe first semester. Any four skill experimentsaretobereportedinjournalCertifiedjournalis musttobeeligibletoappearforthe semester endpractical.

Theschemeofexaminationfortherevisedcoursein Physicsat theFirstYearB.Sc.Semester endexaminationwillbeasfollows.

SemesterEnd Practical Examination:
Schemeof examination:

There will be no internal assessment for practical

A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a Certified journal at the time of practical examination of the semester or a certificate from the Head of the Department /Institute to the effect that the candidate has completed the practical course of that semester of F.Y.B.Sc. Physics as per the minimum requirement. The duration of the practical examination will be two hours per experiment. There will be two experiments through which the candidate will be examined in practical. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics

AC 11-05-2017

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 learnersacross 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 **;** asper rules of passing

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

(pattern as per guidelines)

Revised Syllabus in Physics (Theory and Practical)

as perChoice 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.Sccourse 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 –I15Lectures

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

iiiOscillations **,** 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 **15Lectures**

(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 –III15Lectures

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 Vander 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 :MeghanadSaha and BN Srivastava , 1969, India Press.
6. Mechanics and Electrodynamics Rev Edn. 2005 by Brijlal and Subramanyanand JeevanSeshan.

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: 15Lectures

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 15Lectures

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 15Lectures

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 15Lectures

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)FibreOptics : 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 – SanjeevPuri, Narosa Publication.

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

Unit II : Biophysics 15Lectures

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 15Lectures

Introduction to Materials

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)

Properties of materials

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 (15Lectures)

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: (15Lectures)

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 AplicationsBy Leach, Malvino, Saha 6thedn.

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

RPJ – Modern Digital Electronics by R P Jain 4thedn. (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: 15Lectures

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-15Lectures

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 15Lectures

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 Geophysics15Lectures

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.

1.9Geodynamics 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.*NathaniBasavaiah, 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.*NathaniBasavaiah, Springer (2011).
3. *Textbook of Environmental Chemistry.*BalaramPani, I.K. International Publishing House (2007).

4. *A Textbook of Environmental Studies, 1/e.* D.K. Asthana and MeeraAsthana, S. Chand and Co. Publishing (2006).
5. *Environment: Problems and Solutions, 2/e*. D.K. Asthana and MeeraAsthana, 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, dataformat **,**Addressing Modes,The 8085 Instruction Set(Classification) Data transfer Operations,Arithmetic Operations, Logical Operations Branch Operations ,
Introduction to AdvancedInstructions 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 : 15Lectures

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 12experiments 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 Astablemultivibrator
10. Transistorized Monostablemultivibrator
11. Transistorized Bistablemultivibrator
12. Op-Amp as Astablemultivibrator
13. IC 555 timer as Astablemultivibrator
14. IC 555 timer as Monostablemultivibrator
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.

UNIVERSITY OF MUMBAI

No. UG/ 8 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular Nos. UG/264 of 2017-18, dated 23rd October, 2017, UG/287 of 2017-18, dated 30th October, 2017and UG/263 of 2017-18, dated 23rd October, 2017 relating to syllabus of the Bachelor of Science (B.Sc.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Physics at its meeting held on 23rd April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.26 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.Sc. in Physics including Applied Component - Electronic Instrumentation (EI) & Computer Course (CS) (Sem -V & VI), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
12th June, 2018

To

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.26/05/05/2018

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No. UG/ 8 -A of 2018 MUMBAI-400 032 12th June, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Physics,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

UNIVERSITY OF MUMBAI

SYLLABUS FOR SEM - V & VI

Program: B.Sc.

Course: Physics

(Credit Based Semester and Grading System
w. e. f. the academic year 2018–2019)

T.Y.B.Sc. Physics Syllabus: Credit Based Semester and Grading System to be implemented from the Academic year 2018-2019.

SEMESTER V				
Theory				
Course	**UNIT**	**TOPICS**	**Credits**	**Lectures per Week**
USPH501	I	Mathematical Methods in Physics	**2.5**	**4**
	II	Mathematical Methods in Physics		
	III	Thermal and Statistical Physics		
	IV	Thermal and Statistical Physics		
USPH502	I	Solid State Physics	**2.5**	**4**
	II	Solid State Physics		
	III	Solid State Physics		
	IV	Solid State Physics		
USPH503	I	Atomic Physics	**2.5**	**4**
	II	Atomic Physics		
	III	Molecular Physics		
	IV	Molecular Physics		
USPH504	I	Electrodynamics	**2.5**	**4**
	II	Electrodynamics		
	III	Electrodynamics		
	IV	Electrodynamics		
Practicals				
USPHP05	Practicals of Course USPH501 + Course USPH502		**2.5**	**6**
USPHP06	Practicals of Course USPH503 + Course USPH504		**2.5**	**6**
Project				
USPHPR1	USPH501 + USPH502 + USPH503 + USPH504		**1**	**4**

SEMESTER VI				
Theory				
Course	**UNIT**	**TOPICS**	**Credits**	**Lectures per Week**
USPH601	I	Classical Mechanics	**2.5**	**4**
	II	Classical Mechanics		
	III	Classical Mechanics		
	IV	Classical Mechanics		
USPH602	I	Electronics	**2.5**	**4**
	II	Electronics		
	III	Electronics		
	IV	Electronics		
USPH603	I	Nuclear Physics	**2.5**	**4**
	II	Nuclear Physics		
	III	Nuclear Physics		
	IV	Nuclear Physics		
USPH604	I	Special Theory of Relativity	**2.5**	**4**
	II	Special Theory of Relativity		
	III	Special Theory of Relativity		
	IV	Special Theory of Relativity		
Practicals				
USPH605	Practicals of Course USPH601 + Course USPH602		**2.5**	**6**
USPH606	Practicals of Course USPH603 + Course USPH604		**2.5**	**6**
Project				
USPHPR2	USPH601 + USPH602 + USPH603 + USPH604		**1**	**4**

SCHEME OF THEORY, PRACTICALS AND PROJECT EXAMINATION
(SEM- V & VI)

I.	**Theory: External Examination: 100 marks**			
	Each theory paper shall be of **THREE** hours duration.			
	Each paper shall consist of FIVE questions. All questions are compulsory and will have internal options. Choice in papers has to be 1.5 times.			
	Q – I :	From Unit – I		
	Q – II :	From Unit – II		
	Q – III :	From Unit - III		
	Q – IV :	From Unit - IV		
	Q – V :	Will consist of questions from all the FOUR Units with equal weightage of marks allotted to each Unit.		
II.	**Practicals and Project:** The External Practical Examination will be conducted as per the following scheme.			
Sr. No.	**Particulars of External Practical and Project Examination**			**Total Marks**
1	Laboratory Work	Experiment-1= 60 M	Experiment-2 = 60 M	120
2	Journal	10	10	20
3	Viva	10	10	20
			Sub Total =	**160**
III.	**Project**	Internal Examiner (20 M)	External Examiner (20 M)	**40**
			Grand Total	**200**

Passing Criteria:

1. A student should be considered as passed in the practical examination provided he/she fulfills the following passing criteria
    a. Minimum of 20 marks in each practical component - i.e. **USPHP07** and **USPHP08.**
    b. Minimum of 10 marks in Project Component
    c. And cumulatively scoring 80 marks (i.e. 40 % of 200 marks)

Component	Maximum Marks	Minimum Passing Marks
USPHP07	80	20
USPHP08	80	20
Project 2	40	10
Total	**200**	**80**

Scheme of Examination:

1. The University (external) examination for Theory and Practical shall be conducted at the end of each Semester and the evaluation of Project work at the end of the each Semester.
2. The candidate should appear for **THREE** Practical sessions of **three hours each** as part of his/her Practical course examination.
3. The candidates shall appear for external examination of 2 practical courses each carrying 80 marks and presentation of project work carrying 20 marks at the end of each semester.
4. The candidates shall also appear for internal presentation of project work carrying 20 marks at the end of each semester.
5. The candidate shall prepare and submit for practical examination a certified Journal based on the practical course with **6** experiments from each group.
6. The certified journal must contain a minimum of **12** regular experiments (**6** from each group), **with** minimum **5** demonstration experiments in semester VI. A separate index and certificate in journal is must for each semester course.
7. At the time of practical examination, the candidate must also submit the certified Project Report prepared as per the guidelines given in the Syllabus.

A candidate will be allowed to appear for the practical examination only if the candidate submits a certified journal of TYBSc Physics or a certificate from the Head of the Department to the effect that the candidate has completed the

practical course of TYBSc Physics as per the minimum requirements and a project completion report duly certified by the project in-charge and Head of the Department.

III. Visits: Visits to industry, national research laboratories, and scientific exhibitions should be encouraged.

SEMESTER V

Theory Course - USPH501: Mathematical, Thermal and Statistical Physics

Learning outcomes: From this course, the students are expected to learn some mathematical techniques required to understand the physical phenomena at the undergraduate level and get exposure to important ideas of statistical mechanics.

The students are expected to be able to solve simple problems in probability, understand the concept of independent events and work with standard continuous distributions. The students will have idea of the functions of complex variables; solve nonhomogeneous differential equations and partial differential equations using simple methods. The units on statistical mechanics would introduce the students to the concept of microstates, Boltzmann distribution and statistical origins of entropy. It is also expected that the student will understand the difference between different statistics, classical as well as quantum.

Unit - I	**Probability**	(15 lect.)
Review of basic concepts, introduction, sample space, events, independent events, conditional probability, probability theorems, methods of counting (derivation of formulae not expected), random variables, continuous distributions (omit joint distributions), binomial distribution, the normal distribution, the Poisson distribution. Ref: MB – 15.1-15.9 Expected to cover solved problems from each section and solve at least the following problems:		

section 2: 1-5, 11-15, **section 3:** 1, 3, 4, 5, **section 4:** 1, 3, 5,13, 21, **section 5:** 1, 10, 13, **section 6:** 1 to 9, **section 8:** 1 and 3, **section 9:** 2, 3, 4, 9.		
Unit -II	**Complex functions and differential equations**	(15 lect.)
1. Functions of complex variables: The exponential and trigonometric functions, hyperbolic functions, logarithms, complex roots and powers, inverse trigonometric and hyperbolic functions, some applications. Ref.: MB: 2.11 to 2.16 Expected to cover all solved problems. In addition, solve the following problems: **section 2:** 16 – 2, 3, 8, 9, 10.		
2. Second-order nonhomogeneous equations with constant coefficients, partial differential equations, some important partial differential equations in physics, method of separation of variables. Ref : CH :5.2.4, 5.3.1 to 5.3.4 Expected to cover all solved problems. In addition, solve the following problems: 5.17 a to e, 5.23, 5.26, 5.29 to 5.35.		
Unit -III	**Statistical Thermodynamics**	(15 lect.)
Microstates and configurations, derivation of Boltzmann distribution, dominance of Boltzmann distribution, physical meaning of the Boltzmann distribution law, definition of , the canonical ensemble, relating Q to q for an ideal gas, translational partition function, equipartition theorem, energy, entropy ER: 13.1 to 13.5, 14.1, 14.2, 14.4, 14.8, 15.1, 15.4		
Unit -IV	**Classical and Quantum Statistics**	(15 lect.)
The probability of a distribution, The most probable distribution, Maxwell-Boltzmann statistics, Molecular speeds. Bose-Einstein statistics, Black-body radiation, The Rayleigh-Jeans formula,		

The Planck radiation formula, Fermi-Dirac statistics, Comparison of results. AB : 15.2 to 15.5, 16.1 to 16.6

References:

1.	MB: Mathematical Methods in the Physical sciences: Mary L. Boas Wiley India, 3rd ed.
2.	ER: Thermodynamics, Statistical Thermodynamics and Kinetics: T. Engel and P. Reid (Pearson).
3.	AB: Perspectives of Modern Physics: Arthur Beiser, (Mc Graw Hill International).
4.	CH: Introduction to Mathematical Methods: Charlie Harper (PHI Learning).

Additional References:

1.	Mathematical Physics: A K Ghatak, Chua – 1995 Macmillian India Ltd.
2.	Mathematical Method of Physics: Riley, Hobson and Bence, Cambridge (Indian edition).
3.	Mathematical Physics: H. K. Das, S. Chand & Co.
4.	Mathematical Methods of Physics: Jon Mathews & R. L. Walker, W A Benjamin inc.
5.	A Treatise on heat: Saha and Srivastava (Indian press, Allahabad)
6.	Statistical Physics: F. Reif (Berkeley Physics Course, McGraw Hill)
7.	Introductory Statistical Mechanics: R. Bowley and M. Sanchez (Oxford Science Publications).
8.	An Introduction to Thermal Physics: D. V. Schroeder (Pearson).
9.	PROBABILITY: Schaum's Outlines Series by S. Lipschutz and M. L. Lipson (Mc Graw Hill International).

Theory Course - USPH502: Solid State Physics

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

1. Understand the basics of crystallography, Electrical properties of metals, Band Theory of solids, demarcation among the types of materials, Semiconductor Physics and Superconductivity.
2. Understand the basic concepts of Fermi probability distribution function, Density of states, conduction in semiconductors and BCS theory of superconductivity.
3. Demonstrate quantitative problem solving skills in all the topics covered.

Unit - I	**Crystal Physics**	(15 lect.)

The crystalline state, Basic definitions of crystal lattice, basis vectors, unit cell, primitive and non-primitive cells, The fourteen Bravais lattices and the seven crystal systems, elements of symmetry, nomenclature of crystal directions and crystal planes, Miller Indices, spacing between the planes of the same Miller indices, examples of simple crystal structures, The reciprocal lattice and X-ray diffraction.

Ref: Elementary Solid State Physics-Principles and Applications: M. Ali Omar, Pearson Education, 2012 : (1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.6)

Unit -II	**Electrical properties of metals**	(15 lect.)

1. Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time and mean free path
2. Quantum theory of free electrons, Fermi Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, The Fermi distribution function, Heat capacity of the Electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, Failure of Sommerfeld's free electron Theory
3. Thermionic Emission

Ref.: Solid State Physics: S. O. Pillai, New Age International. 6th Ed.

Chapter 6: II, III, IV, V, XIV, XV, XVI, XVII, XVIII, XX, XXXV, XXXI.

Unit -III	**Band Theory of Solids and Conduction in Semiconductors**	(15 lect.)

1. Band theory of solids, The Kronig- Penney model (Omit eq. 6.184 to 6.188), Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Distinction between metals, insulators and intrinsic semiconductors.

   Ref.: Solid State Physics: S. O. Pillai, New Age International, 6th Ed.

   Chapter 6: XXXVI, XXXVII, XXXVIII, XXXIX, XXXX, XXXXI

2. Electrons and Holes in an Intrinsic Semiconductor, Conductivity of a Semiconductor, Carrier concentrations in an intrinsic semiconductor, Donor and Acceptor impurities, Charge densities in a semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, Hall Effect.

   Ref.: Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.: 4.1 to 4.10.

Unit -IV	**Diode Theory and superconductivity**	(15 lect.)

1. Semiconductor-diode Characteristics: Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction, The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics, Diode resistance.

   Ref.: Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.: 5.1 to 5.8

2. Superconductivity: Experimental Survey, Occurrence of Superconductivity, destruction of superconductivity by magnetic field, The Meissner effect, London equation, BCS theory of superconductivity, Type I and Type II Superconductors, Vortex state.

   Ref.: Introduction to Solid State Physics-Charles Kittel, 7th Ed. John Wiley &

Sons: Topics from Chapter 12.

Main References:

1.	Elementary Solid State Physics-Principles and Applications: M.Ali Omar, Pearson Education, 2012.
2.	Solid State Physics: S. O. Pillai, New Age International, 6th Ed.
3.	Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.
4.	Introduction to Solid State Physics - Charles Kittel, 7th Ed. John Wiley & Sons.
5.	Modern Physics and Solid State Physics: Problems and solutions New Age International.
Additional References:	
1.	Solid State Physics: A. J. Dekker, Prentice Hall.
2.	Electronic Properties of Materials: Rolf Hummel, 3rd Ed. Springer.
3.	Semiconductor Devices: Physics and Technology, 2nd Ed. John Wiley & Sons.
4.	Solid State Physics: Ashcroft & Mermin, Harcourt College Publisher.

Theory Course - USPH503: Atomic and Molecular Physics

Learning Outcome: Upon successful completion of this course, the student will understand

- the application of quantum mechanics in atomic physics
- the importance of electron spin, symmetric and antisymmetric wave functions and vector atom model
- Effect of magnetic field on atoms and its application
- Learn Molecular physics and its applications.

- This course will be useful to get an insight into spectroscopy.

Unit - I		(15 lect.)
1. Hydrogen atom: Schrödinger's equation for Hydrogen atom, Separation of variables, Quantum Numbers: Total quantum number, Orbital quantum number, Magnetic quantum number. Angular momentum, Electron probability density (Radial part). 2. Electron spin: The Stern-Gerlach experiment, Pauli's Exclusion Principle Symmetric and Anti-symmetric wave functions. Ref – Unit – I - B: 9.1 to 9.9, B: 10.1, 10.3. 2		
Unit -II		(15 lect.)
1. Spin orbit coupling, Total angular momentum, Vector atom model, L-S and j-j coupling. Origin of spectral lines, Selection rules. 2. Effect of Magnetic field on atoms, the normal Zeeman effect and its explanation (Classical and Quantum), The Lande g - factor, Anomalous Zeeman effect. Ref – Unit – II - B: 10.2, 10.6, 10.7, 10.8, 10.9. B : 11.1 and 11.2		
Unit -III		(15 lect.)
1. Molecular spectra (Diatomic Molecules): Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational-Rotational spectra. Electronic Spectra of Diatomic molecules: The Born-Oppenheimer approximation, Intensity of vibrational-electronic spectra: The Franck-Condon principle. 2. Infrared spectrometer & Microwave spectrometer . Ref – Unit – III - B: 14.1, 14.3, 14.5, 14.7		
Unit -IV		(15 lect.)
1. Raman effect: Quantum Theory of Raman effect, Pure Rotational Raman spectra: Linear molecules, symmetric top molecules, Asymmetric top molecules, Vibrational Raman spectra: Raman activity of vibrations, Experimental set up of Raman Effect. 2. Electron spin resonance: Introduction, Principle of ESR, ESR spectrometer		

3. Nuclear magnetic resonance: Introduction, principle and NMR instrumentation. **Ref – Unit – IV -** 1. BM: 6.11, 6.1.3. 2. BM: 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.3.1. GA: 8.6.1 2. GA: 11.1,11.2and 11.3 3. GA: 10.1,10.2,10.3

References:

1.	B: Perspectives of Modern Physics : Arthur Beiser Page 8 of 18 McGraw Hill.
2.	BM: Fundamentals of Molecular Spectroscopy : C. N. Banwell & E. M. McCash (TMH).(4th Ed.)
3.	GA: Molecular structure and spectroscopy : G Aruldhas (2nd Ed) PHI learning Pvt Ltd.
4.	Atomic Physics (Modern Physics): S.N.Ghoshal. S.Chand Publication (for problems on atomic Physics).

Theory Course - USPH504: Electrodynamics

Learning outcomes:

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

1) Understand the laws of electrodynamics and be able to perform calculations using them.
2) Understand Maxwell's electrodynamics and its relation to relativity
3) Understand how optical laws can be derived from electromagnetic principles.
4) Develop quantitative problem solving skills.

Unit - I	**Electrostatics**	(15 lect.)
1. Review of Coulomb & Gauss law, The divergence of **E**, Applications of Gauss'		

law, The curl of **E**. Introduction to potential, Comments on potential, The potential of a localized charge distribution. Poisson's equation and Laplace's equation. Solution and properties of 1D Laplace equation. Properties of 2D and 3D Laplace equation (without proof).

2. Boundary conditions and Uniqueness theorems, Conductors and Second Uniqueness theorem, The classic image problem- point charge and grounded infinite conducting plane and conducting sphere.

DG: 2.1.1 to 2.1.3, 2.2.2 to 2.2.4, 2.3.1 to 2.3.4
DG: 3.1.1 to 3.1.4, 3.1.5, 3.1.6, 3.2.1 to 3.2.4

Unit -II	**Electrostatics in Matter and Magnetostatics**	(15 lect.)

1. Dielectrics, Induced Dipoles, Alignment of polar molecules, Polarization, Bound charges and their physical interpretation, Gauss' law in presence of dielectrics, A deceptive parallel, Susceptibility, Permittivity, Dielectric constant and relation between them, Energy in dielectric systems.

2. Review of Biot-Savart's law and Ampere's law, Straight-line currents, The Divergence and Curl of **B**, Applications of Ampere's Law in the case of a long straight wire and a long solenoid, Comparison of Magnetostatics and Electrostatics, Magnetic Vector Potential.

DG: 4.1.1 to 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.4.1, 4.4.3
DG: 5.2.1, 5.3.1 to 5.3.4, 5.4.1

Unit -III	**Magnetostatics in Matter and Electrodynamics**	(15 lect.)

1. Magnetization, Bound currents and their physical interpretation, Ampere's law in magnetized materials, A deceptive parallel, Magnetic susceptibility and permeability.

2. Energy in magnetic fields, Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter, Boundary conditions.

DG: 6.1.1, 6.1.4, 6.2.1, 6.2.2, 6.2.3, 6.3.1, 6.3.2, 6.4.1
DG: 7.2.4, 7.3.1 to 7.3.6

Unit -IV	**Electromagnetic Waves**	(15 lect.)

1. The continuity equation, Poynting's theorem

2. The wave equation for **E** and **B**, Monochromatic Plane waves, Energy and momentum in electromagnetic waves, Propagation in linear media, Reflection and transmission of EM waves at normal incidence, Reflection and transmission of EM

waves at oblique incidence. DG : 8.1.1, 8.1.2 DG : 9.2.1 to 9.2.3, 9.3.1 to 9.3.3

References	
1.	DG: Introduction to Electrodynamics, David J. Griffiths (3rd Ed) Prentice Hall of India.
Additional References	
1.	Introduction to Electrodynamics: A. Z. Capria and P. V. Panat, Narosa Publishing House.
2.	Engineering Electrodynamics: William Hayt Jr. & John H. Buck (TMH).
3.	Foundations of Electromagnetic Theory: Reitz, Milford and Christy.
4.	Solutions to Introduction to Electrodynamics: David J. Griffiths (3rd Ed) Prentice Hall of India.

PRACTICALS - SEMESTER V

The T. Y. B. Sc. Syllabus integrates the regular practical work with a series of skill experiments and the project. There will be separate passing head for project work. During the teaching and examination of Physics laboratory work, simple modifications of experimental parameters may be attempted. Attention should be given to basic skills of experimentation which include:

i)	Understanding relevant concepts.
ii)	Planning of the experiments
iii)	Layout and adjustments of the equipments
iv)	Understanding designing of the experiments
v)	Attempts to make the experiments open ended
vi)	Recording of observations and plotting of graphs
vii)	Calculation of results and estimation of possible errors in the observation of results

i) Regular Physics Experiments: A minimum of **06** experiments from each of the course are to be performed and reported in the journal.

ii) Skill Experiments: All the skill experiments are compulsory and must be reported in the journal. Skills will be tested during the examination through viva or practical.

The certified journal must contain a minimum of **12** regular experiments (**06** from each group), **with ALL** Skill experiments in semester V. A separate index and certificate in journal is must for each semester course.

iii) Project Includes:

a)	Review articles/ PC Simulation on any concept in Physics/ Comparative & differentiative study/Improvement in the existing experiment (Design and fabrication concept) /Extension of any regular experiment/Attempt to make experiment open-ended/Thorough survey of existing active components (devices, ICs, methods, means, technologies, generations, applications etc. / any innovative projects having the concept of physics.
b)	Two students (maximum) per project.
c)	For evaluation of project, the following points shall be considered … • Working model (Experimental or Concept based simulation) • Understanding of the project • Data collection • Data Analysis • Innovation/Difficulty • Report

There will be **THREE** turns of **3Hrs each** for the examination of practical courses.

SEMESTER V	
PRACTICAL COURSE: USPHP05	
Sr. No.	**Name of the Experiment**
1	Determination of ‘g’ by Kater’s pendulum

2	Surface tension of soap solution
3	Elastic constants of a rubber tube
4	Determination of dielectric constant
5	Logarithmic decrement
6	Searle's Goniometer
7	Determination of Rydberg's constant
8	Edser's 'A' pattern
9	Determination of wavelength by Step slit
10	Determination of e/m by Thomson's method
11	R. I. by total internal reflection
12	Velocity of sound in air using CRO
PRACTICAL COURSE: USPHP06	
Sr. No.	**Name of the Experiment**
1	Mutual inductance by BG.
2	Capacitance by parallel bridge
3	Hysteresis loop by CRO
4	L/C by Maxwell's bridge
5	Band gap energy of Ge diode
6	Design and study of transistorized astable multivibrator (BB)
7	Design and study of Wien bridge oscillator
8	Design and study of first order active low pass filter circuit (BB)
9	Design and study of first order active high pass filter circuit (BB)
10	Application of IC 555 timer as a ramp generator (BB)
11	LM 317 as constant current source
12	Counters Mod 2, 5, 10 (2 x 5, 5 x 2)
SKILL EXPERIMENTS	
Sr. No.	**Name of the Experiment**
1	Estimation of errors from actual experimental data

2	Soldering and testing of an astable multivibrator (Tr./IC555) circuit on PCB
3	Optical Leveling of Spectrometer
4	Schuster's method
5	Laser beam profile
6	Use of electronic balance: Find the density of a solid cylinder
7	Dual trace CRO: Phase shift measurement
8	C1/C2 by B G
9	Internal resistance of voltage and current source
10	Use of DMM to test diode, transistor and β factor

References:	
1.	Advanced course in Practical Physics: D. Chattopadhya, PC. Rakshit & B. Saha (8th Edition) Book & Allied Pvt. Ltd.
2.	BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001.
3.	A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4th edition).
4.	B Sc. Practical Physics: C. L. Arora (1st Edition) – 2001 S. Chand & Co. Ltd.
5.	Practical Physics: C. L. Squires – (3rd Edition) Cambridge University Press.
6.	University Practical Physics: D C Tayal. Himalaya Publication.
7.	Advanced Practical Physics: Worsnop & Flint.

SEMESTER VI

Theory Course – USPH601: Classical Mechanics

Learning outcomes:

This course will introduce the students to different aspects of classical mechanics. They would understand the kinds of motions that can occur under a central potential and their applications to planetary orbits. The students should also appreciate the effect of moving coordinate system, rectilinear as well as rotating. The students are expected to learn the concepts needed for the important formalism of Lagrange's equations and derive the equations using D'Alembert's principle. They should also be able to solve simple examples using this formalism. The introduction to simple concepts from fluid mechanics and understanding of the dynamics of rigid bodies is also expected. Finally, they should appreciate the drastic effect of adding nonlinear corrections to usual problems of mechanics and nonlinear mechanics can help understand the irregularity we observe around us in nature.

Unit - I	**Central Force**	(15 lect.)
1. Motion under a central force, the central force inversely proportional to the square of the distance, Elliptic orbits, The Kepler problem. 2. Moving origin of coordinates, Rotating coordinate systems, Laws of motion on the rotating earth, The Foucault pendulum, Larmor's theorem. KRS: 3.13 - 3.15, 7.1 - 7.5.		
Unit -II	**Lagrange's equations**	(15 lect.)
1. D'Alembert's principle, Constraints, Examples of holonomic constraints, examples of nonholonomic constraints, degrees of freedom and generalized coordinates, virtual displacement, virtual work, D'Alembert's principle, illustrative problems. 2. Lagrange's equations (using D'Alembert's principle), properties of Lagrange's equations, illustrative problems, canonical momentum, cyclic or ignorable coordinates. PVP: 4.2 to 4.9, 5.2 to 5.4, 7.2, 7.3.		

Unit -III	**Fluid Motion and Rigid body rotation**	(15 lect.)
1. Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. 2. Rigid dynamics: introduction, degrees of freedom, rotation about an axis: orthogonal matrix, Euler's theorem, Eulerian angles, inertia tensor, angular momentum of rigid body, Euler's equation of motion of rigid body, free motion of rigid body, motion of symmetric top (without notation). KRS : 8.6 to 8.9 PVP: 16.1 to 16.10		
Unit -IV	**Non Linear Mechanics**	(15 lect.)
1. Nonlinear mechanics: Qualitative approach to chaos, The anharmonic oscillator, Numerical solution of Duffing's equation. 2. Transition to chaos: Bifurcations and strange attractors, Aspects of chaotic behavior (Logistic map). BO: 11.1, 11.3 to 11.5		

References	
1.	PVP: Classical Mechanics, P. V. Panat (Narosa).
2.	KRS: Mechanics : Keith R. Symon, (Addision Wesely) 3rd Ed.
3.	BO: Classical Mechanics- a Modern Perspective: V. D. Barger and M. G. Olsson. (Mc Graw Hill International 1995 Ed.)
Additional References	
1.	Classical Mechanics: Herbert Goldstein (Narosa 2nd Ed.).
2.	An Introduction to Mechanics: Daniel Kleppner & Robert Kolenkow Tata Mc Graw Hill (Indian Ed. 2007).
3.	Chaotic Dynamics- an introduction: Baker and Gollub (Cambridge Univ. Press).
4.	Classical Mechanics: J. C. Upadhyaya (Himalaya Publishing House).

Theory Course – USPH602: Electronics

Learning Outcome:

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

1. Understand the basics of semiconductor devices and their applications.
2. Understand the basic concepts of operational amplifier: its prototype and applications as instrumentation amplifier, active filters, comparators and waveform generation.
3. Understand the basic concepts of timing pulse generation and regulated power supplies
4. Understand the basic electronic circuits for universal logic building blocks and basic concepts of digital communication.
5. Develop quantitative problem solving skills in all the topics covered.

Unit - I		(15 lect.)
1. Field effect transistors: JFET: Basic ideas, Drain curve, The transconductance curve, Biasing in the ohmic region and the active region, Transconductance, JFET common source amplifier, JFET analog switch, multiplexer, voltage controlled resistor, Current sourcing. 2. MOSFET: Depletion and enhancement mode, MOSFET operation and characteristics, digital switching. 3. SCR – construction, static characteristics, Analysis of the operation of SCR, Gate Triggering Characteristics, Variable half wave rectifier and Variable full wave rectifier, Current ratings of SCR. 4. UJT: Construction, Operation, characteristics and application as a relaxation oscillator. 1. MB: 13.1 to 13.9 2. MB: 14.1, 14.2, 14.4, 14.6. 3. AM: 28.1, 28.5		
Unit -II		(15 lect.)
1. Differential Amplifier using transistor: The Differential Amplifier, DC and AC analysis of a differential amplifier, Input characteristic-effect of input bias, offset current and input offset voltage on output, common mode gain, CMRR.		

2. Op Amp Applications: Log amplifier, Instrumentation amplifiers, Voltage controlled current sources (grounded load), First order Active filters, Astable using OP AMP, square wave and triangular wave generator using OP AMP, Wein-bridge oscillator using OP AMP, Comparators with Hysteresis, Window Comparator.

1. MB: 17.1 to 17.5
2. MB: 20.5, 20.8, 21.4, 22.2, 22.3, 22.7, 22.8, 23.

Unit -III		(15 lect.)

1. Transistor Multivibrators: Astable, Monostable and Bistable Multivibrators, Schmitt trigger.

2. 555 Timer: Review Block diagram, Monostable and Astable operation Voltage Controlled Oscillator, Pulse Width modulator, Pulse Position Modulator, Triggered linear ramp generator.

3. Regulated DC power supply: Supply characteristics, series voltage regulator, Short circuit protection (current limit and fold back) Monolithic linear IC voltage Regulators. (LM 78XX, LM 79XX, LM 317, LM337).

1. AM: 18.11
2. KVR: 14.5.2.1, 14.5.2.5, 14.5.2.6, 14.5.4.1
3. MB: 23.8, 23.9
4. MB: 24.1, 24.3, 24.4

Unit -IV		(15 lect.)

1. Logic families: Standard TTL NAND, TTL NOR, Open collector gates, Three state TTL devices, MOS inverters, CMOS NAND and NOR gates, CMOS characteristics.

2. Digital Communication Techniques: Digital Transmission of Data, Benefits of Digital Communication, Disadvantages of Digital Communication, Parallel and Serial Transmission, Pulse Modulation, Comparing Pulse-Modulation Methods (PAM, PWM, PPM), Pulse-Code Modulation.

1. ML: 6.2, 6.4, 6.6, 6.7, 7.2 to 7.4.
2. LF: 7.1, 7.2, 7.4

References	
1.	MB: Electronic Principles, Malvino & Bates -7th Ed TMH Publication.
2.	AM: Electronic Devices and Circuits, Allen Mottershead -PHI Publication.
3.	KVR: Functional Electronics, K.V. Ramanan-TMH Publication.
4.	ML: Digital Principles and Applications, Malvino and Leach (4th Ed)(TMH).
5.	LF: Communication Electronics: Principles and applications, Louis E Frenzel 4th edition TMH Publications.

Theory Course – USPH603: Nuclear Physics

Objectives:

The course is built on exploring the fundamentals of nuclear matter as well as considering some of the important applications of nuclear physics. Topics include decay modes – (alpha, beta & gamma decay), nuclear models (liquid drop model, introduction to shell model), Applications of Nuclear Physics in the field of particle accelerators and energy generation, nuclear forces and elementary particles. The lecture course will be integrated with problem solving.

Learning Outcomes:

- Upon successful completion of this course, the student will be able to understand
  the fundamental principles and concepts governing classical nuclear and particle physics and have a knowledge of their applications interactions of ionizing radiation with matter the key techniques for particle accelerators the physical processes involved in nuclear power generation.
- Knowledge on elementary particles will help students to understand the fundamental constituents of matter and lay foundation for the understanding of unsolved questions about dark matter, antimatter and other research oriented topics.

Unit - I	**Alpha & Beta Decay**	(15 lect.)

1. Alpha decay: Velocity, energy, and Absorption of alpha particles: Range, Ionization and stopping power, Nuclear energy levels. Range of alpha particles, alpha particle spectrum, Fine structure, long range alpha particles, Alpha decay paradox: Barrier penetration (Gamow's theory of alpha decay and Geiger-Nuttal law).

2. Beta decay: Introduction, Velocity and energy of beta particles, Energy levels and decay schemes, Continuous beta ray spectrum-Difficulties encountered to understand it, Pauli's neutrino hypothesis, Detection of neutrino, Energetics of beta decay.

1. IK: 13. 1, 13.2, 13.5, SBP: 4. II. 1, 4. II. 2, 4. II. 3, 1.II.3
2. IK: 14.1, 14.7, SBP: 4. III. 1, 4. III. 2, 4. III. 3, 4. III. 5, SNG : 5.5.

Unit -II	**Gamma Decay & Nuclear Models**	(15 lect.)

1. Gamma decay: Introduction, selection rules, Internal conversion, nuclear isomerism, Mossbauer effect.

2. Nuclear Models: Liquid drop model, Weizsacker's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Shell model (Qualitative), Magic numbers in the nucleus.

1. SBP: 4. IV. 1, 4. IV.2, 4. IV. 3, 4. IV. 4, 9.4
2. SBP: 5.1, 5.3, 5.4, 5.5. AB: 11.6-pages (460,461).

Unit -III	**Nuclear Energy & Particle Accelerators**	(15 lect.)

1. Nuclear energy: Introduction, Asymmetric fission - Mass yield, Emission of delayed neutrons, Nuclear release in fission, Nature of fission fragments, Energy released in the fission of U235, Fission of lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor (Four Factor Formula), Nuclear power and breeder reactors, Natural fusion Possibility of controlled fusion.

2. Particle Accelerators: Van de Graaff Generator, Cyclotron, Synchrotron, Betatron and Idea of Large Hadron Collider.

1. SBP: 6.1, 6.3 to 6.9, 9.6, 9.7, 8.1,8.2,8.3
2. SBP: 1.I.4 (i), 1.I.4 (ii), 1.I.4 (iii), 1.I.4 (iv), 6.9, AB: 13.3

Unit -IV	**Nuclear force & Elementary particles**	(15 lect.)

1. Nuclear force: Introduction, Deuteron problem, Meson theory of Nuclear Force- A qualitative discussion.

2. Elementary particles: Introduction, Classification of elementary particles, Particle interactions, Conservation laws (linear &angular momentum, energy, charge, baryon number & lepton number), particles and antiparticles (Electrons and positrons, Protons and anti-protons, Neutrons and anti-neutrons, Neutrinos and anti-neutrinos), Photons, Mesons, Quark model (Qualitative).

1. SBP: 8.6
2. DCT: 18.1, 18.2,18.3, 18.4 , 18.5 to 18.9 AB: 13.5

References	
1.	AB: Concepts of Modern Physics: Arthur Beiser, Shobhit Mahajan, S Rai Choudhury (6th Ed.) (TMH).
2.	SBP: Nuclear Physics, S.B. Patel (Wiley Eastern Ltd.).
3.	IK: Nuclear Physics, Irving Kaplan (2nd Ed.) (Addison Wesley).
4.	SNG: Nuclear Physics, S. N. Ghoshal (S. Chand & Co.)
5.	DCT: Nuclear Physics, D. C. Tayal (Himalayan Publishing House) 5th ed.
Additional References	
1.	Modern Physics: Kenneth Krane (2nd Ed.), John Wiley & Sons.
2.	Atomic & Nuclear Physics: N Subrahmanyam, Brij Lal. (Revised by Jivan Seshan.) S. Chand.
3.	Atomic & Nuclear Physics: A B Gupta & Dipak Ghosh Books & Allied (P) Ltd.
4	Introduction to Elementary Particles: David Griffith, Second Revised Edition, Wiley-VCH.

Theory Course – USPH604: Special Theory of Relativity

Learning outcomes:

This course introduces students to the essence of special relativity which revolutionized the concept of physics in the last century by unifying space and time, mass and energy, electricity and magnetism. This course also gives a very brief introduction of general relativity. After the completion of the course the student should be able to

1. Understand the significance of Michelson Morley experiment and failure of the existing theories to explain the null result
2. Understand the importance of postulates of special relativity, Lorentz transformation equations and how it changed the way we look at space and time, Absolutism and relativity, Common sense versus Einstein concept of Space and time.
3. Understand the transformation equations for: Space and time, velocity, frequency, mass, momentum, force, Energy, Charge and current density, electric and magnetic fields.
4. Solve problems based on length contraction, time dilation, velocity addition, Doppler effect, mass energy relation and resolve paradoxes in relativity like twin paradox etc.

Unit - I		(15 lect.)

Introduction to Special theory of relativity:
Inertial and Non-inertial frames of reference, Galilean transformations, Newtonian relativity, Electromagnetism and Newtonian relativity. Attempts to locate absolute frame: Michelson- Morley experiment (omit derivation part), Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction and Ether drag hypothesis (conceptual), Stellar aberration, Attempt to modify electrodynamics.

Relativistic Kinematics - I: Postulates of the special theory of relativity, Simultaneity, Derivation of Lorentz transformation equations. Some consequences of the Lorentz transformation equations: length contraction, time dilation and meson experiment, The observer in relativity.

RR: 1.1 to 1.9, 2.1 to 2.5

Unit -II		(15 lect.)
Relativistic Kinematics - II: The relativistic addition of velocities, acceleration transformation equations, Aberration and Doppler effect in relativity, The common sense of special relativity. **The Geometric Representation of Space-Time:** Space-Time Diagrams, Simultaneity, Length contraction and Time dilation, The time order and space separation of events, The twin paradox. RR: 2.6 to 2.8, Supplementary topics A1, A2, A3, B1, B2, B3.		
Unit -III		(15 lect.)
Relativistic Dynamics: Mechanics and Relativity, The need to redefine momentum, Relativistic momentum, Alternative views of mass in relativity, The relativistic force law and the dynamics of a single particle, The equivalence of mass and energy, The transformation properties of momentum, energy and mass. RR: 3.1 to 3.7		
Unit -IV		(15 lect.)
Relativity and Electromagnetism: Introduction, The interdependence of Electric and Magnetic fields, The Transformation for E and B, The field of a uniformly moving point charge, Force and fields near a current-carrying wire, Force between moving charges, The invariance of Maxwell's equations. The principle of equivalence and general relativity, Gravitational red shift. RR: 4.1 to 4.7. Supplementary topic C1, C2, C3, C4. **Note: (A good number of problems to be solved from Resnick).**		

References	
1.	RR: Introduction to Special Relativity: Robert Resnick (Wiley Student Edition).
2.	Special theory of Relativity: A. P. French.
3.	Very Special Relativity – An illustrated guide: by Sander Bais - Amsterdam University Press.
4.	Chapter 1: Concepts of Modern Physics by Arthur Beiser.
5.	Chapter 2: Modern Physics by Kenneth Krane.

SEMESTER VI

The T. Y. B. Sc. Syllabus integrates the regular practical work with a series of demonstration experiments and the project. There will be separate passing head for project work. During the teaching and examination of Physics laboratory work, simple modifications of experimental parameters may be attempted. Attention should be given to basic skills of experimentation which include:

i)	Understanding relevant concepts.
ii)	Planning of the experiments.
iii)	Layout and adjustments of the equipments
iv)	Understanding designing of the experiments
v)	Attempts to make the experiments open ended
vi)	Recording of observations and plotting of graphs
vii)	Calculation of results and estimation of possible errors in the observation of results.

i) Regular Physics Experiments: A minimum of **06** experiments from each of the practical course are to be performed and reported in the journal.

ii) Demonstration Experiments: The demonstration experiments are to be performed by the teacher in the laboratory and students should be encouraged to participate and take observation wherever possible.

Demonstration experiments are designed to bring about interest and excitement in Physics. Students are required to enter details of these 'demonstration' experiments in their journal.

The certified journal must contain a minimum of **12** regular experiments (**06** from each practical course), **MINIMUM 06** demonstration experiments in semester VI. A separate index and certificate in journal is must for each course in each semester.

iii) Project Details:

a)	**Project Includes:** Review articles/Simulation on PC on any concept in Physics/ Comparative & differentiative study/Improvement in the existing experiment (Design and fabrication concept) /Extension of any regular experiment/Attempt to make experiment open-ended/Thorough survey of existing active components (devices, ICs, methods, means, technologies, generations, applications etc. / any innovative projects using the concept of physics.
b)	Students/project : 02 (maximum)
c)	Evaluation of the project: The following points shall be considered. • Working model (Experimental or Concept based simulation) • Understanding of the project • Data collection • Data Analysis • Innovation/difficulty • Report

There will be **THREE** turns of **three hours each** for the examination of practical courses.

SEMESTER VI	
PRACTICAL COURSE: USPHP07	
Sr. No.	**Name of the Experiment**
1	Surface tension of mercury by Quincke's method
2	Thermal conductivity by Lee's method
3	Study of JFET characteristics
4	JFET as a common source amplifier
5	JFET as switch (series and shunt)
6	UJT characteristics and relaxation oscillator
7	Study of Pulse width modulation (BB)

8	Study of Pulse position modulation (BB)
9	Determination of h/e by photocell
10	R. P. of Prism
11	Double refraction
12	Lloyd's single mirror: determination of wavelength
PRACTICAL COURSE: USPHP08	
Sr. No.	**Name of the Experiment**
1	Determination of M/C by using BG
2	Self-inductance by Anderson's bridge
3	Hall effect
4	Solar cell characteristics and determination of V_{oc}, I_{sc} and P_{max}
5	Design and study of transistorized monostable multivibrator (BB)
6	Design and study of transistorized bistable multivibrator (BB)
7	Application of Op-Amp as a window comparator
8	Application of Op-Amp as a Log amplifier
9	Application of IC 555 as a voltage to frequency converter (BB)
10	Application of IC 555 as a voltage to time converter (BB)
11	LM-317 as variable voltage source
12	Shift register
DEMONSTRATION EXPERIMENTS	
Sr. No.	**Name of the Experiment**
1	Open CRO, Power Supply, and Signal Generator: block diagrams
2	Data sheets: Diodes, Transistor, Op-amp & Optoelectronic devices
3	Zeeman Effect
4	Michelson's interferometer
5	Constant deviation spectrometer (CDS)
6	Digital storage oscilloscope (DSO)
7	Determination of Op-Amp parameters (offset voltage, slew rate,

	input impedance, output impedance, A_{CM})
8	Transformer (theory, construction and working), types of transformers and energy losses associated with them.
9	Use of LCR meter
10	Lux meter / Flux meter

References:

1.	Advanced course in Practical Physics: D. Chattopadhya, PC. Rakshit & B. Saha (8^{th} Edition) Book & Allied (P) Ltd.
2.	BSc Practical Physics: Harnam Singh. S. Chand & Co. Ltd. – 2001.
3.	A Text book of Practical Physics: Samir Kumar Ghosh New Central Book Agency (4^{th} edition).
4.	B Sc. Practical Physics: C. L. Arora (1^{st} Edition) – 2001 S. Chand & Co.
5.	Practical Physics: C. L. Squires – (3^{rd} Edition) Cambridge Univ. Press.
6.	University Practical Physics: D C Tayal, Himalaya Publication.
7.	Advanced Practical Physics: Worsnop & Flint.

UNIVERSITY OF MUMBAI

No. UG/ 8 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular Nos. UG/264 of 2017-18, dated 23rd October, 2017, UG/287 of 2017-18, dated 30th October, 2017and UG/263 of 2017-18, dated 23rd October, 2017 relating to syllabus of the Bachelor of Science (B.Sc.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Physics at its meeting held on 23rd April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.26 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.Sc. in Physics including Applied Component - Electronic Instrumentation (EI) & Computer Course (CS) (Sem -V & VI), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
12th June, 2018

To

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.26/05/05/2018

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No. UG/ 8 -A of 2018 MUMBAI-400 032 12th June, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Physics,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

UNIVERSITY OF MUMBAI

No. UG/ 8 of 2018-19

CIRCULAR:-

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(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
12th June, 2018

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(Dr. Dinesh Kamble)
I/c REGISTRAR

UNIVERSITY OF MUMBAI

Syllabus for Sem V & VI Program: B.Sc.

Course: Electronic Instrumentation

(Applied Component)

(Credit Based Semester and Grading System with effect from the academic year 2018 –2019)

SEMESTER V			
Theory			
USACEI501	**Analog Circuits, Instruments and Consumer Appliances.**	**No. of Credits**	**Lectures/Week**
Unit I	Transducers, Sensors and Optoelectronics Devices	02	04
Unit II	Signal conditioning, SMPS and Measuring Instruments		
Unit III	Data Acquisition and Conversion		
Unit IV	Modern Techniques and Consumer Appliances		
Practicals			
USACEI5P1	**Analog Circuits, Instruments and Consumer Appliances.**	02	04

SEMESTER VI			
Theory			
USACEI601	**Digital Electronics, Microprocessor, Microcontroller and OOP.**	**No. of Credits**	**Lectures/Week**
Unit I	Digital Electronics.	02	04
Unit II	Advanced 8085 Programming and 8255 (PPI) interfacing.		
Unit III	Introduction to Microcontrollers.		
Unit IV	Basic Concepts of Object Oriented Programming and C++.		
Practicals			
USACEI6P1	**Digital Electronics, Microprocessor, Microcontroller and OOP.**	02	04

The revised syllabus under the credit based grading system in the subject of **Electronic Instrumentation** (Applied Component) for Third Year B.Sc. Physics (Single/Twin major subject) will be implemented **from the academic Year 2018-19**

The scheme of examination in the subject of Electronic Instrumentation (Applied Component) will be as follows:

Semester V & VI: Theory

Course Code: USACEI501 & USAEI601

Theory Examination: 100 marks

- Duration of each Theory paper will be of **three** hours.
- Each theory paper shall consist of **five questions**, one from each unit and the fifth question will be from all the units. All questions are compulsory and will have internal choice.
- The theory examination will be conducted by the respective colleges and the marks will be forwarded to the University

Objectives

The objective of these papers is to introduce the students to sensors and transducers, Signal conditioning, data acquisition systems and measuring instruments used in the laboratory. Students are to be exposed to know, in principle, the modern techniques in the field of medical science. To learn PCB designing and working of consumer electronic devices. To develop logic circuit design and implementation. To know advanced programming skills and interfacing techniques. To understand basic building blocks of microcontrollers. To know the terminologies like embedded, CISK and RISK processors. To master Programming and interfacing skills of microprocessor and microcontrollers. To develop object oriented programming skills and programming in C++. To develop various experimental skills.

Expected learning outcomes

Learner will be able to:

- Understand the difference between a transducer and a sensor.
- Understand the construction, working and uses of different types of transducers.
- Understand the concept of signal conditioning, devices used and their operations.
- Get acquainted with the measuring instruments used in laboratory.
- Get the insight of the modern medical instruments in principle, which are used in day to day life.
- Analyze/design and implement combinational logic circuits.
- Develop assembly language programing skills and real time applications of microprocessor.
- Illustrate how to interface the I/O peripheral (PPI) with 8085 microprocessor
- Understand architecture, silent features, instruction set, programming and interfacing of 8051 microcontroller.
- Develop the programming skills in programming Language C++.
- Train their practical knowledge through lab experiments.
- Get practical training to interface different programmable peripherals and I/O devices to microprocessor and microcontroller.

Semester V & VI: Practical

Course Code: USACEI5P1 & USACEI6P1

The practical examination will be conducted as per the following scheme by the respective colleges and the marks will be forwarded to the University:

Sr. No	**Particulars of External Practical Examination**	**Marks**
1	Laboratory Work	80
2	Journal	10
3	Viva	10
	TOTAL	**100**

Total Marks in each semester: **100 Marks**

- Duration of each Practical paper will be of 3 Hours per semester.
- A certified Journal of Electronic Instrumentation must contain a minimum of **EIGHT** Experiments in each semester. At least TWO experiments from each sub groups, as mentioned in the syllabus, should be performed and reported in journal.
- Every candidate will be required to perform ONE experiment (from sub groups A or B or C or D) at the semester end practical examination.
- A candidate will be allowed to appear for the Practical Examination only if the candidate submits his/her certified Journal or a certificate from the Head of the Department of Physics stating that the candidate has completed the practical Course of Electronic Instrumentation of the respective semester as per requirements.

SEMESTER V

COURSE CODE: USACEI501

ANALOG CIRCUITS, INSTRUMENTS AND CONSUMER APPLIANCES.

Unit- I:	**Transducers, Sensors and Optoelectronic Devices**	(15 lect.)
1.	**Transducers:** Definition, Classification, Selection of transducer.	
2.	**Electrical transducers:** Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT, Peizo-electric Transducer. [Ref. 2, 3, 6 & 9]	
3.	**Chemical sensors:** PH sensor, Gas sensor (Fundamental aspects), Humidity sensor (Resistive). [R6, R7].	
4.	**Electronic Weighing Systems:** Operating principle, Block diagram, features [Ref12 & 13].	
5.	**Optoelectronic Devices:** LDR, LED (Construction, Working & Applications), Multicolour LED, Seven Segment Display, Liquid Crystal Display (LCD), Photodiode (construction, Characteristics & applications), Phototransistor. [Ref. 1, 2 & 3]	
Unit-II:	**Signal Conditioning, SMPS and Measuring Instruments**	(15 lect.)
1.	Half wave precision rectifier, Active Peak detector, Active Positive Clamper [M & B].	
2.	Active Positive and Negative Clippers [G]	
3.	**Microphones:** characteristics, types (list only), carbon microphone and dynamic type microphone (principle, construction and working) [R4].	
4.	**Loud speakers:** Characteristics, Dynamic (Moving coil type) speaker, Multi-way speaker system (woofer and tweeter) [R4]	
5.	**Switching Regulators:** Basic and Monolithic Switching regulators (buck, boost and buck – boost) (Only basic Configurations) Ref M: 24.7	

6.	**Cathode Ray Oscilloscope:** Single trace CRO (Block diagram), Front Panel Controls (Intensity, Focus, Astigmatism, X & Y position, Level knob, Time base (Time/Division) and attenuation (Volts/Division) knobs, X-Y mode), Dual Trace CRO (Block diagram), Probes: 1:1&10:1. Digital Storage Oscilloscope [R3 &10].	
7.	**DMM:** 3 ½ Digit, resolution and sensitivity, general specification. [R3]	
Unit- III:	**Data Acquisition and Conversion**	(15 lect.)
1.	**Data acquisition system:** Objectives of DAS, Signal conditioning of inputs, Single channel Data Acquisition system, Multichannel Data Acquisition system. [Data Transmission systems IEEE-488 GPIB*] [Ref. 11]	
2.	**D to A Converters:** Resistive divider network, Binary ladder network [Ref 7 & 8]	
3.	**A to D Converters:** Successive approximation type, Voltage to Time (Single slope, Dual slope). [Ref. 7 & 8]	
Unit-IV:	**Modern Techniques and Appliances**	(15 lect.)
1.	**Printed Circuit Board:** Idea of PCB, advantages, copper clad, Etching processes, Principle of Photolithography (For PCB). [Ref. 4, 14 & 15].	
2.	**Microwave Oven:** Operating principle, block diagram, features. [Ref. 12 & 13]	
3.	**Medical instruments:** Bio-Potential, Types of electrodes, ECG, EEG, EMG, CT Scan and MRI (principle, block diagram and features), Ultrasonography: working principle [R 16, 17 and18].	

References:

1.	A Textbook of Applied Electronics – R S Sedha, S Chand & Company, New Delhi.
2.	Basic Electronics Solid state - B. L. Thereja, S Chand & Company, New Delhi.
3.	Electronic Instrumentation – H S Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4.	Electronic components and materials: Principles, Manufacture and Maintenance- S. M. Dhir, Tata McGraw-Hill Publishing Company Limited, New Delhi.

	https://books.google.co.in/books?id=sGbwj4J76tEC&pg=PA384&lpg=PA384&dq=4.+Electronic+components+and+materials:+Principles,+Manufacture+and+Maintenance-+S.+M.+Dhir,+Tata+McGraw-Hill+Publishing+Company+Limited,+New+Delhi.&source=bl&ots=U1ekaiN3pB&sig=viKj6soAvVom4Hx9W-53Q-koqFM&hl=en&sa=X&ved=0ahUKEwjCq97viYXaAhUEPo8KHfMNBaQQ6AEIMjAC#v=onepage&q=4.%20Electronic%20components%20and%20materials%3A%20Principles%2C%20Manufacture%20and%20Maintenance-%20S.%20M.%20Dhir%2C%20Tata%20McGraw-Hill%20Publishing%20Company%20Limited%2C%20New%20Delhi.&f=false. https://books.google.co.in/books?id=bftp5ZG8v5kC&pg=PP1&lpg=PP1&dq=digital+Electronics+-+by+A.P+Godse+%26+D.A+Godse+Technical+publications,+Pune,+Revised+third+edition,+2008&source=bl&ots=_ApVT8Km_H&sig=hfrgOdJHfzdZwEy1_JPogAeRhLE&hl=en&sa=X&ved=0ahUKEwif3ZbKssraAhVFPI8KHVaJBKIQ6AEINTAB#v=onepage&q=digital%20Electronics%20-%20by%20A.P%20Godse%20%26%20D.A%20Godse%20Technical%20publications%2C%20Pune%2C%20Revised%20third%20edition%2C%202008&f=false
5.	Measurement and Instrumentation Principles: Alan S. Morris., Butterworth-Heinemann.
6.	Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7.	Digital principles and applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill.
8.	Data Converters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
9.	Modern Electronic Instruments and Measurement techniques- Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
10.	A course in electrical and electronic Measurements and Instrumentation: A. K. Sawhney, DhanpatRai and Sons. https://www.scribd.com/document/258017718/A-K-sawhney-A-Course-in-Electrical-and-Electronic-Measurements-and-Instrumentation
11.	Instrumentation Devices & Systems , 2nd Edition Tata McGrawHill- C.S. Rangan, G.R. Sarma,V.S. Mani
12.	Consumer Electronics R. P. Bali, Pearson Education (2008)

13.	S.P Bali, "Consumer Electronics", Pearson Education Asia Pvt., Ltd., 2008 Edition,
14.	Printed Circuits Handbook pdf, Clyde F. Coombs. Jr. , McGraw Hill Handbooks, 6th ed.
15.	PCB design basics, Mahmoud Wahby, EDN Networks, Nov 2013.
16.	Introduction to Bio-medical Electronics: Joseph-Du-bary, McGraw Hill Co. Ltd.
17.	Medical instrumentation Application and design- J. C. Wobster
18.	Biomedical instruments and measurements – L. Cromwell, F. J. Weibell, Printice hall of India of India Pvt. Ltd, New Delhi.

PRACTICALS (Semester V)

Course Code: USACEI5P1

1. Perform Minimum TWO Experiments from each group.
2. **Group C** experiments must be performed on Bread Boards.

GROUP - A	
Sr. No.	**Name of the Experiments**
1	Thermistor Characteristics –Thermal and electrical. (H & C)
2	Thermistor as sensor in temperature to voltage converter using OPAMP. (C&D Ch.8)
3	Study of LVDT characteristics. (K Ch. 13)
4	Study of Load Cell / Strain Guage. (K Ch. 13)
5	Study of seven segment display.
6	Characteristics of Photo diode and photo transistors.

GROUP - B	
Sr. No.	**Name of the Experiments**
1	Basic Instrumentation Amplifier using 3 Op-Amps coupled to resistance bridge. (C & D Ch. 8)
2	Temperature to frequency Conversion using 555 timer. (C & D Ch.13)
3	OPAMP D/A Converter: Binary weighted resistors.
4	OPAMP D/A Converter: Ladder network. (M & L Ch. 12)
5	Sample and hold circuit using op-amp 741. (G Ch. 8)
6	Peak detector using op-amp 741. (G Ch. 8)

GROUP – C (Must be performed on Bread Board)	
Sr. No.	**Name of the Experiments**
1	Half wave precision rectifier using precision op-amps (OPA177) (C & D Ch. 7)
2	Positive and Negative Clippers using op-amp.(G Ch. 8)
3	Positive and Negative Clampers using single power supply op-amp (124/324). (G Ch. 8)
4	Second Order active Low Pass filter (frequency response & phase relation)
5	Second Order active High Pass filter (frequency response & phase relation) (K.Ch15)
6	Active Notch Filter (frequency response & phase relation) (K.Ch.15)
7	Square and Triangular wave generator using OPAMPs with concept of duty cycle (M.Ch 23)

GROUP - D	
Sr. No.	**Name of the Experiments**
1.	Study of variable dual power supply using LM 317& LM 337 (± 3v to ± 15v). (C&D Ch.13)
2.	Constant Current source using OPAMP and PNP transistor (o/p current less than 50 mA) (C & D Ch 5)
3.	Simple microphone amplifier using a transistor.
4.	Low voltage audio amplifier using IC LM386
5.	Construction of Audio power amplifier using IC TBA 810.
6.	Making PCB for simple circuits (like rectifiers, regulators, oscillators, multivibrators, op-amp applications, single stage amplifier etc.), building and testing of the circuit.
7.	Visit to Hospital/Diagnostic Center/ Bio-medical Research Laboratory and submission of its report.

- Experiment No. 5 & 6 are Hands-on experiments. Learner have to prepare report, PPT and viva voice. Which is equivalent to 2 regular experiments.
- Visit to Hospital/Diagnostic Center/ Bio-medical Research Laboratory and submission of its report which is also equivalent to 2 regular experiments.
- Learner will be examined for Expt. No. 5, 6 and 7 on the basis of submitted report, PPT and viva, and need not perform regular experiment during the Practical Examination.

References:

1.	H & C: Modern Electronic Instrumentation & Measurement Techniques by Albert D. Helfrick & William D. Cooper PHI) Edition.
2.	C & D: OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll (6th edition PHI)
3.	G: OPAMPs and linear integrated circuits by R.A. Gayakwad (4th edition, PHI).
4.	M: Electronic Principles by A. P. Malvino, (PHI), 6th edition.

5.	K: Electronic Instrumentation by H. S. Kalsi, (TMH) 2nd Edition
6.	M & L: Digital Principle and Applications" by Malvino and Leach, (TMH), 5th edition,
7.	RPJ: Modern Digital Electronics, R .P. Jain, (TMH), 3rd edition.

SEMESTER VI

COURSE CODE: USACEI602

DIGITAL ELECTRONICS, MICROPROCESSOR, MICROCONTROLLER AND OOP

Unit- I:	**Digital Electronics**	(15 lect.)
1.	**Combinational Logic Design:** Introduction, Boolean identities, K – map (2, 3 and 4 variable), **Ref: N G P 4.1 – 4.8.** (additional ref. RPJ)	
2.	**Design and implementations of:** Decoders, Encoders, Multiplexers, De-multiplexers, Use of MUX and DEMUX in Combinational Logic design. Code Converters (based on – binary, BCD, Gray and Excess – 3 codes). Tri-State logic, buffers, D latch.	
	Ref: N G P - 5.1 (only introduction), 5.3, 7.1 -7.6 (except 7.5) RPJ - 4.20. RG: 3.5.1, 3.5.2, 3.5.3, 3.5.4 & 3.5.5 NGP: Digital Electronics and Logic design by N G PALAN, https://archive.org/details/hellomr82k_gmail_DE RG: Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition. RPJ: R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition.	

Unit-II:	**Advanced 8085 Programming and 8255(PPI)**	(15 lect.)
1.	Introduction to advanced instructions and applications Ref. RG: 10.7, 10.8, 10.9	
2.	Stack and Subroutines**:** Stack, Subroutine Ref. RG: 9.1, 9.1.1, 9.2&9.2.1	
3.	The 8255 Programmable Peripheral Interface: Block Diagram of the 8255, Mode 0 – Simple Input / Output mode, BSR (Bit Set/Reset Mode) Ref. RG: 15.1.1, 15.1.2& 15.1.3	
	RG: Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition.	
Unit- III:	**Introduction to Microcontrollers**	(15 lect.)
1.	Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Block diagram of 8051 Microcontroller*, Embedded Versus External Memory Devices, 8-bit & 16-bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Commercial Microcontrollers. Ref. AVD-Ch: 1 Ref. MMM - For * Refer 1.2 The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidiand R. D. Mckinlay, Second Edition, Pearson.	
2.	**8051 Microcontrollers:** Introduction, MCS-Architecture, Registers in MCS-51, 8051 Pin Description, 8051 Connections, 8051 Parallel I/O Ports, Memory Organization. AVD-Ch: 2, 3.	
3.	**8051 Instruction Set and Programming:** *MCS-51 Addressing Modes and Instructions***:** 8051 Addressing modes, MCS-51 Instruction Set, 8051 Instructions and Simple Programs, Using Stack Pointer AVD-Ch: 4 Ref. AVD: Microcontrollers (Theory and Applications) by Ajay V Deshmukh, The Tata-McGraw-Hill Companies **Ref. Intel's 8031/8051 Data sheet**	

	https://archive.org/details/bitsavers_intel8051M4_15073500 https://www.8051projects.net/download-d215-intel-mcs-51-8051-user-manual.html https://archive.org/stream/212656146The8051MicrocontrollerByIScott Mackenzie4th Edition/212656146-The-8051-Microcontroller-by-I-Scott-Mackenzie-4th-Edition#page/n47/mode/2up Additional Reference books: 1. The 8051 Microcontroller & Embedded Systems-Dr. Rajiv Kapadia (Jaico Pub. House) 2. 8051 Micro-controller by K.J.Ayala., Penram International. 3. Programming & customizing the 8051 microcontroller By Myke Predko, TMH. 4. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidiand R.D.Mckinlay, Second Edition, Pearson.

Unit-IV:	**Basic Concepts of Object Oriented Programming and C++**	(15 lect.)
1.	**Basics of Object-Oriented Programming & Beginning with C++:** Basic concepts of Object-Oriented Programming, Benefits of OOP, Object-Oriented Languages, Applications of OOP. What is C++?, Applications of C++, A simple C++ program, More C++ Statements, Example with Class, Structure of C++ Program, Creating the Source File, Compiling and Linking. Ref EB: 1.5, 1.6, 1.7 & 1.8 EB: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 & 2.8	
2.	**Tokens and Expressions in C++:** Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Symbolic Constants, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Operators in C++, Scope Resolution Operator, Member Dereferencing Operators, Memory Management Operators, Manipulators, Type Cast Operator, Expressions and Their Types, Special Assignment Expressions, Implicit Conversions, Operator Overloading, Operator Precedence. Ref EB: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22 & 3.23	
3.	**Control Structures and Functions:** Control Structures, Functions: The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, Constant Arguments, Function Overloading, Math Library Functions.	

Ref EB: 3.24, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 & 4.11

Reference:
EB: Object Oriented Programming with C++ by E Balagurusamy, Third /Fourth Edition, Tata McGraw-Hill Publishing Company Limited.

Additional references:

1) Microprocessor and Applications by Vibhute and Borole, Techmax Publications,
2) Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH
3) Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publishing Company Limited.
4) Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company.
5) Digital Electronics - by A.P Godse & D.A Godse Technical publications, Pune, Revised third edition, 2008. Pg.No:2.25-2.70 (for K-maps).

https://www.scribd.com/document/103027386/Digital-Electronics-By-D-A-Godse-A-P-Godse

https://books.google.co.in/books?id=JkMrIjNKI7IC&pg=PP1&lpg=PP1&dq=Digital+Electronics+-+by+A.P+Godse+%26+D.A+Godse+Technical+publications,+Pune,+Revised+third+edition,+2008&source=bl&ots=9VG8scIgqH&sig=d7cyhWaM7cCwabgqRMoWz6snI8s&hl=en&sa=X&ved=0ahUKEwiv55-j6cbaAhUBvY8KHUZJBmMQ6AEIPTAD#v=onepage&q=Digital%20Electronics%20-%20by%20A.P%20Godse%20%26%20D.A%20Godse%20Technical%20publications%2C%20Pune%2C%20Revised%20third%20edition%2C%202008&f=false

PRACTICALS (Semester VI)

Course Code: USACEI6P1

Note: Perform Minimum TWO Experiments from each group.

GROUP – A: Digital Electronics	
Sr. No.	**Name of the Experiments**
1	Study of 3:8 Decoder (74LS138), 8:3 Priority Encoder (74LS148) and their applications.
2	Study of Latch (74LS373) and its application.
3	Study of 8:1 Multiplexer (74LS151), 1: 4 De-multiplexer (74LS155) and their applications.
4	Study of unidirectional buffer (74LS244) and bidirectional buffer (74LS245).
5	Design using K –map and implement 4:1 MUX, 1:4 DEMUX, 2bit comparator, Full adder and Full subtractor. [Note: Use suitable circuit simulator for implementation]
6	Designing (using K –map) and implementation of code convertors. (any two – Binary to Gray, Gray to Binary, BCD to Excess – 3 and Excess-3 to BCD) [Note: Use suitable circuit simulator for implementation]
GROUP – B : 8085 Advanced Programming and 8255 interfacing **Note:** The students should be familiar with Keyboard and Display utilities such as READ KEYBOARD, TO DISPLAY ON ADDRESS FIELD, and TO DISPLAY ON DATA FIELD, mentioned in the 8085 µp kit's manual.	
Sr. No.	**Name of the Experiments**
8085 programming	
1	Write An ALP: a) To Evaluate simple arithmetic Expression (like Y= a x b + c x d where a, b, c and d are 8-bit HEX numbers) b) To Add parity bit to 7-bit ASCII characters.

2	Write An ALP for code conversion (any two)
3	16-bit Data manipulation (Addition, subtraction) Display result on Address field.
4	Write ALP for Addition/ Subtraction/Multiplication of two, 8-bit hex, numbers. [**Note:** Use Read Keyboard Utility for inputting the hex numbers and display the result on the Address field.]
8255 interfacing	
1.	Design a system (both Software and Hardware) that will cause 4 LEDs to flash when a push button switch is pressed. Assume persistence of vision to be 0.1 seconds.
2.	Design a system (both Software and Hardware) using 8 LED display to demonstrate: a) Binary - up, down and ring counters. b) Flashing display.
3.	Design a system (both Software and Hardware) to control ON/OFF operation of 4 electrical loads (appliances).
4.	Interfacing 8 switches and 8 LEDs to 8255: a) Write ALP to read the status of the switches and display on the LEDs. b) Write ALP so that when the first switch is made ON all the LEDs should glow and when the second switch is made OFF all the LEDs should become off.
GROUP – C: Experiments for 8031 / 8051 / 89C51	
Sr. No.	**Name of the Experiments**
1	**8031/51 assembly language programming:** a) Simple data manipulation programs. (8/16-bit addition, subtraction, multiplication, division. b) 8/16 bit data transfer, cubes of nos., to rotate a 32- bit number c) Finding greatest/smallest number from a block of data, decimal / hexadecimal counter.

2	**Study of IN and OUT port of 8031/51 by Interfacing switches, LEDs and Relays:** a) To display bit pattern on LED's b) To count the number of "ON" switches and display on LED's, c) To trip a relay depending on the logic condition of switches d) Event counter (using LDR and light source)
GROUP – D: C++ Programming	
Sr. No.	**Name of the Experiments**
1.	Program based on Input, Output Statements. (Programs to read any two numbers through keyboard and to perform simple arithmetic operations and to display the result).
2.	Program based on Control Statements a) Program based on if-else statement b) Program based on nested if statement
3.	Program based on for loop, while loop and do-while loop.
4.	Program using switch statements and if-else ladder.
5.	Program to study function declaration, function calling and function prototype.