A.C. 10/2/12
Item No. 4.5

University of Mumbai

Revised Syllabus for

Second Year B.Sc. in Physics

(Credit Based Semester and Grading system)

for

Semesters - III & IV

With effect from the academic year 2012-13

Revised Syllabus in Physics

Semester Based Credit and Grading System

(Theory & Practical)

S. Y. B. Sc. 2012 – 2013.

The revised syllabus in Physics for the Semester **III** and Semester **IV** will be implemented from the academic year 2012 – 2013. The scheme of examination for the revised course in Physics at the Semester **III** and Semester **IV** Examination will be as per semester based credit and grading system. There will be an internal and external assessment as prescribed by ordinances and regulations. The other details are follows:

Course code	Title	Credits
USPH301	Theory of errors and Mechanics	2
USPH302	Electricity and magnetism	2
USPH303	Thermodynamics and Material Science	2
USPHP3	Practical-3	3
		Total= 09
USPH401	Optics	2
USPH402	Electronics	2
USPH403	Introduction to Theory of Relativity and Wave Mechanics	2
USPHP4	Practical -4	3
		Total=09

For practical courses USPHP3 and USPHP4:

		Internal	External Marks	Credits
Practical –I	Experiments from Group - A	20	30	3 credits
Practical- II	Experiments from Group – B	20	30	
Practical - III	Experiments from Group – C	20	30	
Total Marks	Practical :	60	90	
Total 150 to be converted to out of 100 to assign grade for 3 credits				

Format for Physics Theory

		Assignment								
Course	Cr	A1	A2	Class Test 10	other	Internal 40	External 60	Total	Grade Point	Letter grade
		10	10	10	10	16/40	24/60	100		
I	6	7	8	6	8	29	30	59	7	O
II		6	7	7	8	28	45	73		
III		9	6	7	7	29	50	79		

Format for Physics practical (Each practical will be evaluated out of 50)

		Practical								
Course	Cr	P1	P2	J	Viva	Internal 20	External 30	Total 50	Grade Point	Letter grade
USP HP3		5	5	5	5	8/20	12/30	20/50		
Gr-A	3	4	4	5	3	16	20	36	7	O
Gr-B		4	5	4	4	17	25	42		
Gr-C		3	4	5	3	15	26	41		

Scheme of Examination

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40% marks in the first part by conducting the Semester End Examinations with 60% marks in the second part. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

(a) Internal assessment i)Theory 40 %

Sr No	Evaluation type	Marks
1	Two Assignments/Case study/Project	20
2	One class Test (multiple choice questions objective)	10
3	Active participation in routine class instructional deliveries(case studies/ seminars//presentation)	05
4	Overall conduct as a responsible student, mannerism and articulation and exhibit of leadership qualities in organizing related academic actives	05

ii) Practicals 40%

Sr No	Evaluation type	Marks
1	Two best practicals, test on pract, skill/demo expt, error calculations, graph plotting.	10
2	Journal	05
3	Viva	05

Semester III

USPH301: Theory of errors and Mechanics

Unit-I (15 Lectures)

Theory of errors: Significant Digits – Dropping of non-significant digits, Rounding of numbers, Absolute and relative errors, relative errors and significant digits, errors o computation, Accuracy of a function.

Elementary theory of errors: Introduction, various kinds of errors, Different ways of measuring random errors, Uncertainty and Significant digits, fractional uncertainty and significant digits, significance of uncertainty.

The estimation of errors: The normal distribution, The average or mean value of measurements, average errors, the average or mean value of measurements, average errors, standard errors, probable errors, The practical determination of errors an Peter's formula (Without proof), error in single measurement, the error in the mean, reliability of measurement.

JCP: 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.7, 2.7(a), 2.9, 3.4, 3.5, 3.6, 3.6(a), 3.6(b), 3.10, 3.10(a), 3.11.

Unit-II (15 Lectures)

Damped Vibrations: Decay of free vibrations of a simple harmonic oscillator due to the damping force proportional to the first power of velocity, types of damping,

Energy of a damped oscillator, logarithmic decrement, relaxation time and quality factor.

HP : 9.3, 9.4.

Forced vibration and resonance: Forced damped harmonic oscillator, special cases: low driving frequency, high driving frequency, Resonance. Quality factor of a driven oscillator.

HP: 9.6, 9.7.

Compound pendulum: Expression for period, maximum and minimum time periods, Centres of suspension and oscillations, Reversible compound pendulum, Kater's reversible pendulum. Advantages of a compound pendulum over a simple pendulum.

HP: (pages 279 to 289)

Unit III (15 Lectures)

Collisions: Introduction, types of collisions, laboratory and centre of mass syems, relationship between displacements and velocities, relationship between angles.

H.P.: 7.1, 7.3, 7.3.1, 7.3.2.

Bending of beams: bending moment, Basic assumptions for theory of bending, cantilever, beam supported at its ends and loaded in the middle, I-section girders, determination of Y by bending, Determination of elastic constants by Searle's method.

BS: 10.16, 10.17, 10.18, 10.19, 10.20, 10.22, 10.23, 10.26.

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

References :

JCP. : The theory of errors in Physical Measurements J. C. Pal, New Central Book agency, Reprint 2008.

H. P. : Mechanics – H. S. Hans and S. P. Puri, Tata McGraw Hill (2^{nd} Ed.)

B. S. : Mechanics and Electrodynamics. – Brij Lal, N. Subramanyam, Jivan Seshan, S. Chand (Revised and Enlarged Edition 2005)

Additional References:

1. Fundamental of Vibrations and Waves. S P Puri. (Tata Mc Graw Hill)

2. Mechanics – K R Symon : [Addition & Wesley (3^{rd} Ed)]

3. Mechanics – D. S. Mathur (S Chand & Co.)

4. Text book of Mechanics: Bhargava and Sharma.

5. Error of observation and their treatment – J Topping (Institute of Physics Monographs for students Series.)

6. An introduction to error Analysis: John R Taylor, University Science Books: Mill Valley California

USPH302: Electricity and Magnetism

Unit I (15 Lectures)

Triple products, the ∇ operator, the gradient, divergence and the curl, product rules. The fundamental theorem of gradient divergence and curl, spherical polar coordinates, cylindrical co-ordinates, one dimensional and three dimensional Dirac- delta function.

DG: 1.1.3, 1.2.2 TO 1.2.6, 1.3.3, 1.3.4, 1.3.5, 1.4.1, 1.4.2, 1.5.2, 1.5.3.

Unit II (15 Lectures)

1. The work done in moving a charge, the energy of a point charge distribution, the energy of continuous charge distribution, comment on electrostatic energy.

2. The Biot-Savart law, applications of Biot- Savart law:

Magnetic field due to a current carrying straight wire, circular loop, Helmholtz coils and solenoid.

DG: 1) 2.4.1 TO 2.4.4

CR: 2) 8.7, 8.8

Unit III (15 Lectures)

Charged particle dynamics

Kinetic energy of a charged particle in an electric field, motion of a charged particle in a constant electric field, Charged particle in an alternating electric field, Force on a charged in a magnetic field. Charged particle in a uniform and constant magnetic field. The cyclotron.

Motion of a charged particle in combined electric and magnetic field:

Case I: Parallel electric and magnetic field

Case II: Crossed electric and magnetic field

Velocity selector

HP:13.1, 13.2, 13.3, 13.4, 13.5,13.5.1,13.6, 13.6.1

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

References:

1. HP : Mechanics – HS. Hans and S. P. Puri Tata Mc. GrawHill (2nd Ed.)
2. DG : Introduction to Electrodynamics – David J. Griffiths Prentice Hall India (EEE) 3rd Ed.
3. CR : Electricity and Magnetism - D. Chattopadhyay and P. C. Rakshit Books and allied (P) Ltd. Reprint 2000 (4th Ed.)

Additional References:

UNIT-I : Introduction to Electrodynamics, Z. Capri and P. V. Panat (Narosa Pub. House)

UNIT–II: Mechanics and Electrodynamics, Brij Lal, Subramanyam, Jivan Sesan, (S. Chand) (Revised & Enlarged ED. 2005)

USPH303: Thermodynamics and Material Science

Unit I (15 Lectures)

Reversible and irreversible process, Heat engines, definition, of efficiency, Carnot's ideal heat engine, Carnot's cycle, effective way to increase efficiency, Carnot's engines and refrigerator, coefficient of performance, second law of thermodynamics, Carnot's theorem, Clapeyron's latent heat equation using Carnot's cycle and its applications

Steam engine, Otto engine, petrol engine, diesel engine

BS: 1) 4.20 TO 4.29, 6.11

BS: 2) 4.30 TO 4.33

Unit II (15 Lectures)

Concept of entropy, Change in entropy in adiabatic process, Change in entropy in reversible cycle, Principle of increase of entropy, Change in entropy in irreversible process.

T-S diagram, Physical significance of Entropy, Entropy of a perfect gas, Kelvin's thermodynamic scale of temperature, (Omit alternative method using Carnot cycle), The size of a degree, Zero of absolute scale, Identity of a perfect gas scale and absolute scale.

Third law of thermodynamics, Zero point energy, Negative temperatures (not possible), Heat death of the universe.

BS: 5.1 TO 5.9, 5.11 TO 5.18

Unit III (15 Lectures)

Material Science:

Classification and selection of materials: Classification of materials, organic, inorganic and biological materials, semiconductor materials, current trends and advances in materials. Material structure and examination, selection of materials.

Crystal geometry and structure: Crystals, single crystal, Whiskers, lattice point and space lattice. Unit cell, primitive cell, Atomic radius, Density of crystal, Direction lattice planes, Miller indices, Inter-planar spacing, Crystal planes in cubic unit cell, common planes in simple cubic structure. Coordination number, Crystal growth.

KK: CHAPTER 1(3 TO 9)

KK CHAPTER 3 (1 TO 18, 33)

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

References:

1. BS : Heat, Thermodynamics and statistical Physics- Brij Lal, Subrahmanyam, Hemne (S. Chand

(Revised Multicoloured Ed. 2007)

2. KK : Material Science – S. K. Kakani and Amit Kakani, New Age International (P) Ltd. – Reprint 2004.

Additional References :

UNIT - I and II:

1. Basic Thermodynamics – Evelyn Guha (Narosa Publications)

2. Thermal Physics - Philip M. Morse (W. A. Benjamin Inc, New Yark)

3. Heat & Thermodynamics – Robert and Miller (E LBS)

4. A treatise of Heat - Saha and Srivastava.

UNIT – III

1. Solid State Physics: Ajay Kumar Saxena. Macmillian India Ltd. (2006 Ed)

2. Material Science: R. S. Khurmi & R. S. Sedha (S. Chand & Co. Ltd.) 5th Rev. & Enlarged Ed-2007.

3. Material Science and Metallurgy – O P Khanna- Dhanpat Rai Publication (XI Reprint)

4. Modern Physics: Hans. C. Chanian – Prentice – Hall of India.

5. Atomic Physics: D S Murty, V. Laxminarayana, Bangar Raju. Tata Mc. Graw Hill Publication co. Ltd.

Revised Practical course: USPHP3: Regular Experiments:

Group A

1 Surface tension by Jaeger's Method.
2 Bar pendulum: determination of g.
3 Resonance pendulum.
4 Y by bending.
5 Searle's experiment : determination of Y and η
6 Logarithmic decrement

Group B

7 CE amplifier: determination of bandwidth
8 CE amplifier : variation of gain with load
9 Wein bridge oscillator (transistorised).
10 Colpitt's oscillator.
11 Half adder and full adder (7486, 7408)
12 Study of MS-JK flip flop and divide by 2 counter.

Group C

13 Bridge rectifier : Ripple , Load regulation. (with and without C filter)
14 Figure of merit of a mirror galvanometer
15 LCR transients
16 C1/C2 by de- Sauty's method
17 Passive low pass filter
18 Passive high pass filter

Skill experiments:

1. Wiring of a simple circuit using bread board
2. Use of oscilloscope
3. Travelling microscope (radius of capillary)
4. Spectrometer: mean μ of yellow doublet of mercury source.
5. Component testing, colour code of resistors, capacitors etc.
6. Drawing of graph on semi logarithmic / logarithmic scale.

Question paper for each course for the semester end examination will consist of four questions, out of which first three questions will be one each on each unit with internal option, fourth question is to be set on all the three units with internal option and should be of objective nature. Each question will be of 20 to 23 marks with internal options. All four questions in a paper are compulsory carrying 60 marks. The duration of each paper will be 2 hours.
For practical examination the learner will be examined in **three experiments** (one from each group). Each experiment will be of one and half hour duration. Minimum **3** from each group and in all minimum **12** experiments and all the skill experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. The learner be evaluated at the time of viva voce on the basis of regular experiments and skill experiments

A learner will be allowed to appear for the semester end practical examination only if the candidate 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.

REFRENCES

1. Advanced course in Practical Physics D. Chattopadhya, PC. Rakshit & B. Saha. (6^{th} Edition) Book & Allied Pvt. Ltd.
2. BSc Practical Physics – Harnam Singh S. Chand & Co. Ltd. – 2001

3. A Text 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 & Co. Ltd.

5. Practical Physics – CL Squires – (3^{rd} Edition) Cambridge University Press.

6. University Practical Physics – D C Tayal. Himalaya Publication.

7. Advanced Practical Physics – Worsnop & Flint.

SYBSc PHYSICS

Semester IV

USPH401: Optics

UNIT I (15 Lectures)

Polarization: Introduction, The wire grid polarizer and a Polaroid, polarization by reflection, polarization by double refraction, Malus' law, Superposition of two disturbances, the mathematical analysis, the phenomenon of double refraction, quarter wave plates and half wave plates.

AG: 19.1, 19.2.1, 19.2.2, 19.2.3, 19.3, 19.4, 19.4.1, 19.5, 19.6.

Unit II (15 Lectures)

Diffraction:

Fresnel's diffraction: Introduction, Huygen's-Fresnel's theory, Fresnel's assumptions, Distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction, diffraction due to single edge, position of maximum and minimum intensity, intensity at a point inside a geometrical shadow, diffraction due to a narrow slit, diffraction due to narrow wire.

Fraunhoffer diffraction: introduction, Fraunhoffer diffraction at a single slit, intensity distribution in diffraction pattern due to single slit, Frounhoffer diffraction due to double slit, distinction between single slit and double slit diffraction patterns, plane diffraction grating, theory of plane transmission grating, width of principal maxima, prism and grating spectra.

SBA: 17.1, 17.2, 17.3, 17.6, 17.7, 17.10, 17.10.1, 17.10.2, 17.11, 17.12, 18.1, 18.2, 18.2.1, 18.4, 18.4.2, 18.7, 18.7.1, 18.7.2, 18.7.8(I to vi)

Unit III (15 Lectures)

Michelson Interferometer: principle, construction, working, circular fringes, localised fringes, Visibility of fringes. Applications of Michelson interferometer, a) measurement of wavelength b) Determination of the difference in wavelengths of two waves c) Thickiness of thin transparent sheet. d) Standardization of metre.

Fabry-Perot interferometer and etalon: Formation of fringes, determination of wavelength, Measurement of difference in wavelength.

SBA: 15.7, 15.7.1 to 15.7.7, 15.8, 15.8.1 o 15.8.3, 15.8.5, 15.12, 15.12. to 15.12.3

Resolving Power: introduction, Raleigh's criterion, resolving power of optical instruments, criterion for resolution according to Lord Rayleigh's, Resolving power of telescope, resolving power of a prism, resolving power of a plane transmission grating.

SBA:19.1, 19.2, 19.5, 19.6, 19.7, 19.11, 19.12.

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

REFRENCES

1. SBA.: A text book of Optics – Subramanyam, Brij Lal, Avadhanulu – S. Chand & Co. Multicoloured Ed. 2007.

2. AG. : Optics – Ajoy Ghatak (3rd Ed) Mc. Graw Hill Co.

USPH402: Electronics

Unit I (15 Lectures)

(Review of CE amplifiers, load line, operating point)

1. Transistor Biasing: inherent variations of transistor parameters, stabilization, essentials of transistor biasing circuit, stability factor, methods of transistor biasing, Base resistor method, biasing with feedback resistor (Collector to base bias), voltage divider bias method, midpoint biasing. Silicon versus germanium.

MM: 12.2, TO 12.10, 12.12, 12.14

2. General amplifier characteristics

Concept of amplification, amplifier notations, current gain, Voltage gain, power gain, input resistance, output resistance Decibels and frequency response: general theory of feedback, reasons for negative feedback, loop gain, practical circuit of transistor amplifier, phase reversal.

AM: 7.1, 7.2, 7.3, 7.4, TO 7.7, 17.1, 17.2, 17.3.

SC: 9.3, 9.4.

MM: 13.4, 13.5.

UNIT II (15 Lectures)

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

AM: 18.0 TO 18.3, 18.5, 18.6

2. Operational amplifiers: symbol, ideal op-Amp, Opamp IC, architecture, Inverting amplifier, Non inverting amplifier, frequency Response and slew rate, Opamp applications: summing amplifier, differential amplifier, integrator, differentiator, emitter coupled differential amplifier.

SC: 11.1 TO 11.5, 11.8.2,11.8.3, 11.9, 11.9.1,11.9.2, 11.9.3, 11.9.4,

MM: 17.1 FOR DIFFERENTIAL AMPLIFIER

Unit III (15 Lectures)

1. Number system: Decimal, binary, hexadecimal number system and their mutual conversions, binary arithmetic, representation of Binary numbers, addition and subtraction using 2's compliment.

2. Implementation of logic circuit from truth tables:

   Sum of products and product of sums method

3. Flip-flop and counters: R-S flip flops, clocked RS flip flop D Flip flop, edge triggered J K flip flop, Master slave flip flop, T flip flop, D Flip flop using JK flip flop, 4 biy binary ripple up counter, 4 bit binary ripple down counter.

SC: 1) 15.3, 15.3.1, 15.3.2, 15.3.4, 15.3.5, 15.3.6

2) 15.7, 15.7.1, 15.7.2.

3) 15.11, 15.11.1, 15.11.2, 15.11.3 TO 15.11.8, 15.12.2

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

References:

1. MM : Principles of Electronics – V. K. Mehta & Rohit Mehta. (S. Chand – Multicoloured illustrative edition)
2. AM : Electronic devices and circuits – An introduction Allan Mottershead (PHI Pvt. Ltd. – EEE – Reprint – 2007)
3. SC : A textbook of electronics – Santanu Chattopadhyay New Central Book Agency. 2006 Ed.
4. M : Electronic principles – A. P. Malvino – TMH (6^{th} Ed.).

Additional references:

UNIT – I: Electronics Fundamental and applications (8^{th} Ed.) D. Chattopadhyay & P. C. Rakshit (New Age International)

Unit-II : Electronic Devices and Circuit theory, Robert Boylestand & Louis Nashelsky (PHI)

UNIT–III : Digital Principles and applications, Malvino and Leach

USPH403: Introduction to Special Theory of Relativity and Wave Mechanics

Unit I (15 Lectures)

Experimental background of special theory of relativity, Galilean transformations, Newtonian relativity, Electromagnetism and Newtonian relativity. Attempts to locate absolute frame: Michelson- Morley experiment, Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction and ether drag hypothesis, Attempt to modify electrodynamics, postulates of the special theory of relativity.

RR: 1.1 TO 1.9

Unit II (15 Lectures)

Quantum mechanics, Wave equation, Schrodinger equation- time dependent form, Linearity and superposition, Expectation values, operators, Schrodinger ewquation- stady state form.

Worked out examples and problems.

AB:5.1 TO 5.7

Unit III (15 Lectures)

Free states: The free particle, potential step, The rectangular potential barrier- the Tunnel effect, Emission of a particle for a radioactive element. Square well potential, free states, Bound states: particle in a box, particle in a rectangular three dimensional box.

Worked out examples and problems.

SPS: 5.1 TO 5.6, 6.1 TO 6.3.

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

References:

1. RR : Introduction to Special Theory of Relativity= Robert Resnick (Wiley Eastern Ltd)

2. SPS: Quantum Mechanics – S P Singh, M K Bagade, Kamal Singh, - S. Chand : 2004 Ed.

3. AB : Concepts of Modern Physics – A. Beiser (6^{th} Ed.) Tata McGraw Hill.

Additional references:

UNIT – II

Special theory of Relativity – A P French – Thomas Nelson and Sons.

Revised Practical course: USPHP4 : Regular experiments:

Group A

1. Optical lever : determination of μ
2. Determination of Couchy's constants.
3. Cylindrical obstacle : determination of λ
4. Fresnel's biprism : determination of λ
5. Resolving power of telescope.
6. Brewster's law : determination of μ

Group B

7. Opamp: inverting amplifier
8. Opamp : noninverting amplifier and voltage follower
9. Opamp : difference amplifier
10. Opamp: integrator
11. Opamp : Differentiator.
12. Passive band pass filter.

Group C

13. Verification of Stefan's law (electrical method)
14. Determination of absolute capacitance using BG
15. High resistance by mirror galvanometer
16. Series Capacitance Bridge.
17. LCR parallel resonance.
18. Verification of maximum power transfer theorem.

Demonstration experiments:

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. Error analysis of a given experiment

6. Wave form generator using Op-amp
7. PC simulations: graph, curve fitting etc.
8. Straight edge Fresnel diffraction
9. Double refraction
10. First order active filter.

REFRENCES

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

Question paper for each course for the semester end examination will consist of four questions, out of which first three questions will be one each on each unit with internal option, fourth question is to be set on all the three units with internal option and should be of objective nature. Each question will be of 20 to 23 marks with internal options. All four questions in a paper are compulsory carrying 60 marks. The duration of each paper will be 2 hours.

For practical examination the learner will be examined in **three experiments** (one from each group). Each experiment will be of **one and half hour** duration. **Minimum 3** from each group and in all minimum **12** experiments and minimum of 4 demonstration experiments are required to be completed compulsorily. Students are required to report all these experiments in the journal. The learner be evaluated at the time of viva voce on the basis of regular experiments and the demonstration experiments.

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

~*~*~*~*~*~*~*~*~*~*~