SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS

FOR

S. Y. B. Sc.

PHYSICS

(With effect from June - 2016)

PHY-231: Waves and Oscillations

Unit - I: Composition of two S. H. M.'s

Composition of two S.H.M.s of equal frequencies along same line of vibration (analytical method only), Composition of two S.H.M.s of equal frequencies acting at right angles (analytical method with different cases), Composition of two S.H.M.'s right angles to each other (time period in the ratio 1:2), Lissajous figures- demonstration by mechanical, optical and electrical methods. **(12P, 12M)**

Unit - II: Free and damped oscillations

Undamped free oscillations, Damped free oscillations, Differential equation of damped harmonic oscillator and its solution- discussion of three different cases, Logarithmic decrement, Energy equation of damped harmonic oscillator, Power dissipation, Quality factor, Application to series L-C-R circuit. **(12P, 12M)**

Unit - III: Forced oscillations

Idea of forced oscillations, Resonance and its types- Mechanical resonance (Barton's pendulum), Acoustic resonance (resonance tube), Electrical resonance (LCR circuit) and Optical resonance (sodium vapour lamp), Differential equation of forced oscillations and its solution, Amplitude of forced oscillations, Amplitude resonance, Sharpness of resonance, Velocity Resonance, Energy in forced oscillations, Power dissipation, Band width and quality factor, Application to series L-C-R circuit. **(14P, 14M)**

Unit -IV: Sound

Sound intensity, Loudness, Pitch, Quality and timber, Acoustic intensity level measurement, Acoustic pressure and its measurement. Classification of sound frequencies, Piezoelectric effect, Magnetostriction effect, Generation of ultrasonic waves by Piezoelectric oscillator (using transistor) and Magnetostriction oscillator (using transistor), Detection of ultrasonics waves, Applications of ultrasonic waves (list only). **(12P, 12M)**

Unit -V: Doppler Effect

Doppler effect, Doppler effect in sound, Expression for apparent frequency (different cases when source, observer and medium are in relative motion), Asymmetric nature of Doppler effect in sound, Doppler effect in light, Symmetric nature of Doppler effect in light, Applications of Doppler effect in sound and light. **(10P, 10M)**

Reference Books:

1. Waves and oscillations- Brijlal and Subramaniyam (Vikas Publishing House)
2. Waves and Oscillations- R.N. Chaudhari, New Age International (Pvt.) Ltd.
3. Conceptual Physics- A. P. Taggarase, Jivan Sheshan (Himalaya Publishing).
4. The Physics of Waves and Oscillations- N. K. Bajaj (Tata McGraw Hill).
5. Oscillations and Waves- B. S. Agarwal (KedarNath, Ram Nath Publishers)
6. Sound- Mee and Heinmann, London Edition

PHY- 232 (A): Electronics- I

Unit - I: P-N JUNCTION: P-N junction diode, formation of depletion layer and barrier potential, I-V characteristics of junction diode, reverse saturation current, reverse breakdown (Zener, Avalanche), Zener diode, equivalent circuit of Zener diode, I-V characteristics of Zener diode, Zener diode specifications (P_{Zmax}, I_Z, Rz, Vz), Symbols and Working Principles of LED and Photodiode. **(12P, 12M)**

Unit - II: RECTIFIERS AND FILTERS: Half wave, full wave and bridge rectifiers, ripple factor for half wave, full wave and bridge wave rectifier, filters: capacitance filter, inductor filter and π filter. Concept of voltage regulation, Zener diode as a voltage regulator. **(8P, 8M)**

Unit - III: BIPOLAR JUNCTION TRANSISTOR: Basic construction of bipolar transistors (NPN and PNP), operation of transistor, transistor circuit configurations (CB, CE, CC), current gains (α, and β) and their interrelationship, input and output characteristics of transistor in common emitter configuration. Transistor biasing: Need of biasing, Different Methods of biasing (only listing), Voltage Divider bias method in detail, dc load line and ac load line. **(12P, 12M)**

Unit - IV: TRANSISTOR AMPLIFIER AND OSCILLATOR CIRCUITS: Transistors Amplifier: Single stage R-C coupled common emitter amplifier, its frequency response characteristics and band width.

Sinusoidal Oscillators: Types of feedbacks, Barkhausen Criterion, Oscillatory circuit (tank circuit), Types of Oscillators (List only), Hartley oscillator, Colpitts Oscillator. **(8P, 8M)**

Unit – V : NUMBER SYSTEMS: Decimal number system, Binary number system, Decimal to binary conversion, Binary to decimal conversion, binary arithmetic,1's and 2's complements, hexadecimal number, hexadecimal to decimal conversion, decimal to hexadecimal conversion, Hexadecimal to binary and Binary to hexadecimal conversion, BCD code. **(8P, 8M)**

Unit - VI : DIGITAL CIRCUITS: Positive and negative logic, OR, AND, NOT logic gates using DTL: Symbol, Boolean Expression and Truth Tables, NAND, NOR and Ex-OR gates, De Morgan's theorems, NAND realization of logic gates, R-S, clocked R-S, D , JK and T flip flops using logic gates. **(12P, 12M)**

Total: (60 Periods, 60 Marks)

REFERENCES:

1) Electronic Principles – A. P. Malvino, Mc Graw-Hill Publishing House
2) Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition
3) Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi
4) Electronic Devices and Circuits – Allen Mottershead, Good year Publishing Company
5) Digital Principles and Applications – Malvino and Leach, Mc Graw-Hill Publication.
6) Modern Digital Electronics – R. P. Jain, Tata Mc Graw-Hill Pvt. Ltd., New Delhi

PHY- 232 (B) - Instrumentation -I

[Note : For students opting electronics as one of the subjects at F. Y. B. Sc. Class]

Unit-I Fundamentals of Measurements :

1.1 : Functional elements of typical measurement system (Block digram only) (R1 : 1.3)

1.2 : Standards of measurements (R1 : 1:6.1) and calibration (R1 : 1:6.2)

1.3 : Static peformance characteristics (R1 : 2.4)

- (a) Accuracy (R1 : 2.4.1)
- (b) Precision (R1 : 2:4.2)
- (c) Accuracy versus precision
- (d) Sensitivity (R1 : 2.4.5)
- (e) Linearity (R1 : 2.4.6)

1.4 : Concept of Errors and their types (R1 : 2.2.1) **(8P, 8M)**

Unit-II Measurement of Temperature :

2.1 : **Non - electrical Methods :**

- (a) Liquid- in-glass Thermometer (R1 : 11.5.2)
- (b) Pressure Thermometer construction and their types (R1 : 11.5.3)
- (i) constant volume gas thermometer and
- (ii) Vapour pressure Thermometer.

2.2 : **Electrical Methods :**

- (a) Metallic resistance Thermometer (Platinum resistance thermometer) (R1 : 11.6.1)
- (b) Semiconductor resistance sensors (Thermistor) (R1 : 11.6.1)
- (c) Thermo-electric Sensors (Thermocouple) (R1 : 11.6.2)

2.3 : **Rediation Methods (Pyrometry) :** (R1 : 11.7) :-

- (a) Total Radiation Pyrometer (R1 : 11.7.1)
- (b) Selective Radiation Pyrometer (R1 : 11.7.2) **(16P, 16M)**

Unit-III: **Measurement of Pressure :**

3.1 : High pressure Measurement (R1 : 10.3)

3.2 : Measurement of low pressure (Vacuum) (R1 : 10.4)

- (a) McLaud Guage
- (b) Pirani Gauge

3.3 : Calibration & Testing (Dead - weight tester) (R1 : 10.5) **(10P, 10M)**

Unit-IV: Measurement of Flow :

4.1 : Classification of flow meters (R2 : 8.2)

4.2 : Expression for rate of flow using Bernoullis theorem (R2 : 8.3)

4.3 : Measurement of flow using :

(a) Venturi tube (R2 : 8.3.2)

(b) Pitot tube (R2 : 8.3.4)

(c) Rotameter (R2 : 8.4) **(10P, 10M)**

Unit-V: Acoustics (Sound) Measurement :

5.1 : Characteristics of sound (R1 : 13.2)

5.2 : Sound pressure level (R1 : 13.3.1)

5.3 : Sound power level (R1 : 13.3.2)

5.4 : Variation of intensity of sound with distance (R1 : 13.3.5)

5.5 : Typical sound measuring system (Sound level Meter) (R1 : 13.5.1)

5.6 : Microphones :

(a) Condenser or capacitor type Microphone (R1 : 13.6.1)

(b) Electret Microphone (R1 : 13.6.2)

(c) Electrodynamic types of Microphone (R1 : 13.6.4)

(d) Carbon granules type Microphone **(12P, 12M)**

Unit-VI: Magnetic Field Measurement :

Measurement of magnetic field by using

(a)search coil method (R3 : 9.9 (a))

(b)Hall gauge meter (R3 : 8.6.11) **(4P, 4M)**

Total : (60 Periods 60 Marks)

Reference Books :

1. R1 : Instrumentation, Measurement & Analysis by (Nakra and Chaudhary), 2nd Edition
2. R2 : Instrumentation : Devices & Systems by (Rangan, Mani & Sarma), 2nd Edition
3. R3 : Electricity and magnetism by D.C.Tayal,3rd Edition
4. R4 : Electricity & Magnetism by Khare & Shrivastav
5. R5 : Modern electronic instrumentation and Measurement Techniques by Helfrick & Cooper.

PHY – 241: Modern Physics

Unit 1: Solar Energy

Energy crisis, conventional and non-conventional energy sources, solar energy option, principle of photothermal conversion, flat-plate collector, liquid flat plate collector: construction, working and energy balance equation only, principle of photovoltaic conversion. solar cell, types of solar cell- Homojuction (PN solar cell), Hetrojunction solar cell (PIN solar cell and MIS solar cell), I-V characteristics of solar cell, Parameters of solar cell, Basic photovoltaic system for power generation, solar cell modules, merits and demerits of photovoltaic solar energy conversion.

(18 P, 18 M)

Unit 2: LASER

Principle of LASER, Characteristics of LASER , Basic staeps required to form a LASER- absorption, spontaneous emission, stimulated emission, Metastable state, population inversion, optical pumping, Types of LASER- Ruby LASER, He-Ne LASER, Applications of LASER (list only), Basic idea of Hologram, construction and reconstruction of Hologram .

(14P, 14M)

Unit 3: Bohr's and Sommerfield theories of hydrogen atom

Introduction of atomic spectra, Inadequacy of classical planetary model of hydrogen atom, Bohr's theory of hydrogen atom, Extension of Bohr's theory, Experimental verification of discrete atomic energy levels, correspondence principle, Bohr's Sommerfield model and relativistic effects, Limitations of quantum mechanical model.

(14 P, 14 M)

Unit 4: Matter Waves

Wave particle duality of matter, de-Broglie hypothesis, Expression for matter waves, Electron diffraction , Davission and Germer experiment, concept of wave group , phase velocity, group velocity, particle velocity and relations between them, Uncertainty principle, Thought experiment (Gamma ray microscope), different forms of uncertainty principle, applications of uncertainty principle (Non existence of electron in nucleus, determination of ground state of electron and size of hydrogen atom).

(14 P, 14 M)

Total: (60 Periods, 60 Marks)

REFERENCES-

1. Solar energy utilization - G. D. Rai (Khanna Publisher,Delhi,1996).
2. Non Conventional energy sources- G. D. Rai (Khanna Publisher, Delhi, 2000).
3. Solar Energy- S.P.Sukhtme (Tata MacGraw Hill).
4. Fundamental of Solar Cell- M.A.Green.
5. Solar energy Fundamentals-H.P.Garge (Tata MacGraw Hill)
6. Modern Physics – B.L.Theraja
7. Elementary Modern Physics A.P.Arya
8. Concept of Modern Physics- Aurther Beiser(3^{rd} edition)
9. Modern Physics – D.L.Sehgal,K.L.Chopraand N.K.Sehagal (S.Chand & sons Pub.)
10. An Introduction to Laser – Theory and applications – M.N.Avadhanale
11. Lasers and nonlinear optics – B.B.Laud

PHY-242: Optics

Unit I: Geometrical Optics : Deviation produced by thin lenses, equivalent focal length of two thin lenses separated by a distance and when in contact. Power of lens, Spherical aberration in lens, reduction of spherical aberration (without derivation),Chromatic aberration, Achromatism; (two lenses in contact and separated by finite distance without derivation).

(10P, 10M)

Unit II: Interference: Intensity distribution in the interference pattern, Phase change on reflection (Stoke's treatment only), Interference due to reflected light in parallel sided thin films, Interference in thin wedge shaped film, fringe width in case of fringes of equal thickness. Newton's rings- experimental setup, theory and its application to determine wavelength of source and refractive index of liquids, Michelson Interferometer (experimental setup and its application for measurement of wavelength of monochromatic source)

(18P, 18M)

Unit III: Diffraction: Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction –Diffraction at single slit and double slits, Theory of plane transmission grating, Intensity distribution in diffraction pattern. Fresnel diffraction, rectilinear propagation of light, Resolving power of grating.

(16P, 16M)

Unit IV: Polarization: Polarization, Polarization by reflection ,Brewster's law, Polarization by double refraction in uniaxial crystals, Maluss Law (Ref. optics by Ajoy Ghatak 4 th edition 22.9) Double refracting crystals, Huygens explanation for normal incidence, Positive and negative crystals, Production and detection of circularly and elliptically polarized light, Construction of Polaroid, Quarter and Half wave plates, Nicol prism, Optical activity, Rotation of the plane of polarization, Specific rotation, Polarimeter or Sacherimeter, (Principle and working).

(16P, 16M)

Total: (60 Periods, 60 Marks)

REFERENCES

1. Optics: N. Subrahmanyam, Brijlal
2. Optics: Jenkins and White .
3. Optics : Singh ,Agrawal
4. Optics : D.S.Mathur.
5. Optics: Ajoy Ghatak.
6. Optics :Eugene Hetch.

PHY 233: PRACTICAL COURSE-I

Note: Students should perform at least **four** experiments from each section

SECTION-I
(GENERAL AND WAVES AND OSCILLATIONS)

1. Determination of the decrement factor by using Logarithmic decrement (in air / water).
2. Study of acoustic resonance by using bottle as a resonator.
3. Determination of velocity of sound by using Kundt's tube.
4. Study of electrical resonance by using series L-C-R circuit.
5. Study of acoustic resonance by using resonance tube.
6. Study of resonance using Kater's pendulum.
7. Comparison of capacities by De Saughty's method.
8. R, Γ, Q using damped harmonic motion.
9. Demonstration of Lissajous figures by using C.R.O.

SECTION-II
(ELECTRONICS)

1. Study of full wave rectifier with capacitor filter and to calculate its ripple factor.
2. Study of zener diode as a voltage regulator.
3. Study of CE transistor characteristics to find out 'β' of the transistor.
4. Study of logic gates (AND, OR and NOT) using diodes and transistors.
5. Verification of De Morgan's Theorems (using ICs).
6. To study the characteristics of Light Emitting Diode (LED).
7. Experimental verification of NAND gate as a universal building block.
8. Experimental verification of NOR gate as a universal building block.
9. To study I – V characteristic of (i) a resistor and (ii) a p–n junction diode and compare it.
10. Frequency response of CE single stage transistor amplifier and to calculate its bandwidth.

OR

SECTION-II
(INSTRUMENTATION-I)

1. Use of C.R.O as a measurement tool for different electrical parameters (frequency, a.c. /d.c.voltage, pulse height, pulse width, rise time and fall time).
2. To obtain Lissajous figures using C.R.O.
3. To determine characteristics of Thermistor and to find an unknown temperature by using thermistor.
4. Measurement of magnetic field by search coil.
5. Measurement of magnetic field by hall probe method.
6. Directional characteristics of a microphone.
7. Platinum resistance thermometer. (Determine the melting temperature of Wax)
8. Velocity of sound by phase shift method.
9. Measurement of Noise by Using Sound Pressure level Meter.

PHY 243: PRACTICAL COURSE-II

Note: Students should perform at least **four** experiments from each section

SECTION-I
(MODERN PHYSICS)

1. Determination of an electronic charge using PN junction diode.
2. Determination of an energy gap of a 'Ge' semiconductor.
3. I-V characteristics of photocell.
4. Determination of Planck's constant by using Photo cell.
5. To verify Inverse square law of light using a photo cell.
6. Determination of Planck's constant by using LED.
7. Comparison of luminous intensities of two light sources by using photo voltaic cell.
8. Determination of efficiency of a Solar cell.
9. Determination of solar constant.

SECTION-II
(OPTICS AND LASER)

1. Determination of the wavelength of a given source of light using Newton's rings.
2. To determine the refractive index of a liquid by using Newton's rings apparatus.
3. Determination of unknown wavelength of source using diffraction grating.
4. Determination of unknown wavelength of given source by Fresnel's biprism.
5. Measurement of beam divergence of a LASER beam.
6. Measurement of wavelength of a LASER beam.
7. Measurement of beam size of a LASER beam.
8. Determination of specific rotation α of optically active substance using Polarimeter.
9. R. I. of prism.
10. Dispersive power of prism.

References for PHY-233 and PHY-243:

1. A text Book of Experimental Physics – Dr. V.Y. Rajopadhye, V.L.Purohit and A. S. Deshpande (Continental Prakashan, Poona-30).
2. AN ADVANCED COURSE IN PRACTCIAL PHYSICS- D. Chattopadhyay and P.C. Rakshit.
3. Practical Physics by R. K. Shukla, Anchal Srivastava (New Age International).
4. B.Sc. Practical Physics by Harnam Singh and Dr. P.S. Hemne (S. Chand).
5. Advance Practical Physics by S.P.Singh (Pragati).
6. College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi)
7. Practical Physics: Gupta and Kumar (Pragati Prakashan Meerat)
8. Advanced Level Practical Physics: J. M.Nelkon, J.M.Ogloom (EIBS)
9. A Text book of practical Physics: Shrinivasan and Balasubranian
10. A Text book of practical Physics: Indu Prakash and Ramkrishna.
11. B.Sc. Practical Physics by C.L. Arora (S. Chand and Co. Ltd , Delhi)
12. Practical Course in Electronics by Prof. J.R.Patil and other (Jaydeep Prakashan).

List of Equivalent courses for S. Y. B. Sc. (Physics):

Old course		Equivalent new course	
PHY-231	Waves and Oscillations	PHY-231	Waves and Oscillations
PHY-232 (A)	Electronics- I	PHY-232 (A)	Electronics- I
PHY-232 (B)	Instrumentation -I	PHY-232 (B)	Instrumentation -I
PHY-241	Modern Physics	PHY-241	Modern Physics
PHY-242	Optics	PHY-242	Optics
PHY-203	Practical course	PHY-233	Practical course-I
		PHY-243	Practical course-II