SKILL ENHANCEMENT COURSES

SYLLABUS FOR THE

SUBJECT: PHYSICS

for the award of the Degree in

BACHELOR OF ARTS/ BACHELOR OF SCIENCE/ HONOURS

(Offered under 4-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

Batch: 2025–29

GURU NANAK DEV UNIVERSITY AMRITSAR

SCHEME

SKILL ENHANCEMENT COURSES

PHYSICS

SEC-I

Sr. No.	Course Code	Course Title	Credits L-T-P	Total Marks
1.		APPLIED OPTICS	3-0-0	75

SEC-II

Sr. No.	Course Code	Course Title	Credits L-T-P	Total Marks
1.		WAVES & VIBRATIONS : THEORY & APPLICATIONS	3-0-0	75

SEC-III

Sr. No.	Course Code	Course Title	Credits L-T-P	Total Marks
1.		NANOSTRUCTURES, NANODEVICES & SPINTRONICS	3-0-0	75

SKILL ENHANCEMENT COURSES

PHYSICS

(SEC-I)

APPLIED OPTICS

(THEORY)

Time: 3 Hrs.

L-T-P
3-0-0
Marks: 75
(3 Hrs./week)
Course Hrs. :45

Note : There should be 20% numericals in each paper.

Instructions for the Paper Setters:-
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION-A

Superposition of light waves and interference, Young's double slit experiment, conditions for sustained interference pattern, coherent sources of light, spatial and temporal coherence, interference pattern by division of wave front, Fresnel Biprism, displacement of fringes, change of phase on reflection, interference in thin films due to reflected and transmitted light, Newton's Rings. Michelson, Fabry Perot and Mach Zehnder Interferometer.

Lectures: 10

SECTION-B

Fresnel's theory of diffraction, half-period zones, Zone plate, distinction between Fresnel and Fraunh offer diffraction. Fraunh offer diffraction at rectangular and circular apertures, Resolving power of telescope in diffraction grating, its use as a spectroscopic element and its resolving power, resolving power of microscope

Lectures 10

SECTION-C

Plane Polarized light, elliptically polarized light, wire grid polarizer, Sheet polarizer, Mauls' Law, Brewester's Law, Polarization by reflection, scattering, double reflection, Nicol prism, Retardation plates, Production Analysis of polarized light, quarter and half-wave plates.

Lectures 10

SECTION-D

Derivation of Einstein relations, concept of stimulated emission and population inversion, broadening of spectral lines, three level and four-level laser schemes, elementary theory of optical cavity, longitudinal and transverse modes. Components of laser devices, condition for laser action, types of lasers, (Ruby and Nd: YAG lasers, He-Ne and CO_2 lasers) construction, mode of creating population inversion and output characteristics, application of lasers –a general outline. Holography and its applications, Optical fibres, design, basic principle, numerical aperture, applications of fibres in optical communication. **Lectures: 15**

Books Suggested:-

1. Fundamentals of Optics, F. Jenkins and H. E. White, John Wiliey & Sons
2. Optics, Ajoy K. Ghatak, McMillan India
3. Optical Electronics, K. Thyagrajan and Ajoy K. Ghatak, Cambridge University Press
4. Principles of Optics: Max Born and E. Wolf, (Pergamon Press) 3rd Edition, 1965.
5. Laser Fundamentals: W.T. Silfvast (Foundation Books), New Delhi, 1996.
6. Laser and Non-Liner Optics: B.B. Laud (New Age Pub.) 2002
7. Laser: Svelto, Plenum Press, 3rd Edition, New York

SKILL ENHANCEMENT COURSES

PHYSICS

(SEC-II)

WAVES & VIBRATIONS : THEORY & APPLICATIONS (THEORY)

Time: 3 hrs.

L-T-P
Credits : 3 -0 -0
M. Marks: 75
(3 hrs./week)
Course Hrs. : 45

Note : There should be 20% numericals in each paper.

Instructions for the Paper Setters:-
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION–A

Simple harmonic motion, Energy of a Simple harmonic oscillator, Compound pendulum, Torsional pendulum, Electrical Oscillations, Transverse vibrations of a mass on string, Superposition of two perpendicular SHMs having periods in the ratio 1:1 and 1:2.

10 Lectures

SECTION–B

Decay of free vibrations due to damping, Differential equation of damped Harmonic motion, Types of motion, Types of damping, Determination of damping co–efficient–Logarithmic decrement, Relaxation time and Q–Factor, Electromagnetic damping (Electrical oscillator, Eddy currents)

10 Lectures

SECTION–C

Differential equation for forced mechanical and electrical oscillators, Transient and steady state behaviour, Displacement and velocity variation with driving force frequency, Variation of phase with frequency, Resonance, Power supplied to an oscillator and its variation with frequency, Q–value and band width, Q–value as an amplification factor, Stiffness coupled oscillators, Normal co–ordinates and normal modes of vibration, Inductive coupling of electrical oscillators.

10 Lectures

SECTION–D

Types of waves, Wave equation (transverse) and its solution, Characteristic impedance of a string, Impedance matching, Reflection and Transmission of waves at a boundary, Reflection and transmission of energy, Reflected and transmitted energy coefficients, Doppler effect in sound, Sound waves in gases.

Ultrasonics: Ultrasonic waves, Properties of ultrasonic waves, Production of ultrasonic waves: magnetostriction method, its merits and demerits, Piezoelectric method and principle of inverse piezoelectric effect; Detection of ultrasonic waves: Quartz Crystal Method, Thermal Detection Method, Sensitive Flame Method, Kundt's Tube Method; Applications of ultrasonic waves in science, engineering and medical field.

Basic concepts of communication systems, need for modulation, amplitude modulation and demodulation, frequency modulation and demodulation

15 Lectures

Books Suggested:

1. Electronics Communication Systems–George Kennedy (TMH), Reprint 2005.
2. Physics of Vibrations and Waves by H.J. Pain.
3. Fundamentals of Vibrations and Waves by S.P. Puri
4. Fundamentals and Applications of Ultrasonic waves by J. David and N. Cheeke, CRC Press.
5. Fundamentals of Acoustic Waves and Applications, Sanchiro Yoshida, Springer

SKILL ENHANCEMENT COURSES

PHYSICS

(SEC-III)

NANOSTRUCTURES, NANODEVICES & SPINTRONICS

(THEORY)

Time: 3 Hrs.

L-T-P
3-0-0
Marks: 75
(3 Hrs./week)
Course Hrs. :45

Note : There should be 20% numericals in each paper.

Instructions for the Paper Setters:-
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

SECTION–A

Introduction to nanomaterials and nanostructures, quantum dots, quantum wires, and quantum wells, quantum size effect on melting point and optical properties of semiconductors, Confinement, and electron transport in nanostructure, conductance formula for nanostructures, quantized conductance. density of states and Fermi energy for 1D, 2D and 3D electron gas. Ballistic transport, Coulomb blockade.

Lectures: 10

SECTION–B

Preparation of Carbon Nano-Tubes ; CVD and other methods of preparation of CNT, Properties of Carbon Nanotubes; Electrical, Optical, Mechanical, Vibrational properties etc. Graphene-preparation, characterization and properties.
Quantum structures and Devices; quantum layers, wells, dots and wires, mesoscopic devices, nanoscale transistors, single electron transistors, MODFET, MOSFET & NanoFET, Resonant Tunneling Devices,

Lectures 10

SECTION-C

Micro and nano-sensors ; fundamentals of sensors, biosensor, micro fluids, MEMS and NEMS, packaging and characterization of sensors, methods of packaging at zero level, dye level and first level.
Sensors ; sensors for aerospace and defense, accelerometer, pressure sensor, night vision system, nano tweezers, nano-cutting tools, integration of sensor with actuators and electronic circuitry, sensor for bio-medical applications: cardiology, neurology and as diagnostic tool, other civil applications: metrology, bridges etc.

Lectures: 15

SECTION-D

Spintronics Introduction, Overview, History & Background, Generation of Spin Polarization; theories of spin injection, spin relaxation and spin dephasing, Spintronic devices and applications, spin filters, spin diodes, spin transistors.

Lectures 10

Books Suggested:

1. Nanoscale Materials - Liz Marzan and Kamat - Springer - 2003.
2. Synthesis functionalization and surface treatment of nanoparticles - Marie Isabelle Baraton - American Scientific Publishers - 2003
3. Physical properties of Carbon Nanotube-R. Saito, G. Dresselhaus, and M. S. Dresselhaus - Imperial College Press - 1998
4. Applied Physics Of Carbon Nanotubes : Fundamentals Of Theory, Optics And Transport Devices S. Subramoney & S.V. Rotkins - Springer - 2005
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell - CRC Press - 2006
6. Carbon Nanotubes- Liming Dai – Elsevier - 2006
7. Nanotubes and Nanowires- CNR Rao and A Govindaraj - Royal Society of Chemistry - 2005
8. Springer Handbook of Nanotechnology - Bharat Bhusan – Springer - 2004
9. Handbook of Semiconductor Nanostructures and Nanodevices Vol 1-5-A. A. Balandin - K. L. Wang - American Scientific Publishers - 2006
10. Nanostructures and Nanomaterials - Synthesis, Properties and Applications- Cao, Guozhong - Imperial College Press - 2004
11. Concepts in Spintronics – Sadamichi Maekawa - Oxford University Press - 2006
12. Spin Electronics – David Awschalom – Springer - 2004
13. Quantum Transport: Atom to Transistor-Supriyo Datta - Cambridge University Press - 2005
14. Nanoplasmonics, From Fundamentals to Applications Vol. 1 & 2 - S. Kawata & H. Masuhara - Elsevier - 2004
15. Enabling Technology for MEMS and nano devices - H. Baltes, O. Brand, G. K. Fedder, C. Hierold, J. G. Korvink, Dr. O. Tabata (Editors) - WILEY-VCH Verlag GmbH & Co. - 2004
16. Optimal Synthesis Methods for MEMS - G. K. Ananthasuresh (Editor) - Kluwer Academic Publishers – 2003
17. Quantum Transport: Atom to Transistor - SupriyoDatta- Cambridge University Press - 2005
18. Physics of Low Dimensional Semiconductors - John H. Davies- Cambridge University Press -1998