ST. JOSEPH'S COLLEGE (AUTONOMOUS)

BENGALURU-27

Re-accredited with **'A++' GRADE with 3.79/4 CGPA** by
NAAC Recognized by UGC as College of Excellence

DEPARTMENT OF PHYSICS

Curriculum for B.Sc.

as per

NEP- 2020

SYLLABUS FOR I and II semester
UNDERGRADUATE PROGRAMME

2021-2022 Onwards

Curriculum Structure

Semester	Title	
	Major: Paper Code-Discipline Core	**OE/DSE**
I Semester	DSC 1: PH121-Mechanics & Properties of Matter	PHOE1.1 Astronomy – the evolving universe PHOE1.2 Medical Physics DSE1: -
II Semester	DSC 2: PH221-Electricity and Magnetism	PHOE2.1 Wonders of Physics PHOE2.2 Physics of Nanomaterials DSE2:
III Semester	DSC 3: PH321-Oscillations, Waves and Optics	PHOE3.1 Energy Resources PHOE3.2 Introductory Nanotechnology DSE3:
IV Semester	DSC 4: PH421-Thermal Physics and Electronics	PHOE4.1 Introductory Nanotechnology PHOE4.2 Physics of Sports DSE4:
V Semester	DSC 5: PH5118-Electronics and Relativity DSC 6: PH5218-Quantum Mechanics, Atomic and Molecular Physics	(Any two)
VI Semester	DSC 7: PH6118-Solid state and Statistical Physics DSC 8: PH6218-Astronomy, Astrophysics and Nuclear Physics	(Any two)

DSC: Discipline Core (Major)

OE: Open Elective (Open for all the streams)

DSE: Discipline Elective (Optional for I and II Semester)

Course Outcomes and Course Content

Semester	III
Paper Code	**PH321**
Paper Title	**Oscillations, Waves and Optics**
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the Paper:

To make the students understand and learn the basic concepts of Physics in detail which makes a firm basis for the advanced topics taught in higher semesters. The paper gives a detailed overview of Waves and Oscillations, Simple Harmonic Motion of Waves. It also provides an overview on light wave phenomena such as Interference, Diffraction and Polarisation which are the basic building blocks for understanding and designing Fiber Optic devices and Lasers.

Semester- III

PH321: OSCILLATIONS, WAVES AND OPTICS

Unit I **(10 Hours)**

Simple Harmonic Motion: Definition of Simple harmonic motion, Differential equation of simple harmonic motion, Solution of differential equation. Simple harmonic motion as a projection of circular motion, velocity and acceleration of a particle having simple harmonic oscillation, Energy conservation in SHM, Angular SHM. Composition of two SHM's - Lissajou's figures. Equation of motion of Damped harmonic oscillation – critical damping, under damping and over damping (qualitative). Concept of coupled oscillator.
Self-Study. Forced oscillation – concept of resonance. **(1 hour)**

Unit II **(08 Hours)**

Wave Motion: Characteristics of wave motion, progressive wave equation- differentforms of wave equations, differential equation of wave motion. - phase of the wave-relation between phase difference and path difference. Dispersive and non-dispersive medium. Energy transmitted by a wave,Intensity and Power transmitted by a sine wave, superposition of waves-concept of phase

velocity, group velocity, and the relation between them, Derivation of Vg=dw/dk.Fourier theorem, Fourier series, Evaluation of the Fourier coefficients, Fourier analysis of a square wave. (If square wave is above or below the X-axis should be mentioned clearly)

Self-study - Superposition of waves- beats. **(1hour)**

Text Book: Undergraduate Physics Volume II – A. B. Bhattacharya

UNIT III **(07 Hours)**

Various theories of light, Huygens' principle and construction of wave front. Theory of interference- conditions for sustained interference. Fresnel's Biprism-distance between two virtual sources by shift method, effect of thin film in one of theinterfering beams. Interference at thin films (reflected system), theory of interference at a wedge and theory of Newton's rings. **Self-study:** Young's double slit experiment. **(1 Hour)**

Unit IV **(09 Hours)**

Fresnel and Fraunhofer diffraction, Fresnel half period zones-rectilinear propagation of light, Zone plate – construction and theory, comparison of a zone plate with a convex lens. Cylindrical wave front-half period strips, theory of diffraction at a straight edge, Fraunhofer diffraction -theory of single slit diffraction, theory of grating - oblique incidence, normal incidence.

Self-study: Discussion of dispersive power - Grating, Rayleigh's criterion for resolution, resolving power of a grating (no derivation) **(1 hour)**

Original paper of Sir. C.V. Raman on oblique incidence

Unit V **(07 Hours)**

Review of Polarization of light and methods of polarization, plane of polarization, Polarization by reflection-Brewster's law, Malus' law with proof. Huygens' theory of double refraction in uniaxial crystal (mention as- Normal incidence, optic axis being perpendicular to the paper) birefringence, theory of retarding plates, quarter & half wave plates. production and detection of plane, circularly and elliptically polarized light, Optical activity, specific rotation, Fresnel's theory of optical rotation.

Self-study: Applications of polarized light, Polaroid, optical isolator **(1 hour)**

Unit VI **(06 Hours)**

General principles - Spontaneous and stimulated emission, Einstein's A and B coefficients, monochromaticity, coherence and directionality, spatial and temporal coherence, spectral energy density, Condition for laser action - population inversion, metastable states, optical pumping, lasing and active systems. Construction and working- Ruby laser and He- Ne laser with energy level diagrams.

Self-study: Applications of lasers, organic dye lasers **(1 Hour)**

Unit VII **(05 Hours)**

Fibre optics: Description of optical fibre – principle and construction, Types of optical fibre (w.r.t refractive index) -single mode and multi-mode - step index mode and graded index mode Expressions for acceptance angle and numerical aperture (NA), Fractional index change (Δ) and relation between NA and Δ, Modes of propagation, (Qualitative) V-number. Mechanisms of energy loss in optical fibre, attenuation.
Self-study: Applications of optical fibre - communication and medical field. **(1 Hour)**

Course Outcomes

At the end of this course, students will be able to

- Study and analyze basic properties of waves and oscillations.
- Recognize the general wave motion and its properties
- Identify the importance of Fourier theorem and series and its applications
- Understand the wave nature phenomena of light.
- Describe the behavior of basic fiber optic devices
- Understand the properties of Lasers
- Study to construct the laser and fiber optic devices.
- Explain the characteristics and applications of Optical fibers and Lasers..

Reference Books:

1. Oscillations & waves – D.P.K. Hadelwal, Himalaya Publishing house.
2. Oscillations & Waves – Brijlal & Subramanyam, S Chand & co.
3. Concepts of Physics Vol.I – H.C. Verma , Bharathibavan Publications- Delhi.
4. Mechanics by Berkley Physics Course Vol I, Mittal, Knight & Rudermann, TMH- Delhi, 1981.
5. University Physics – F. W. Sears and Zemansky & H.D. Young – Narosa Publications – New Delhi.
6. Fundamentals of Physics, 6th Edition – Resnick, Halliday & Walker – Asian Books Pvt Ltd-New Delhi, 5th Edition.
7. Optics & Spectroscopy by Murugeshan S. Chand and Co. Ltd 2008.
8. Optics by D. N. Vasudeva, S. Chand and Co.Ltd
9. Optics by Ajoy Ghatak and Thyagarajan, Tata-McGraw-Hill Education Pvt Ltd, 4th Edition, 2006.
10. Optics by Khanna and Gulati, S. Chand and Co. Ltd. 1985.
11. Optics by Brijlal and Subramanyam S. Chand and Co. Ltd. 2012.
12. Lasers and Fiber Optics by B.B. Laud.
13. Engineering Physics by R.K. Gaur and S.L. Gupta, Dhanpat Rai Publicaitons.
14. Undergraduate Physics by A.B. Bhattacharya and R. Bhattacharya.
15. Engineering Physics by S. B. Bhasavaraju.
16. Waves and oscillation by A.P.French

PH3P1: PHYSICS PRACTICAL

PH 3P1: Practical **(11 sessions 4 hours/week)**

List of experiments

1. Air Wedge – determination of thickness of a wire.
2. Newton's rings – determination of radius of curvature of a plano-convex lens
3. Diffraction grating- determination of wavelengths of spectral lines in normal incidence position.
4. Diffraction grating- determination of wavelengths of spectral lines in minimum deviation position.
5. Focal length of combination of lenses
6. Polarimeter-determination of specific rotation of sugar
7. Measurement of numerical aperture and attenuation coefficient of an optical fiber.
8. Wavelength of laser using grating.
9. Determination of acceleration due to gravity using spring mass oscillator.
10. Coupled Oscillators – determination of period for normal modes and frequency of energy transfer.
11. Melde's experiment -Determination of frequency in transverse and longitudinal mode.
12. Fourier analysis

PHOE5- OPEN ELECTIVE-V

ENERGY RESOURCES/ NON-CONVENTIONAL ENERGY RESOURCES

Prerequisite: I B.Sc. **Total hours: 45**

Course Title: **Energy Resources**	Course Credits: 3
Total Contact Hours: 39	Self-study Hours: 6
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Duration of ESA: 1 Hr 30 min	

The objective of the course: Students be able to

1. Get an introduction to the renewable energy resources – Sun, Wind, Biomass and Geothermal heat.

2. introduce the fundamental physical processes governing various non-conventional energy technology and applications.

3. stresses scientific understanding, analysis and applications of non-conventional energy technology.

4. understand that these sources can play a very important supportive role in addition to conventional energy resources.

5. understand the energy planning, policy making and consumption.

SYLLABUS

1. **INTRODUCTION TO ENERGY SCIENCE AND TECHNOLOGY**
   Classification of Energy resources –common forms of energy-its merits and demerits-importance of non-conventional energy sources – and its salient features –Global Energy Scenario: availability of energy: conventional and non-conventional resources – Energy scenario in India – availability of energy: conventional and non-conventional resources**. (Hours 5)**
   Applied thermodynamics: important terms and definitions-Laws of thermodynamics and its limit – power cycles: Carnot, Brayton and Stirling cycles- its comparison. **(Hours 2)**

2. **SOLAR ENERGY**
   Sun and Earth- its radiation spectrum- Extra-terrestrial and terrestrial radiations- spectrum power distribution of solar radiation – Depletion of solar radiation – measurement of solar radiation: pyranometer- pyrheliometer & Sunshine recorder –solar radiation data- solar

time(LAT) – Solar radiation geometry- solar day length – Extraterrestrial radiation on inclined surface -Solar radiation on inclined plane surface. **(Hours 7)**

3. WIND ENERGY

Origin of winds-nature of winds-estimation of wind energy at a site-applications of wind power. Wind turbine aerodynamics – Wind turbine types and its constructions-conversion system and energy storage- wind energy program in India.

Basic Fluid Mechanics: Elementary fluid flow – stream line and turbulence. **(Hours 6)**

4. BIO-MASS ENERGY

Photosynthesis – Biomass forms, composition and fuel properties – Biomass resource-conversion methods- Urban waste to energy conversion-Biomass gasification – Biomass liquification – Biogas production from waste biomass- Various biogas models .**(Hours 7)**

5. GEOTHERMAL ENERGY

Introduction of geothermal energy and its applications – types of geothermal resources – mathematical analysis of geothermal resources – Exploration and its development – Geothermal energy in India. **(Hours 6)**

6. OCEAN ENERGY

Tidal Energy: Origin- Limitations and technology – tidal range power-ocean tidal energy conversion scheme-Environmental impact.

Wave Energy: Power in waves – its technology- Environmental impact.

Ocen thermal Energy: Origin and characteristics- conversion technology-Environmental impact. **(Hours 6)**

7. ENERGY TECHNOLOGIES AND ITS STORAGE

Energy Technology: Introduction -Fuel Cell – Hydrogen as Energy Carrier - Thermoelectric power conversion- Magneto Hydrodynamic power conversion – Thermionic power conversion.

Energy storage: Its necessity- specifications – energy storage devices. Storage methods: mechanical, Electrochemical (secondary battery storage), Chemical (hydrogen and reversible chemical storage), Electromagnetic (Superconducting Magnetic Energy storage), Electrostatic (supercapacitors), thermal (sensible and latent heat storage) and biological energy storage methods. **(Hours 7)**

TEXT BOOK:

1. Non-conventional Energy Resources by B.H.Khan.

REFERENCE BOOK:

1. Non-conventional Energy Resources by G.D. Rai.
2. Renewable Energy Resources by John Twidell and Tony Weir.

3. Non-conventional Energy Resources by G.S. Sawhney.
4. Non-conventional Energy Resources by Shobh Nath Singh.
5. Energy and Society: an introduction by Schobert and Harold H.

PHOE6 & PHOE 7- OPEN ELECTIVE-VI

INTRODUCTORY NANOTECHNOLOGY

Note: This OE paper is approved by the BOS members, however it needs some revision as suggested by members.

Prerequisite: I B.Sc. **Total hours: 45**

Course Title: Introductory Nanotechnology	Course Credits: 3
Total Contact Hours: 39	Self-study Hours: 6
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Duration of ESA: 1 Hr 30 min (or) 2 Hr	

The objective of the course: Students be able to

1. understand the basics of Nanoscience and Nanotechnology.

2. identify 0D, 1D, 2D and 3D nanomaterials.

3. know various synthesis techniques available for nanostructured materials.

3. recognize the role of nanotechnology in electronics and medicine.

SYLLABUS

1. **INTRODUCTION TO NANOMATERIALS**
   Basic concepts of nano materials – Density of states of 1,2 and 3D - quantum well, wire, dot-Schrodinger wave equation for quantum wire, Quantum well, Quantum Dot-Formulation of super lattice- Quantum confinement- Quantum cryptography. **(Hours 9)**

2. **FABRICATION OF NANOSCALE MATERIALS**
   Top-down versus Bottom-up –Thin film deposition -Epitaxial growth -CVD, MBE, plasma - Lithographic, photo, e-beam - Etching -Synthesis -Colloidal dispersions - Atomic and molecular -manipulations –Self-assembly -Growth modes, Stransky-Krastinov etc –Ostwald ripening. **(Hours 9)**

3. **ELECTRICAL AND MAGNETIC PROPERTIES**

Electronic and electrical properties-One dimensional systems-Metallic nanowires and quantum conductance -Carbon nanotubes and dependence on chirality -Quantum dots – Two dimensional systems -Quantum wells and modulation doping -Resonant tunnelling – Magnetic properties Transport in a magnetic field - Quantum Hall effect. -Spin valves - Spin-tunnelling junctions -Domain pinning at constricted geometries -Magnetic vortices. **(Hours 10)**

4. MECHANICAL AND OPTICAL PROPERTIES

Mechanical properties hardness – Nano indentation - Individual nanostructures -Bulk nanostructured materials-Ways of measuring- Optical Properties-Two dimensional systems (quantum wells)-Absorption spectra -Excitons - Coupled wells and superlattices -Quantum confined Stark effect. **(Hours 8)**

5. NANODEVICES

Background -Quantization of resistance -Single-electron transistors - Esaki and resonant tunneling diodes -Magnetic Nanodevices -Magnetoresistance –Spintronics- MEMS and NEMS. **(Hours 9)**

REFERENCE BOOK:

1. Introduction to Nanotechnology, Charles P. Poole, Jr. and Franck J. Owens, Wiley 2004.
2. Silicon VLSI Technologies, J.D. Plummer, M.D. Deal and P.B. Griffin, Prentice Hall, 2000.
3. Introduction to Solid State Physics, C. Kittle, a Chapter about Nanotechnology, Wiley, 2004.
4. Quantum Well, Wire and Dot: Theory and Applications, Paul Harrison, John Wiley & Sons, (2005).

Course Outcomes and Course Content

Semester	IV
Paper Code	**PH421**
Paper Title	**Thermodynamics and Electronics**
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the Paper:

To make the students understand and learn the basic concepts of Thermodynamics and Electronics in detail which makes a firm basis for the advanced topics taught in higher semesters. The paper gives a detailed overview of Thermodynamics and Electronics with real time applications. It also provides an overview on semiconductor devices such as semiconductor diodes, BJT, FET, OPAMs and Oscillators which are the basic building blocks for understanding and designing integral parts on devices.

PH421: THERMAL PHYSICS AND ELECTRONICS

Unit I **09 Hours**

Kinetic theory of gases: Assumptions of kinetic theory of gasses, Deduction of the pressure of an ideal gas, Deduction of Boyle's law, Charles's law & Avogadro's law from kinetic theory, Maxwell's velocity distribution (Graph & interpretation without derivation), Definition & expressions for rms, mean & most-probable velocity. Degrees of freedom, Principle of equipartition of energy, ratio of specific heat capacity for mono-atomic, di-atomic & tri-atomic gas. Mean free path (Derivation). Transport phenomenon – derivation of coefficient of viscosity.
Self-study: Coefficient of thermal conductivity **(1Hour).**

Unit II **07 Hours**

Thermodynamics: Zeroth law, First law of thermodynamics, Concept of internal energy, Different types of thermodynamic processes – isothermal, adiabatic, isobaric & isochoric. Derivation of PV^{γ} = constant. Work done during isothermal & adiabatic changes.

Carnot cycle, Carnot engine – efficiency, Carnot's theorem (No proof only statement & explanation). Concept of absolute zero, Entropy & second law of thermodynamics. Expressions for change of entropy- for phase transition and change in temperature. Statement of Clausius

inequality, T-S diagram & its use to find the efficiency of Carnot cycle. Third law of thermodynamics.
Self-study: Reversibility of Carnot engine – refrigerator, coefficient of performance. **(1 Hour)**

Unit III **06 Hours**

Thermodynamic potentials: Internal energy, enthalpy, Helmholtz free energy, Gibbs free energy & their significance, Maxwell's thermodynamic relations from thermodynamic potentials & their significance. Application of Maxwell's thermodynamic relation – nature of variation of internal energy with volume, Clausius – Clayperon's equation.
Self-study: Application of Maxwell's thermodynamic relation - difference between the specific heat capacities for ideal gases & real gases. **(1 Hour)**

Unit IV **04 Hours**

Real gases & Liquefaction of gases: Andrew's isothermal curves for real gases, Vander Waals' equation critical constants (Definition & derivation). Joule Thomson expansion- porus plug experiment with theory.
Self-study: Difference between Joule Thomson expansion & adiabatic expansion, adiabatic de-magnetization. **(1 Hour)**

Unit V **06 Hours**

Semiconductor diodes: p-n junction, forward and reverse bias. Rectifiers – half wave and full wave with input and output waveforms, expression for ripple factor and efficiency, capacitor filter. Zener diode-characteristics and application as a voltage regulator-load and line regulation.
Self-study: Bridge rectifier- ripple factor, efficiency **(1 hour)**

Unit VI **12 Hours**

Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET)
BJT- Construction and basic action, Configurations (CB, CE and CC). Definition of α, β and their relations. Input, output and transfer characteristics of CE mode. Comparison between CB, CE, and CC mode. CE mode - leakage current and thermal runaway. Biasing methods – base biasing and voltage divider biasing. DC load line, operating point (Q point). Transistor as an amplifier: CE amplifier– working, gain and frequency response, CC amplifier - applications.
FET- Construction and working, Static Characteristics, Shockley's equation. Drain characteristic and transfer characteristic. FET parameters. FET amplifiers.
Self-study- Comparison between BJT and FET. Transistor as a switch MOSFET **(2 Hours)**

Unit VII **08 Hours**

Operational Amplifiers, Oscillators

Operational Amplifier - Characteristics of an ideal op-amp. CMRR, slew rate. Concept of virtual ground. Inverting and non-inverting operational amplifiers - expression for gain. Operational amplifier as adder, subtractor, integrator and differentiator.

Oscillators - Concept of positive and negative feedback. Barkhausen criterion for an oscillator. RC and LC oscillations. RC oscillator - Wien bridge oscillator, Phase shift oscillator. LC oscillator – Hartley Oscillator and Colpitt oscillators – Construction, working, expression for frequency (no derivation), applications.

Self-Study- Operational amplifier as comparator. **(1 hours)**

Reference books:

1. Physics for Degree students (BSc First year)- C. L Arora, Dr. P. S. Hemne S. Chand & Company 2nd revised edition -2013
2.Heat and Thermodynamics – D. S. Mathur – S Chand & Co, New Delhi 5th Edition (2004).
3. Heat Thermodynamics and Statistical Physics – Brijlal Subramanyam & P.. Hemne, S Chand & Co.
4. Heat and Thermodynamics – J.B Rajam
5. Heat and Thermodynamics - M.W. Zemansky, Richard H. Dittman
6. Thermodynamics -Enrico Fermi
7. Why are Things They are? (Vignettes of Physics) - G. Venkataraman
8. Electronic devices and circuit theory – Robert Boylsted
9. Electronic principles – A.P Malvino
10.Principles of electronics- A.P.Malvino (Mc Graw-Hill Pub.)
11. Electronic devices and circuits- Millman and Halkias (Mc Graw-Hill Pub.)
12. OP AMP and linear integrated circuits-Gayakwad (Pearson Education)
13. Basic electronics – B.L.Theraja (S. Chand& Company Ltd)
14.Basic Electronics - B.L.Theraja, S.Chand and Co. Ltd. 2008.

PH4P1 PHYSICS PRACTICAL

PH 4P1: Practical **(11 sessions 4 hours/week)**

List of experiments

1. Transistor Characteristics-CE Mode
2. Transistor Amplifier – CE mode and CC Mode
3. FET Characteristics
4. FET amplifier
5. OP AMP- Inverting & Non-inverting amplifiers
6. Wien bridge oscillator
7. Half-wave and Full-wave rectifiers – determination of ripple factor and percentage of regulation with and without filter.
8. Zener diode characteristics – study of characteristics and voltage regulation.
9. Determination of specific heat of water by Joule's calorimeter.
10. Determination of Thermal conductivity of rubber.
11. Determination of Thermal conductivity of a bad conductor.

PHOE8- OPEN ELECTIVE-VIII

PHYSICS OF SPORTS

Prerequisite: I B.Sc. **Total hours: 45**

Course Title: Physics of Sports	Course Credits: 3
Total Contact Hours: 39	Self-study Hours: 6
Formative Assessment Marks: 40	Summative Assessment Marks: 60
Duration of ESA: 1 Hr 30 min (or) 2 Hr	

The objective of the course: Students be able to

1. Understand the fundamental scientific concepts of body mechanics.
2. Discover several physics aspects in running and jumping body dynamics
3. Understand numerous physics principles and how to use them effectively in tournaments
3. Recognize the importance of physics in gymnastics and adventure sports.

SYLLABUS

Unit – I : **Introduction:**

Distribution of mass in Human body – forces in muscles and bones – elastic properties – work, energy and power of the body – sizes – strength and food requirements – calculation of calorific content needed for each sports person. **(8 Hours)**

Unit – II : Running and Jumping :

Basic ideas about distance – velocity and speed –acceleration, acceleration due to gravity – angular distance , speed and angular acceleration. Analysis Of Track Techniques: Starting, running, hurdling, stride length, frequency, sprint length, frequency and sprint start. Analysis Of Field Techniques: Standing broad jump, running broad jump, pole vault-techniques involved-guiding principles–(video demonstration of track and field events and the techniques). **(8 Hours)**

Unit – III : **Bats and Balls Linear Kinetic :**

Inertia-mass –force-momentum – Newton's laws of motion – friction – impulse – impact – oblique impact – elasticity – impact on fixed surface, moving bodies. Analysis Of Cricket / Base Ball: Impact – moment of inertia – spin – size of the ball-size of the bat – batting – stride

– swing – bunting. Analysis Of Tennis Techniques: Grip- striking – serve – direction of flight of ball – guiding principles (video demonstrations of the above events). **(9 Hours)**

Unit – IV: Different Projectiles in Sports:

Projectiles – horizontal and vertical motion- range of projectile – trajectory – Analysis of throwing events: techniques involved in speed of release, angle of release and reverse in shot-put, discus, javelin and hammer throw-analysis of broad jump-basketball shooting and football kicking (video demonstration of projectiles in sports) – guiding principles – analysis of basketball techniques: Dribbling and passing. **(10 Hours)**

Unit – V: **The Gymnastics and Adventure Sports:**

Eccentric force-moment – equilibrium – centre of gravity – weight – rotator and circular motion – Analysis of Gymnastics activities: Techniques of lift-rotation-take off – landing for long horse vault, parallel bar etc., - Analysis of rope climb, tight rope walking, skipping – car race, boat race, cycle race – guiding principles (video demonstration). Swimming And Diving: Basic ideas of flotation – buoyant force – centre of buoyancy – specific gravity - relative motion – fluid resistance – conservation of momentum – Analysis of swimming techniques – starting – racing – turn different strokes – diving techniques (video demonstration) Other Factors Influencing Performance: Air resistance – spin or gyration – available force – human characteristics – effects of gyroscopic action – guiding principles. **(10 Hours)**

REFERENCE BOOK:

1. The Biomechanics of Sports Technique, Third Ed. Hay. G. James – Relevant portion of Chapter 3 to 10 & 12, 13 to 17.
2. Scientific Principles of Coaching, Second Ed. – Relevant portion of chapters, 5,7 to 14, 16 to 18.
3. General Physics with Bioscience Essays, Marion and Noryak, Second Ed, - Chapter 1.2, 2.5, 2., 3.4, 4.2, 5.3, 7.3.

Question Paper Pattern

Exam duration: 3hrs
Total marks : 100

Part A	MCQ (Answer all the following)	1*20 = 20
Part B	Descriptive (Answer any 5 out of 7)	12*5 = 60
Part C	Numerical (Answer any 5 out of 7)	4*5 = 20
	Total	100

*Note: 100 will be converted to 60