Quaid-i-Azam University
Department of Physics

Syllabus For M.Phil./Ph.D AdmissionTest

The entry test for M.Phil/Ph.D admission in the Department of Physics, Quaid-i-Azam University mainly covers the following areas of Physics. This document contains the course syllabus for test. The syllabus contains the main topics and recommended books[*] that may help students.

[*]Students may cover the syllabus from any relevant book.

Classical Mechanics

Contents	Recommended Books
Motion in two dimensions, Projectile motion, Particle in uniform and non-uniform circular motion, Tangential and Radial acceleration. Laws of motion and their applications. Forces of Friction. Newtonian mechanics of single particle, Inertial frames and Equation of motion for particles.	Ch 4,5,6: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Cha2: *Classical dynamics of particles and systems by Marian, Thornton, 5th Edition*
Conservation of energy and linear momentum, Collisions in one and two dimensions, Equilibrium and stability. Newton's Law of universal gravitation, Kepler's Laws and the Motion of planets, Energy considerations in planetary and satellite motion	Ch 7, 8, 9, 12, 13: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch 2: *Classical dynamics of particles and systems by Marian, Thornton, 5th Edition*
Rotation of a rigid object about a fixed axis, Angular position, velocity, and acceleration, Torque, Rigid object under a net torque, Calculation of moments of inertia, Rolling motion of a rigid object, angular momentum and its conservation. Center of mass.	Ch 10, 11: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch2: *Classical dynamics of particles and systems by Marian, Thornton, 5th Edition*
Motion of an object attached to a spring, Particle in Simple harmonic motion, Energy of the simple harmonic oscillator, The Pendulum, Damped and forced oscillations, Traveling wave, The Speed of waves on strings. Einstein's principle of relativity, Consequences of the special theory of relativity, Relativistic linear Momentum, Relativistic energy	Ch 15, 16, 39: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch 3, 14: *Classical dynamics of particles and systems by Marian, Thornton, 5th Edition*
Lagrangian and Hamiltonain Dynamics: Hamilton's principal, Generalized coordinates, Lagrange's equations of motion, Canonical equations of motion, Phase space and Liouville's theorem.	Ch 7: *Classical dynamics of particles and systems by Marian, Thornton, 5th Edition*

Recommended Books

Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition

Classical dynamics of particles and systems by Marian, Thornton, 5th Edition

Quantum Mechanics

Contents	Recommended Books
Observables and operators, postulates of quantum mechanics, state function and expectation values, time development of state functions and time development of expectation values.	Ch 3, 6: *Introductory Quantum Mechanics* (4th Edition) by Richard Liboff
Time dependent and time independent Schrodinger equation, one-dimensional problems, stationary states, free particles, infinite and finite square well.	Ch 3, 4, 8: *Introductory Quantum Mechanics* (4th Edition) by Richard Liboff
Hilbert space, Dirac notation, Hermitian operators and their properties, unitary operators, superposition principle, commutator relations, uncertainty principle	Ch 4, 5: *Introductory Quantum Mechanics* (4th Edition) by Richard Liboff
One-dimensional barrier problems, tunneling, rectangular well, reflection and transmission coefficients.	Ch 7: *Introductory Quantum Mechanics* (4th Edition) by Richard Liboff
Harmonic oscillator	Ch 7: *Introductory Quantum Mechanics* (4th Edition) by Richard Liboff
Angular momentum (orbital, spin and total angular momentum), their eigenvalues and eigenfunctions, addition of angular momentum, angular momentum matrices, properties of Pauli matrices.	Ch 9, 11, 12: *Introductory Quantum Mechanics* (4th Edition) by Richard Liboff
Hydrogen atom	Ch 10: *Introductory Quantum Mechanics* (4th Edition) by Richard Liboff

Recommended books:

Introductory Quantum Mechanics by Richard Liboff 4th Edition
Quantum Mechanics, concepts and applications by Nouredine Zettili

Mathematical Methods for Physicists

Contents	Recommended Books
Single and multivariant calculus	Ch 1: *Mathematical Methods for Physicists (7th Edition): by George B. Arfken*
Coordinate systems: rectangular, spherical, and cylindrical	Ch3: *Mathematical Methods for Physicists (7th Edition): by George B. Arfken*
Vector algebra, Cross product and dot product, vector differential operators [Gradient, Divergence, Curl, Laplacian] Line Integral, Surface Integral, and volume Integrals, and relevant theorems.	Ch3: *Mathematical Methods for Physicists (7th Edition): by George B. Arfken* *Ch9: and Ch10: Advanced Engineering Mathematics (10th Edition) by Erwin Kreyszig*
Matrices and determinants, Inverse of a matrix, Eigenvalues, diagonalization of Matrices	Ch2: and Ch 6: *Mathematical Methods for Physicists (7th Edition): by George B. Arfken* *Ch7: and Ch8:Advanced Engineering Mathematics (10th Edition) by Erwin Kreyszig*
Differential equations [ODEs, 1st and 2nd order], and initial value, and boundary value problems.	Ch7: *Mathematical Methods for Physicists (7th Edition): by George B. Arfken* *Ch1: and Ch2: Advanced Engineering Mathematics (10th Edition) by Erwin Kreyszig*
Infinite series [Series of functions, Taylor's expansion, Maclaurin Series, power series] Properties of Dirac delta function	Ch:1 *Mathematical Methods for Physicists (7th Edition): by George B. Arfken* *Ch15: Advanced Engineering Mathematics (10th Edition) by Erwin Kreyszig*
Functions of complex variables [complex algebra, Cauchy-Riemann Conditions, Cauchy's Integral formula, Laurent expansion, singularities, residue theorem]	Ch: 11 *Mathematical Methods for Physicists (7th Edition): by George B. Arfken* *Ch11: Advanced Engineering Mathematics (10th Edition) by Erwin Kreyszig*
Periodic Function, Fourier Series and its properties, Fourier Integral, Fourier Cosine and Sine Transforms,	Ch:19 and Ch 20: *Mathematical Methods for Physicists (7th Edition): by George B. Arfken* Ch13 and Ch14: *Advanced Engineering Mathematics (10th Edition) by Erwin Kreyszig*

Recommended Books

Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition
Advanced Engineering Mathematics (10th Edition) by Erwin Kreyszig

Electromagnetic Theory

Contents	Recommended Books
Electrostatics: Coulomb's Law, Electric Fields due to a point charge and an electric dipole, Electric field due to a charge distribution, Electric dipole in an electric field, Electric flux, Gauss' law and its applications in planar, spherical, and cylindrical symmetries.	Ch 23, 24: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch2: *Introduction to Electrodynamics by David J. Griffiths 4th Edition*
Electric Potential: Potential due to a point charge and a group of point charges, Potential due to an electric dipole, Potential due to a charge distribution, Relation between electric field, Electric potential energy, Laplace equations in 1-3 Dimensions	Ch 25: : *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch3: *Introduction to Electrodynamics by David J. Griffiths 4th Edition*
Capacitors and Capacitance: Parallel-plate, cylindrical, and spherical capacitors, Capacitors in series and parallel, Energy stored in capacitors, Capacitors with dielectrics and electric dipole in an electric field.	Ch 26: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch4: *Introduction to Electrodynamics by David J. Griffiths 4th Edition*
DC Circuits: Electric current and current density, Resistance and resistivity, Ohm's Law, Power in electric circuits, Resistances in series and parallel, Single and multi-loop circuits, Kirchhoff's rules, RC circuits, Charging and discharging of a capacitor.	Ch: 27, 28: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition*
Magnetic Field and Magnetic Force: Crossed electric and magnetic fields and their applications, Magnetic force on a current carrying wire, Torque on a current loop.	Ch 29: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch5: *Introduction to Electrodynamics by David J. Griffiths 4th Edition*
Ampere's Law and Biot- Savart Law: Magnetic field due to a current, long straight wire carrying current, Solenoids and toroids.	Ch 30: : *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch5: *Introduction to Electrodynamics by David J. Griffiths 4th Edition*
Inductance: Faraday's law of induction, Lenz's law, Inductors and inductances, RL circuits, Energy stored in a magnetic field, Energy density. Gauss' Law for Magnetism, Displacement Current, Maxwell Equations	Ch 31, 32,34: : *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition* Ch7: *Introduction to Electrodynamics by David J. Griffiths 4th Edition*

Recommended Books

Introduction to Electrodynamics by David J. Griffiths 4th Edition
Physics for Scientists and Engineers by Serway and John W. Jewett 9th Editio

Thermal and Statistical Physics

Contents	Recommended books
Basic concepts of thermodynamic quantities [Temperature, Pressure, Heat & Work, Internal Energy, Heat Capacity, Latent Heat, Extensive & Intensive Quantities], Discrete and continuous probability distributions, Combinatorial problems and Stirling's approximation, Zeroth law of thermodynamics, Thermometers, Thermal expansion of solids and liquids.	Ch 1,2,3: *Concepts in Thermal Physics* by Stephen J. Blundell Ch.19,20: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition*
Thermal equilibrium, Concepts of micro and macro states, Ensembles, Canonical ensemble and Boltzmann factor, Maxwell-Boltzmann distribution [Kinetic theory of gases], Ideal gas law, Equipartition theorem and its applications, Degrees of freedom [quadratic modes], Van der Waals gas	Ch4, 5, 6, 19, 25, 26: *Concepts in Thermal Physics* by Stephen J. Blundell Ch 21: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition*
First law of thermodynamics and thermodynamic processes [isothermal, adiabatic, isobaric, etc], Cyclic processes, PV diagrams, Energy transfer mechanisms in thermal processes [Thermal conduction, convection, radiation]	Ch 11, 12: *Concepts in Thermal Physics* by Stephen J. Blundell Ch20: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition*
Second law of thermodynamics, Carnot and other heat engines, Heat pumps and refrigerators, Reversible & irreversible processes, Joule expansion, Entropy and probability. Third law of thermodynamics.	Ch 13, 14, 18: *Concepts in Thermal Physics* by Stephen J. Blundell Ch.22: *Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition*
Thermodynamic potentials [Internal energy, enthalpy, Helmholtz & Gibbs functions] and Maxwell's Relations.	Ch 16: *Concepts in Thermal Physics* by Stephen J. Blundell
Partition function, Combining partition function, Density of states, Indistinguishability, Gibbs paradox, Statistical mechanics of ideal gas.	Ch 20, 21: *Concepts in Thermal Physics* by Stephen J. Blundell
Grand canonical partition function, Chemical potential, Photons[black body radiation], Phonons [Einstein and Debye models], Quantum statistics, Bose-Einstein & Fermi-Dirac distributions, Fermi and Bose gases.	Ch 22, 23, 24, 29, 30: *Concepts in Thermal Physics* by Stephen J. Blundell

Recommended Books

Concepts in Thermal Physics by Stephen J. Blundell
Physics for Scientists and Engineers by Serway and John W. Jewett 9th Edition