Engineering Physics Important Questions PDF

Engineering Physics in the first year usually covers quantum mechanics, electromagnetic field theory, wave optics (interference and diffraction), fibre optics and lasers, and superconductors with nanomaterials. Expect derivations such as the Schrödinger equation and Newton's rings, and short numericals on de Broglie wavelength, particle in a box, gratings and numerical aperture.

Key takeaways

- Quantum mechanics: de Broglie waves, Compton effect, Schrödinger equations and particle in a 1D box.
- EM theory: Maxwell's equations, displacement current, Poynting theorem and skin depth.
- Wave optics: thin films, Newton's rings, single-slit diffraction and the plane transmission grating.
- Fibre optics and lasers: numerical aperture, acceptance angle, Einstein coefficients and population inversion.
- These are practice questions based on common syllabus topics, not verified past papers.

About these important questions

These are **practice questions** built from topics that appear in most Indian B.Tech syllabi for Engineering Physics, including AKTU and universities that follow the AICTE model curriculum. They are **not verified past papers**, and we do not claim that any question will appear in your exam. Unit numbers and topic order differ between universities, so first match each unit below with your own university syllabus. For real previous papers, use your university's official archive. AKTU students can download them from the AKTU old question paper page.

Each unit lists key definitions, derivations or theory questions, numericals with short answer outlines, and long-answer questions. Use the outlines to check your method, then write full solutions yourself.

Unit 1: Quantum Mechanics

Key definitions: black body radiation, photoelectric effect, Compton effect, de Broglie hypothesis, phase and group velocity, wave function and its physical meaning, Heisenberg uncertainty principle.

Derivations:

- Derive the time-independent and time-dependent Schrödinger wave equations.

- Derive the energy eigenvalues and normalised wave functions for a particle in a one-dimensional box: $E(n) = n^2h^2/(8mL^2)$.
- Derive the expression for the Compton shift: $\Delta\lambda = (h/m_0c)(1 - \cos\theta)$.

Numericals (answer outline):

- Find the de Broglie wavelength of an electron accelerated through 100 V. Outline: $\lambda = 1.226/\sqrt{V}$ nm = 0.1226 nm.
- Find the lowest energy of an electron in a box of width 1 Å. Outline: $E1 = h^2/(8mL^2) \approx 6.0 \times 10^{-18}$ J ≈ 37.6 eV.
- Find the Compton shift at a scattering angle of 90°. Answer: about 0.0243 Å.

Long-answer questions: Explain the wave-particle duality with experimental evidence (Davisson-Germer), and derive the particle-in-a-box result with a sketch of the first three wave functions.

Unit 2: Electromagnetic Field Theory

Key definitions: gradient, divergence and curl, Gauss law, Ampere's law, Faraday's law, displacement current, Poynting vector, skin depth.

Derivations:

- Write Maxwell's equations in differential and integral form and explain the physical meaning of each.
- Show how Ampere's law is modified by the displacement current and derive the continuity equation.
- Derive the electromagnetic wave equation in free space and show that the wave travels at $c = 1/\sqrt{(\mu_0\varepsilon_0)}$.
- State and prove the Poynting theorem.

Short questions: Difference between conduction and displacement current. Define skin depth and explain why it is small for good conductors at high frequency.

Unit 3: Wave Optics

Key definitions: coherence, interference by division of wavefront and amplitude, thin film, Newton's rings, Fraunhofer and Fresnel diffraction, resolving power, dispersive power.

Derivations:

- Derive the condition for bright and dark fringes in a thin film by reflection.
- Explain Newton's rings and show that the diameter of the nth dark ring satisfies $D^2 = 4n\lambda R$.
- Derive the intensity distribution for Fraunhofer diffraction at a single slit.
- Derive the grating equation $d \sin\theta = n\lambda$ and the resolving power of a grating.

Numericals (answer outline):

- A grating has 5000 lines per cm and is used with light of 5000 Å. Find the highest order visible. Outline: $d = 2 \times 10^{-6}$ m, $n(max) = d/\lambda = 4$.
- Find the wavelength from the diameters of the 5th and 15th dark Newton's rings: $\lambda = (D_{15}^2 - D_5^2)/(4 \times 10 \times R)$.

Unit 4: Fibre Optics and Lasers

Key definitions: total internal reflection, numerical aperture, acceptance angle, step and graded index fibres, attenuation, dispersion, spontaneous and stimulated emission, population inversion, metastable state, pumping.

Derivations:

- Derive the expression for numerical aperture: NA = $\sqrt{(n1^2 - n2^2)}$.
- Derive the relation between Einstein's A and B coefficients.

Numericals (answer outline):

- Core index 1.50, cladding index 1.47. Find the NA and the acceptance angle. Outline: NA = $\sqrt{(2.25 - 2.1609)} \approx 0.30$, acceptance angle = $\sin^{-1}(0.30) \approx 17.4°$.
- Find the number of modes or the V-number for a step-index fibre with given core radius and wavelength.

Long-answer questions: Explain the construction and working of the ruby laser and the He-Ne laser with energy level diagrams. Compare them. List applications of lasers in industry and medicine.

Unit 5: Superconductors and Nanomaterials

Key definitions: critical temperature, critical magnetic field, Meissner effect, type I and type II superconductors, Cooper pairs, BCS theory (qualitative), nanomaterials, quantum confinement, carbon nanotubes.

Short questions:

- Show that a superconductor is a perfect diamagnet.
- Explain the variation of critical field with temperature: $H_c = H_0[1 - (T/T_c)^2]$.
- Compare type I and type II superconductors with B-H curves.
- Explain why properties of materials change at the nanoscale.

Long-answer questions: Applications of superconductors (MRI magnets, SQUID, maglev). Synthesis methods of nanomaterials (top-down and bottom-up) and properties of carbon nanotubes.

How to score well in Engineering Physics

- Derivations carry the most marks. Practise each one in full at least twice, with diagrams.
- Keep a constants sheet: h, c, e, electron mass, μ_0, ε_0. Many numericals lose marks because of wrong powers of ten.
- Write units at every step of a numerical.
- For short answers, a labelled diagram (energy levels, fringe pattern, fibre cross-section) makes the answer clear and quick to check.

Short-answer (2-mark) questions for Engineering Physics

Short questions test definitions and one-line results. Practise answering each in two to four lines:

1. State Heisenberg's uncertainty principle.
2. What is the physical meaning of $|\psi|^2$?
3. Why is the Compton effect not observed with visible light?
4. Define phase velocity and group velocity.
5. What is displacement current?
6. Write Maxwell's equations in differential form.
7. What are coherent sources?
8. Why is the centre of Newton's rings dark in reflected light?
9. Define numerical aperture and acceptance angle.
10. What is population inversion, and why is a metastable state needed?
11. What is the Meissner effect?
12. What is quantum confinement in nanomaterials?

A 7-day revision plan for Engineering Physics

Use this plan in the last week before the exam. Adjust it to the units and weightage in your own syllabus.

- **Day 1 (Unit 1, Quantum Mechanics):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 2 (Unit 2, Electromagnetic Field Theory):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 3 (Unit 3, Wave Optics):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 4 (Unit 4, Fibre Optics and Lasers):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 5 (Unit 5, Superconductors and Nanomaterials):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 6:** attempt one full three-hour practice paper made from these questions, or an official previous paper from your university archive.
- **Day 7:** go through your formula sheet, the short-answer list and every question you got wrong in the practice paper.

Frequently asked questions

Which derivations are most important in Engineering Physics?

Schrödinger equations, particle in a box, Compton shift, Maxwell's equations and the EM wave equation, Newton's rings, the grating equation, numerical aperture and Einstein coefficients are the core derivations in most syllabi.

Are numericals in physics difficult?

Most numericals are one or two formula steps. The common mistakes are unit conversions (Å, nm, eV) and powers of ten, so write units on every line.

How should I revise the lasers and fibre optics unit?

Make one page with the NA formula, acceptance angle, V-number and Einstein relations, plus energy-level diagrams for the ruby and He-Ne lasers. That covers most questions from this unit.

Are these questions from real past papers?

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