Some Tips for the Revised CSIR – UGC NET Exam
With Syllabus & Discussion
(EFFECTIVE from DECEMBER 2008 EXAMINATION)

Applying for NET

The NET is held twice every year - in June/July and December. Keep an eye on the CSIR website (http://csirhrdg.res.in) which will tell you about all that you need to apply for the test. Before filling in the form, make it a point to have all the details with you (especially the subject code and centre code) since you won't be able to change anything later on.

Preparing for NET

Follow the syllabus thoroughly. Even if you cannot finish all the options given, at least make sure that you know some of the concepts in each unit. It is always good to consult your peers and seniors who have gone through the process, though sometimes worrying too much may leave you in the middle of utter confusion. Develop genuine interest in the subject so that a career in physics is really challenging after all. Making use of the previous year objective type question papers of exams like GATE can be a good practice before the exam. Also check out the CSIR website for model question paper for the new scheme.

Writing the Exam

The Paper I of the NET contains multiple choice questions where you will have to finish 100 questions in 150 minutes. The first 25 questions comprise of general science and math questions including earth sciences and computer science, where as the remaining 75 questions are from your subject. The major difference from the previous scheme is that one can choose from 40 questions to answer 25 in Part A and 100 to answer 75 in Part B! At the same time, the Part B now includes the entire physics syllabus and thereby demanding more from the candidate. But there is more time and choice at your disposal. This could be a blessing in disguise, as one need not study the subject objectively and then subjectively!

First, attempt the questions you are sure about and then attempt the other questions. There is negative marking and it takes practice and patience to answer this paper promptly so that you should avoid questions which you cannot score. If you have time, recheck your answers. The question paper for Paper II will be given in the afternoon session and it is important to note that if you don’t score above a cut off mark in Paper I, your Paper II will not be evaluated, which means you won’t qualify at all. Furthermore, Paper II will have two sections as described in the syllabus.

With regard to the first part of Paper I (General Science), try to recollect your undergraduate Chemistry and Biology. It is assumed that a Physics student is comfortable in dealing with the Math, Computer Science and Physics questions of this part which is meant for all science students taking the CSIR exam. If you are not comfortable with any of these, put some common sense or logic into the questions and given answers, then you will not be disappointed. About the Earth Sciences part, read the physical geography part of NCERT class

XI or XII text books. Let us set the target for this session as at least 20 correct answers out of 25 questions.

The new scheme demands equal attention on all topics in the syllabus. Sections in the syllabus may appear relatively tougher or easier to different people, but it is imperative to put more attention to Mathematical Methods, Statistical & Quantum Mechanics, Solid State Physics and Electrodynamics that form the core of the subject. Choose the core areas from each section and concentrate on them after ensuring that you have some basic idea of the section.

Syllabus for Paper I

This paper shall be of 2 hours and 30 minutes duration and shall have a maximum of 200 marks.

Part A

Max. Score = 25*2=50.

Part 'A' of Paper I shall contain 40 General Science questions. These questions shall be common to all subject areas of NET Examination. A candidate shall be required to answer a maximum of 25 questions from Part 'A'. In case a candidate answers more than 25 questions, only the first 25 answered questions will be taken up for evaluation.
All questions shall be of 2 marks each.
There will be negative marking for wrong answers.

TOPICS

1.
   - General information on Science and its interface with society to test the candidate's awareness of science, aptitude of scientific and quantitative reasoning. Questions would be so designed to judge the creativity, analytical ability and research aptitude of a candidate.
   - The questions would be setup in each of the subject areas of NET, viz., Chemical Sciences; Earth, Atmospheric, Ocean & Planetary Sciences; Life Sciences;
   - Mathematical Sciences and Physical Sciences

2. COMMON ELEMENTRY COMPUTER SCIENCE:
   (Applicable to all candidates offering any subject area; a few questions dealing with basic computer awareness and uses)
   - PROGRAMMING INSTRUCTIONS
   - SIMPLE ALGORITHMS AND COMMPUTATIONAL METHODS

Part B

Max. Score = 75*2=150 marks.

Part ‘B’ of Paper I shall have 100 questions. A candidate shall be required to answer a maximum of 75 questions. In case a candidate answers more than 75 questions, only the first 75 answered questions shall be evaluated.
All questions shall be of 2 marks each. There will be negative marking for wrong answers.
The full Syllabus for Part B of Paper I is the same Part B of Paper II.

How to Avoid a Disaster?

They say “when the going gets tough, only the tough get going.” So cover the difficult, yet important, portions of the subject to score a maximum. Prepared candidates survive in all situations and objective type questions demand good practice (unless, of course, you are a genius)!

Though we cannot say anything about the cut off marks, experience tells that one has to score well in Paper I to get a JRF. At the same time leave your thoughts about the performance in the Paper I back and do well in the afternoon session with a clear and sound mind. Some may have a tendency to give it up feeling dejected about your performance during the day. Also be cool in your approach to the exam and never give up during the examination by doing things like answering all the multiple choice questions randomly based on luck, feeling dejected of your performance. There is plenty of time to prepare and perform well. And from experience, many have come out successfully even after believing that they did perform very poorly.

Why Negative Marking?

Negative marking is incorporated in any objective type examination to nullify the effect of gamblers. If you look at it statistically, the maximum probable score one can get is 25% out of 100 having four choices each. Remember, this is the maximum and sometimes there is a remote probability that you score a cent percent. Rather, experience may tell you that you get relatively low score when you leave things to chance alone. Negative marking with $1/4^{th}$ of the marks given to a correct answer tries to reduce the marks one gets by chance but the usual practice these days is to have $1/3^{rd}$ of a correct answer as a negative marking. One may get negative marks as a result of the former, whereas, a more natural latter system will get ‘zero’ as minimum.

In examinations with objective type multiple choice questions (MCQs), there is a tendency called the ‘Red Wire Syndrome’ which means that one may answer all questions whether he or she knows the correct answer or not. If we can classify the questions into three categories, viz. 1) *Easy*, 2) *Fifty – Fifty*, and 3) *Lucky*, indicating one knows the correct answer, possible but some doubt still prevails, and almost impossible, respectively. The ‘red wire syndrome’ means that one will have a tendency to answer all the questions, which is disastrous, just like a child who touches a ‘red hot wire’ seeing it as something beautiful!

The key to success lies in answering all the ‘easy’ ones, and leaving out the ‘lucky’ type. It is imperative to learn the art of intelligent guessing to answer the type 2. This evidently comes from one’s experience and basic knowledge of the subject. So never ever find it insulting to go back to your basics (at least refer to some of the basic books in the list below). Also never forget to practice well using previous question papers of GATE, UPSC Civil Services etc. so that you are prepared!

Syllabus for Paper II

This paper shall be of 2 hours and 30 minutes duration and shall have a maximum of 200 marks. Paper II consists of questions that require short answers and/or calculations. You are provided one page for answering each question.

Part 'A' consists of 10 questions that carry 15 marks each. Candidates are required to answer a maximum of 8 questions. In case a candidate answers more than 8 questions, only the first 8 answered questions shall be evaluated. (15*8=120 marks).

Part 'B' consists of 20 questions that carry 10 marks each. Candidates are required to answer a maximum of 8 questions. In case, a candidate answers more than 8 questions, only the first 8 answered questions shall be evaluated. (1*8=80 marks).

In Paper II, one will have to answer a specified number (8+8=16) of questions, each one a page long choosing from two sections and the paper total will be 200 marks. It is important to answer to the point with all relevant points so that one gets good score for this paper. Accuracy, brevity and clarity are the scorers here. This will help to make one qualify for the JRF as well to appear for the selection process for the Shyama Prasad Mukherjee (SPM) Fellowship. Only the top qualify for the SPM selection exam which is followed by an interview. This is highly challenging when one sees the number of people who have been selected for the SPM so far.

After the Exam

Once the exam is over, you will be relieved. But don't stop now! Write down the questions you can remember. Do this the same day or you won't be able to recall them afterwards. This will help you in preparing for the next exam in case you do not clear it this time. If you do clear it, well, you could pass on the questions to your friends who plan to take the test. Let us get ready for a memory retention test too!

Detailed Analysis with Syllabus and Reading List

General Reference

1. Fundamentals of Physics – R Resnick, D Halliday & J Walker (Wiley)
2. Concepts of Physics – H C Verma (Bharati Bhawan)
3. Feynman Lecture in Physics, especially Vol. I is a must read.
4. Calculus and Analytical Geometry – Thomas and Finney (Pearson) {for those who want some basic math}
5. Concepts of Modern Physics – A Beiser (TMH)
6. Modern Physics – R Gautreau and W Savin (*Schaum's Outline Series*)
7. Quantum Mechanics – Y. Peleg *et al*. (*Schaum's Outline Series*)

8. Read the linked article in Physics Kerala by Gerard't Hooft and use the resources cited by him thereof (**www.physicskerala.org**).

Part A

I. Mathematical Methods of Physics

> **Syllabus:** Dimensional analysis; Vector algebra and vector calculus; Linear algebra, matrices, Cayley Hamilton theorem, eigenvalue problems; Linear differential equations; Special functions (Hermite, Bessel, Laguerre and Legendre); Fourier series, Fourier and Laplace transforms; Elements of complex analysis: Laurent series-poles, residues and evaluation of integrals; Elementary ideas about tensors; Introductory group theory, SU(2), O(3); Elements of computational techniques: roots of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, solution of first order differential equations using Runge-Kutta method; Finite difference methods; Elementary probability theory, random variables, binomial, Poisson and normal distributions.

The new syllabus has enhanced the level of understanding a little bit further. One can easily see that group theory, numerical methods and probability theory are new additions. These topics are highly important for a successful understanding of the subject, especially in the modern day of computers. Key areas are: Vector Calculus, Properties of Matrices and Matrix Equations, Fourier series and Complex analysis. Also be prepared with the basics of group theory and important operations in it along with important groups and their properties. Expect simple problems in Paper I & II based on your basic understanding of the subject. Knowledge of areas like the Eigen value equations of matrices and vectors are important throughout the subject especially in areas like Quantum mechanics. Given below are some books that may help. One can find the book by Chow covers the syllabus, except numerical techniques, but there are other books as well. References 3 and 4 make good resources if you have one in the library, but please feel comfortable to refer to any good book that comes by.

1. Mathematical Methods for Physicists – Arfken and Weber
2. Mathematical Methods for Physicists: A concise introduction - Tai L. Chow (Cambridge University Press - 2000)
3. Mathematical Techniques for Engineers and Scientists – Andrews and Phillips (SPIE Press)
4. Mathematical Methods for Scientists and Engineers – Donald A McQuarrie (University Science Books: California)
5. Complex Variables – Churchill (McGraw-Hill)
6. Differential Equations – G. F. Simmons (McGraw-Hill)
7. Mathematical Methods in Classical and Quantum Physics – Tulsi Dass and Satish K. Sharma (University Press – 1998)

II. Classical Mechanics

Syllabus: Newton’s laws; Phase space dynamics, stability analysis; Central-force motion; Two-body collisions, scattering in laboratory and centre-of-mass frames; Rigid body dynamics, moment of inertia tensor, non-inertial frames and pseudo forces; Variational principle, Lagrangian and Hamiltonian formalisms and equations of motion; Poisson brackets and canonical transformations; Symmetry, invariance and conservation laws, cyclic coordinates; Periodic motion, small oscillations and normal modes; Special theory of relativity, Lorentz transformations, relativistic kinematics and mass–energy equivalence.

This section is important from the point of view that most of the questions are sure types if you develop some skill over dynamics and relativity. Relativity is important since ‘easy but tricky’ problems can be asked in both papers. Working out as many problems as possible using books like Beiser and Resnick will help in that area. Also expect problems in areas like Lagrangian Dynamics, Canonical Transformations, Commutation brackets and Wave Phenomena. Prior knowledge of ideas involving conservative forces, dispersion relations of waves and the mathematical treatment of dynamics in general is important. Get a good grip of the topic by covering that excellent book by Landau. Book two will be useful to understand the role of mechanics in physics and to have a good view of the methodology of physics compared to other sciences. Someone who needs more basics mechanics than that of Resnick and Halliday may refer to R. Douglas Gregory.

1. Mechanics – Landau and Lifshitz (Pergamon Press)
2. Classical Mechanics – H S Hans and S P Puri (Tata McGraw Hill).
3. Classical Mechanics – Goldstein, Poole and Safko (Pearson) 3rd Edn.
4. Lagrangian and Hamiltonian Mechanics – M G Calkin (World Scientific).
5. Relativity – The Special and General Theory – A Einstein (available for download from the Physics Kerala web).
6. Introduction to Special Relativity – R Resnick (Wiley).
7. Special Relativity – A. P. French (The MIT Introductory Physics Series – 1968).
8. Classical Mechanics - R. Douglas Gregory (Cambridge University Press 2006).

III. Electromagnetic Theory

Syllabus: Electrostatics: Gauss’ Law and its applications; Laplace and Poisson equations, boundary value problems; Magnetostatics: Biot-Savart law, Ampere's theorem, electromagnetic induction; Maxwell's equations in free space and linear isotropic media; boundary conditions on fields at interfaces; Scalar and vector potentials; Gauge invariance; Electromagnetic waves in free space, dielectrics, and conductors; Reflection and refraction, polarization, Fresnel’s Law, interference, coherence, and diffraction; Dispersion relations in plasma; Lorentz invariance of Maxwell’s equations; Transmission lines and wave guides; Dynamics of charged particles in static and uniform electromagnetic fields; Radiation from moving charges, dipoles and retarded potentials.

This is a highly scoring area for those who have the basic knowledge of electromagnetics Begin with Resnick and Halliday or Kraus and master Griffiths by solving problems. Maxwell’s equations are the milestone but each among the four equations has a story to tell. Differentiate

between conducting and non-conducting media and learn about the symmetry of fields and boundaries to be able to solve problems in the area. It is mostly a problem of defining your equations, and solving them using the appropriate boundary conditions. It will be worthwhile to notice that both electric and magnetic fields have many things in common (like both are not conservative fields) but they have fundamental differences (like the presence of electric monopole and absence of magnetic monopole). Fundamentals make good hunting ground for examiners. So be prepared! Also, never forget to look into the relativistic electrodynamics and different gauges used.

Notice the change in the syllabus which now includes some optics which can be had from Hecht. Daniel Fleisch introduces the heart and soul of EMT to an average student through his latest book (ref. 4), have a look at it, if you can. Irodov introduces the concepts of the subject briefly but aptly. It also has several worked out examples and problems.

1. Introduction to Electrodynamics – D J Griffiths (Prentice Hall)
2. Basic Laws of Electromagnetism – I E Irodov (Mir Publishers)
3. Electromagnetics with Applications – Kraus and Fleisch (McGraw-Hill)
4. A Student's Guide to Maxwell's Equations - Daniel Fleisch (Cambridge University Press - 2008)
5. Optics – Eugene Hecht (Pearson)
6. Introduction to Modern Optics – Grant R. Fowles (Dover)
7. Modern Optics – Robert D. Guenther (Wiley - 1990).

IV. **Quantum Mechanics**

> ***Syllabus:*** Wave-particle duality; Wave functions in coordinate and momentum representations; Commutators and Heisenberg's uncertainty principle; Matrix representation; Dirac's bra and ket notation; Schrödinger equation (time-dependent and time-independent); Eigenvalue problems such as particle-in-a-box, harmonic oscillator, etc.; Tunneling through a barrier; Motion in a central potential; Orbital angular momentum, Angular momentum algebra, spin; Addition of angular momenta; Hydrogen atom, spin-orbit coupling, fine structure; Time-independent perturbation theory and applications; Variational method; WKB approximation; Time dependent perturbation theory and Fermi's Golden Rule; Selection rules; Semi-classical theory of radiation; Elementary theory of scattering, phase shifts, partial waves, Born approximation; Identical particles, Pauli's exclusion principle, spin-statistics connection; Relativistic quantum mechanics: Klein Gordon and Dirac equations.

This is the heart of modern physics and some good mathematical concepts along with physical insight will make it interesting. Stick to the basics again and work out basic problems like the calculation of Eigen values, probabilities, expectation values etc. Commutation relations and conservation laws are a must. Remember the solutions to different basic problems like the free particle, one dimensional well, particle in a box and the harmonic oscillator. Angular momentum and coupling are important. Scattering may be difficult to bite but questions can be asked. There are plenty of books available following different strategies. A book like Modern Quantum Mechanics by Sakurai is quite refreshing, but from the examination point of view it is better to follow more general books considering the demands of the syllabus and examination

patterns. Before going to dwell into the following or any serious book, have firm grip of the basics of quantum world using books such as Beiser and Resnick & Halliday.

First two books are sufficient for any level and Griffiths has several good problems and examples to help you with the exam. If you need a more elaborative and a different book, resort to Greiner. Levi gives a picture of QM as applied to real systems.

1. Quantum Mechanics – E. Merzbacher (John Wiley & Sons)
2. Principles of Quantum Mechanics – R. Shankar (Kluwer Academic/Plenum Publishers)
3. Textbook of Quantum Mechanics - P. M. Mathews and K. Venkatesan (Tata McGraw-Hill)
4. Introduction to Quantum Mechanics - David J. Griffiths (Prentice Hall)
5. Quantum Mechanics An Introduction – Walter Greiner (Springer)
6. Quantum Mechanics – A. Goswami (Waveland Pr Inc)
7. Lecture on Quantum Mechanics – Ashok Das (Himalaya Publishers)
8. Applied Quantum Mechanics – A. F. J. Levi (Cambridge University Press - 2004)

V. **Thermodynamic and Statistical Physics**

> **Syllabus:** Laws of thermodynamics and their consequences; Thermodynamic potentials, Maxwell relations; Chemical potential, phase equilibria; Phase space, micro- and macrostates; Microcanonical, canonical and grand-canonical ensembles and partition functions; Free Energy and connection with thermodynamic quantities; First- and second-order phase transitions; Classical and quantum statistics, ideal Fermi and Bose gases; Principle of detailed balance; Blackbody radiation and Planck's distribution law; Bose-Einstein condensation; Random walk and Brownian motion; Introduction to nonequilibrium processes; Diffusion equation.

It is important to know the basic laws of thermodynamics and the relations that define thermodynamic variables which are obtainable otherwise using the methods of statistical mechanics. It will be better to use books like Patria and Huang to crack the questions in this section. Develop basic idea of the partition function, ensembles and their classification (put the logic into your mind), and the need for different statistical approaches. The last part is important as we deal with microscopic particles everywhere in physics. It is always helpful if one can draw parallels between different topics in physics and find ways to understand the microscopic origin of macroscopic behaviour.

Your job is done when you are able to obtain the ‘partition function’ of any system that you are considering. One can, in theory, obtain the thermodynamic variables required to understand the system under consideration from the partition function. The partition function depends on whether you have a closed system (canonical ensemble) or an open system (grand canonical ensemble). Have good grasp of probability theory and try to understand how it can be applied to various situations in microscopic systems such as Fermi and Bose systems.

Those who would like to start from the scratch can refer to Blundell & Blundell (ref. 8) if they are not satisfied with the work of M. W. Zemasnky. Ref. 4-7 may be redundant but each of them gives a unique introduction to the topic.

1. Statistical Mechanics – R. K. Patria (Butterworth Heinemann)
2. Statistical Mechanics – K. Huang (Wiley)
3. Elements of Statistical Mechanics – Kamal Singh and S. P. Singh (S. Chand)
4. Statistical Mechanics: A Set of Lectures – R. P. Feynman (W A Benjamin Inc: New York)
5. Fundamental of Statistical and Thermal Physics – P. Reif (McGraw-Hill)
6. Statistical Physics – I. Ishihara (Academic Press).
7. Elementary Statistical Physics – C. Kittel (John Wiley & Sons)
8. Concepts in Thermal Physics - Stephen J. Blundell and Katherine M. Blundell (Oxford University Press 2006)

VI. **Electronics**

Syllabus: Semiconductor device physics, including diodes, junctions, transistors, field effect devices, homo and heterojunction devices, device structure, device characteristics, frequency dependence and applications; Optoelectronic devices, including solar cells, photo detectors, and LEDs; High-frequency devices, including generators and detectors; Operational amplifiers and their applications; Digital techniques and applications (registers, counters, comparators and similar circuits); A/D and D/A converters; Microprocessor and microcontroller basics.

Any good book covering the syllabus, for a problem oriented strategy to tackle the simple questions from this high scoring part. A good grasp of basic ideas in electronics is a prerequisite.

1. Elements of Electronics – Bagde & Singh (S Chand & Co)
2. Principles of Electronics – V. K. Mehta (S Chand & Co.)
3. Operational Amplifiers & Linear Integrated Circuits – R. Gayakawad (Pearson)
4. Electronic Principles – A. P. Malvino (Tata McGraw-Hill)
5. Electronic Devices and Circuits – Allen Mottershed (?)
6. Integrated Electronics – Millman and Halkias (?)
7. Digital Principles and Applications – Malvino and Leech (McGraw-Hill)

Part B

VII. **Experimental Techniques and data analysis**

Syllabus: Data interpretation and analysis; Precision and accuracy, error analysis, propagation of errors, least squares fitting, linear and nonlinear curve fitting, chi-square test; Transducers (temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors), measurement and control; Signal conditioning and recovery, impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding; Fourier transforms; lock-in detector, box-car integrator, modulation techniques.

Applications of the above experimental and analytical techniques to typical undergraduate and graduate level laboratory experiments

Remember your Laboratory lessons and the working principles of instruments used. Give a reading over thermal gauges and gadgets, pressure gauges, vacuum pumps, nuclear detectors, electric and electronic circuits for detection etc. Some basic books on specific areas mentioned in the syllabus may help. Refer to laboratory guides and books on spectroscopy to have an idea of techniques used to gather and process data experimentally by avoiding noise to have the desired data.

VIII. **Atomic & Molecular Physics**

Syllabus: Quantum states of an electron in an atom; Electron spin; Stern-Gerlach experiment; Spectrum of Hydrogen, helium and alkali atoms; Relativistic corrections for energy levels of hydrogen; Hyperfine structure and isotopic shift; width of spectral lines; LS & JJ coupling; Zeeman, Paschen Back & Stark effect; X-ray spectroscopy; Electron spin resonance, Nuclear magnetic resonance, chemical shift; Rotational, vibrational, electronic, and Raman spectra of diatomic molecules; Frank – Condon principle and selection rules; Spontaneous and stimulated emission, Einstein A & B coefficients; Lasers, optical pumping, population inversion, rate equation; Modes of resonators and coherence length.

Much easier to learn and answer. Books 2 and 3 below can be helpful in general but if one wants to go more elaborately, Eisberg and Resnick may be helpful. One should be able to answer all questions related to this section, especially from different parts of spectroscopy. Reference #1 will be useful for other sections like Nuclear and Elementary Particle Physics too.

J. M. Hollas gives an elaborative description of the subject if one is not content with Barnwell. Those who want some serious laser fundamentals are encouraged to use Silfvast.

1. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, - R Eisberg and R Resnick (Wiley)
2. Introduction to Atomic Spectra - H. E. White (McGraw-Hill)
3. Molecular Spectroscopy – C. N. Barnwell (McGraw-Hill)
4. Modern Spectroscopy - J. Michael Hollas (John Wiley & Sons - 2004)
5. Laser Fundamentals – William T. Silfvast (Cambridge University Press - 2004)

IX. **Condensed Matter Physics**

Syllabus: Bravais lattices; Reciprocal lattice, diffraction and the structure factor; Bonding of solids; Elastic properties, phonons, lattice specific heat; Free electron theory and electronic specific heat; Response and relaxation phenomena; Drude model of electrical and thermal conductivity; Hall effect and thermoelectric power; Diamagnetism, paramagnetism, and

ferromagnetism; Electron motion in a periodic potential, band theory of metals, insulators and semiconductors; Superconductivity, type – I and type - II superconductors, Josephson junctions; Defects and dislocations; Ordered phases of matter, translational and orientational order, kinds of liquid crystalline order; Conducting polymers; Quasicrystals.

This is a crucial paper worth spending time. In physics research, some of the most remarkable results were published in this area. So a good knowledge of the subject not only helps in the exam but also helps in a future career. The section include simple theories in crystallography and superconductivity to acoustic and electric properties of matter, free electron theory, heat capacity models, band theory, theory of magnetism etc. Knowledge of statistical and quantum mechanics will be highly helpful. Most of the bulk properties are derived from microscopic analysis of matter. It is important to notice that the temperature dependence of many material characteristics such as heat capacity, electrical conductivity; and magnetic properties are obtained through quantum theory using statistical methods. Syllabus follows the contents of Kittel which is more of an abstract text than the other books. Have a go at the book #3 if you are feeling other books too abstract.

1. Introduction to Solid State Physics – C Kittel (Wiley)
2. Solid State Physics – Ali Omar (Pearson)
3. Problems and Solutions in Solid State Physics – S. O. Pillai (New Age)
4. Solid State Physics – Azhcroft and Mermin

X. **Nuclear and Particle Physics**

Syllabus: Basic nuclear properties: size, shape, charge distribution, spin and parity; Binding energy, semi-empirical mass formula; Liquid drop model; Fission and fusion; Nature of the nuclear force, form of nucleon-nucleon potential; Charge-independence and charge-symmetry of nuclear forces; Isospin; Deuteron problem; Evidence of shell structure, single-particle shell model, its validity and limitations; Rotational spectra; Elementary ideas of alpha, beta and gamma decays and their selection rules; Nuclear reactions, reaction mechanisms, compound nuclei and direct reactions; Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); Spin and parity assignments, isospin, strangeness; Gell-Mann-Nishijima formula; C, P, and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics.

Nuclear physics, not *per se*, is not that highly challenging if you go by the syllabus. Nuclear models, semi empirical mass formula, nuclear stability, and ideas of different counters can come in handy. In case of reactions and emissions, beta particle decay is important. Follow different mechanisms possible within a nucleus. Elementary particle physics can be tougher for some but learn the classification of particles (there are not many groups – ref. Resnick & Halliday), with the aid of some group theory and general reading. Learn to solve any nuclear or elementary particle reactions using the basic conservation laws used to group them. Hypercharge, Iso-spin, Baryon or Lepton Number, Strangeness etc. are not that difficult to digest. Ideas of violation of

parity, CPT etc. will help. Questions from this section mostly follow the syllabus and ref. #1 and #2 are very useful to cover the syllabus. One can easily find books that give good coverage of nuclear physics.

1. Introduction to Nuclear and Particle Physics – A. Das and T. Ferbel (World Scientific – 2005)
2. Subatomic Physics - Ernest M. Henley and Alejandro Garcia (World Scientific - 2007)
3. An Introduction to Nuclear Physics – W. N. Cottingham and D. A. Greenwood (Cambridge University Press - 2004)
4. Particles and Nuclei: An Introduction to the Physical Concepts - Bogdan Povh *et. al.* (Springer - 2006)
5. Introduction to Elementary Particle Physics – Khanna (Prentice Hall)

About the Author

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This article is never an authorized account of the CSIR – UCG exam and do not bear any official confirmation from the part of the agencies mentioned above. Views expressed are personal to the author and readers are recommended to follow their own discretion in following the views expressed in the article. Readers please notice that the reading list is not exhaustive and there are many other books available in any of the subject areas mentioned above. One can always find replacements and resort to locally available resources.

Feedbacks and comments (and corrections, if any) are always welcome. Please share your experience to make this article more users friendly