

JNTUH COLLEGE OF ENGINEERING HYDERABAD

Syllabus for Ph.D. Course Work

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4	0	0	4

R20PHYCW01

QUANTUM MECHANICS & ITS APPLICATIONS

UNIT I: Fundamental Concepts

Introduction to Quantum mechanics, Schrodinger equation, continuity equation, Ehrenfest theorem, Admissible wave functions, Stationary states - One-dimensional potential well problems-particle in box, tunneling through potential barrier, Application of Schrodinger equation to Harmonic oscillator.

UNIT II: General Formalism of wave mechanics

Heisenberg Uncertainty relation of x and p , states with minimum uncertainty product, Fundamentals of wave mechanics, Wave-function in coordinate and momentum representations, Commutation relations, Representation of states and dynamical variables, Dirac delta function, bra and ket notation, Matrix representation of an operator.

UNIT III: Angular momentum Formalism

Angular momentum in QM, Central force problem: Solution of Schrodinger equation for spherically symmetric potentials, Hydrogen atom.

UNIT IV: Perturbation Theory

Time-independent perturbation theory, Non-degenerate and degenerate cases, Stark effect, Selection rules, Pauli Exclusion Principle, Variation method: WKB approximation and time dependent perturbation theory.

UNIT V: Relativistic Quantum Mechanics

Klein Gordon equation, plane wave solutions and equation of continuity, Dirac equation, probability density, Dirac matrices, Plane wave solutions, spin of the Dirac particle, Dirac particle in electromagnetic fields, Dirac equation in covariant form.

Text Books:

1. L I Schiff, Quantum Mechanics (McGraw-Hill).
2. Mathews and Venkateshan, Quantum Mechanics.

Reference Books:

1. Quantum mechanics by E.Merzbacher (Wiley 1970).
2. B Craseman and J D Powell, Quantum Mechanics (Addison Wesley).

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R20PHYCW02 SYNTHESIS AND CHARACTERIZATION OF NANOMETERIALS

Unit-I: Introduction to Nanomaterials: nano scale, role of size in nano materials, surface to volume ratio, quantum confinement, Classification of Nano structured materials - 0D,1D,2D,3D ,nanoparticles, nano-wires, nano-clusters, quantum wells, properties of nano materials. Synthesis routes: Bottom-Up Approaches, Top-Down Approaches, applications of nano materials.

Unit-II: Synthesis of nanomaterials by Physical methods: Inert gas condensation, Arc discharge, RF Plasma, plasma organic spraying sputtering and thermal evaporation, laser pyrolysis, ball milling, molecular beam epitaxy, electro deposition.

Unit-III: Synthesis of nanomaterials by Chemical methods: chemical nucleation theory for cluster formation, metal nano crystal by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, sonochemical routes, liquid-liquid interface, hybrid methods, solvated metal atom dispersion, chemical vapour deposition method, sol-gel, micelles and micro-emulsion technology.

Unit-IV: Structural Characterization methods: Introduction , Working of EDAX, SEM, TEM, X-ray diffraction (XRD), (powder method), Determination of grain size/crystallite using X-ray broadening studies (Scherer's formula), Determination of Crystallite size distribution, Small angle X-ray scattering (SAXS).

Unit-V: Introduction to Lithographic & spectroscopic techniques: e-beam lithography and SEM based nanolithography, ion beam lithography, deep UV lithography, X-ray based lithography. Fourier transforms infrared spectroscopy (FTIR), Raman spectroscopy, DSC, UV vis spectroscopy.

Recommended Books:

1. Textbook of Nanoscience and Nanotechnology-B.S.Murty, P.Shankar, BaldevRaj, BBRath and James Murday Universities press,IIM, Metallurgy and Materials Science.
2. Principles of Nanoscience & Nanotechnology M.A.Shah, Tokeer Ahmad, Narosa Publishing House.
3. Nanocrystals: Synthesis, Properties and Applications C. N. Rao, P. J. Thomas, G. U. Kulkarni
4. Springer Handbook of Nanotechnology – Bharat Bhushan
5. Nano materials Handbook – Yury Gogotsi