

**AFFILIATED INSTITUTIONS
ANNA UNIVERSITY, CHENNAI
M.TECH. NANOTECHNOLOGY
CURRICULUM – FULL TIME
SEMESTER – I**

Code No.	Course Title	L	T	P	C
Theory					
MA9328	Applied Numerical Methods	3	0	0	3
NO9311	Introduction to Quantum Concept	3	0	0	3
NO9312	Introduction of Nanoscience & Technology	3	0	0	3
NO9313	Advanced Material technology	3	0	0	3
NO9314	Introduction of Biomaterials	3	0	0	3
NO9315	Computer programming in C and C++	3	0	0	3
Practical					
NO9316	Practical I – Synthesis and Preparation of Nanomaterial	0	0	4	2

UNIT I**9**

Solution of Algebraic and Transcendental Equations, Bisection Method, Method of False Position, Iteration Method, Secant Method and Muller's Method

UNIT II**9**

Matrices and Linear Systems of Equations, Solution of Linear Systems: Matrix Inversion Method, Gauss Elimination Method, Gauss-Jordan Method, Gauss-Seidal iteration Method, Solution of Tridiagonal Systems. Eigenvalue Problems- Eigenvalues of a symmetric Tridiagonal Matrix, Householder Method, QR Method.

UNIT III**9**

Numerical Solution of Ordinary Differential Equations, Picard's Method of Successive approximations, Eulers Method, Modified Euler's Method, Range-Kutta Methods. Boundary-Value Problems- Finite Difference Method, Shooting Method, Cubic Spline Method

UNIT IV**9**

Numerical Solution of Partial Differential Equations, Laplace's Equation: Jacobi's Method, Gauss-Seidal Method, ADI Method, Parabolic Equations, and Hyperbolic Equations.

UNIT V**9**

Numerical Solution of Integral Equations, Numerical integrations by Trapezoidal and Simpson's 1/3 and 3/8 rules, Two and three point Gaussian quadrature formulas, Double integrals using trapezoidal and Simposon's rules. Finite Element Method- Rayleigh-Ritz Method, Galerkin Method

TOTAL: 45 PERIODS**TEXT / REFERENCE BOOKS:**

1. S.S. Sastry, "Introductory Methods of Numerical Analysis", Prentice-Hall of India , PVT. LTD, New Delhi, 2005.
2. M.K. Jain , S.R.K. Iyenkar and R.K.Jain " Numerical Methods Problems and Solutions", New Age International Limited Wiley Eastern Limited, New Delhi, 1995.
3. P. Kandasamy, K.Thilakavathy and K. Gunavathy "Numerical Methods"S. Chand &Company Ltd, NewDelhi, 2005.
4. B.S. Grewal, "Numerical Methods in Engineering & Science with Programs in FORTRAN 77, C &C++ , Khanna Publishers, New Delhi, 2003.
5. V.N. Vedamurthy and N.Ch.S.N. Iyengar, Vikas Publishing House PVT. LTD, 2000, New Delhi.
6. S. Arumugam, A. Thangapandian Isaac and A. Somasundram, " Numerical Methods Second Edition", SCITECH Publications (India) PVT. LTD, C

NO9311

INTRODUCTION TO QUANTUM CONCEPTS

L T P C

3 0 0 3

UNIT I THE PHYSICAL BASIS OF QUANTUM MECHANICS 9

Limitation of classical physics – Plank's Quantum hypothesis- Einstein's photoelectric effect- wave nature of particle-The uncertainty principle- Schrodinger's Time dependent and independent wave equations- particle in a box- Harmonic oscillator- rigid rotator.

UNIT II FORMALISM OF QUANTUM MECHANICS 9

Linear operator- Hermitian operator-Postulates of Quantum mechanics-Simultaneous measurability of observable – Equations in motion- Linear harmonic oscillator- Operator method-particle moving in a spherically symmetric potential- hydrogen atom- Hydrogen orbitals- Matrix representation of wave functions.

UNIT III ANGULAR MOMENTUM 9

The angular momentum operators-Eigen values and eigen functions of L and L_z –Eigen values of J and J_z - spin angular momentum- Addition of angular momenta-Clebsh-Gordan coefficients-Computations.

UNIT IV THE VARIATION METHOD AND PERTURBATION THEORY 9

The variational principle- variation method for excited states- The ground states of Helium, hydrogen molecule-Deuteron-First order perturbation-Harmonic perturbation- Transition to continuous states.

UNIT V RELATIVISTIC WAVE EQUATIONS 9

Klein-Gordan equation-particle in a coulomb field- Dirac's equation for a free particle-plane wave solution-Negative energy states- Magnetic moment of the electron-Radial equations for an electron in a general potential-many electrons atoms-Hartree equations-Hartree-Fock equation.

TOTAL: 45 PERIODS

TEXT / REFERENCE BOOKS:

1. Aruldhass.G "Quantum Mechanics", Printice Hall of India pvt Ltd. New Delhi 2004.
2. Mathew.B.M and Venkatesan.K "A Text book of Quantum Mechanics", Tata McGraw Hill publication New Delhi 2007.
3. Schiff.L.I "Quantum Mechanics", McGraw Hill book company 1968.
4. Ghatak and Lokanathan, "Quantum Mechanics", The Macmilan company of India Ltd, 1975
5. Amit Goswami, "Quantum Mechanics", WCB publishers, 1992.

UNIT I**9**

Scientific Revolutions-Types of Nanomachines and Nanotechnology-periodic table-Atomic structure molecules and phase Energy-Molecular and Atomic size-surfaces and dimensional space-Top down and bottom up.

UNIT II**9**

Forces between atoms and molecule particles and grain boundaries surfaces-Strong intermolecular forces-Electrostatic and Vander Waals forces between surfaces-Similarities and differences between intermolecular and inter particle forces-covalent and coulomb interactions- Basic principles of Nano Scale materials, synthesis, processing. Mechanical grinding, wet chemical synthesis – Sol – gel processing.

UNIT III**9**

Opportunity at the nano scale-length and time scale in structures-energy landscapes-Inter dynamic aspects of inter molecular forces-Evolution of band structure and Fermi surface.

UNIT IV**9**

Quantum dots-Nano wires-Nano tubes 2D and 3D films Nano and mesopores, miscelles, bilayers, vesicles-binano machines-biological membranes.

UNIT V**9**

Influence of Nano structuring on Mechanical, optical, electronic, magnetic and chemical properties-gram size effects on strength of metals optical properties of quantum dots and quantum wires-electronic transport in quantum wires and carbon nano tubes-magnetic behavior of single domain particles and nanostructures-surface chemistry of tailored monolayer-self assembling.

TOTAL: 45 PERIODS**TEXT / REFERENCE BOOKS:**

1. Nano technology: Basic Science and Emerging technologies, Mick Wilson, Kamali Kannargare., Geoff Smith Overseas Press (2005)
2. Introduction to Nanotechnology, Charles P.Poole, Frank J.Owens, Wiley Interscience (2003)
3. Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)
4. Fundamental properties of nanostructured materials Ed D. Fioran, G.Sberveglier, World Scientific 1994.
5. Nano technology ed by Gregory Timp, Springer – Verlag, New York 1999.
6. Hand book of Nanoscience, Engineering and Technology (HNEI) Ed, W.A. Godderd, D.W.Brenner SE Lysheki, CRC Press New York 2003
7. www.nanonet.vice.edu/intronanosci/
8. Understanding Nanotechnology, Scientific American editors at scientific American , Warner Book (2002).

UNIT I	9
Introduction: Symmetry elements-seven crystals systems-Reciprocal lattice-Different type of bonding-Classification of materials-Insulator-Semiconductor-Metals-Lattice Vibration-Brillouin zones-Thermal properties.	
UNIT II	9
Dielectric Materials: Basic concepts-Langevin's Theory of Polarisation-Clausius-Mossotti Relation-Ferro electricity-Piezoelectricity-Properties of Dielectric in alternating fields-The complex Dielectric Constant and Dielectric Loss-Ionic Polarizability as a function of frequency-Complex dielectric constant of non-polar solids-Dipolar relaxation-Effects of Dielectrics.	
UNIT III	9
Magnetic materials: Dia and Paramagnetic materials-Quantum theory of paramagnetic materials-Paramagnetic susceptibility of conduction electrons-Ferro-anti ferromagnetic materials-Superconducting materials.	
UNIT IV	9
Semi-conducting materials: Semiconductor-Direct and Indirect bonding characteristics-Importance of Quantum confinement-quantum wires and dots-Ferro electric semiconductors-applications-Polymer semiconductors-Photo conductive polymers.	
UNIT V	9
New Materials: Smart materials-shape memory alloys-shape memory effects-Martensitia Transformation functional properties-processing-texture and its nature.	

TOTAL : 45 PERIODS

TEXT / REFERENCE BOOKS:

1. Solid State Physics, So Pillai, 2003, New Age International Publishers.
2. Introduction to Solid State Physics, C.Kittel.
3. Funakuho Shape Memory Alloys, Gordon and Breach, New York 1984.
4. www.solidstatephysics.com/book/
5. www.solidstatephysics.com/book/prob
6. www.solidstatephysics.com/book/sample.html
7. Rajendran V and Manikam, Material Science, Tata McGraw Hill, New Delhi 2004.

UNIT I**9**

Biomaterials and biological materials-examples and uses: First generation biomaterials-General characteristics – naturally occurring biomaterials- pure metals-alloys-ceramics-polymers-composites.

UNIT II**9**

Second generation biomaterials and their properties-bioactive and biodegradable ceramics-biodegradable polymers-hydro gels.

UNIT III**9**

Third generation biomaterials-characteristics-biomaterials in tissue engineering-enzyme conjugate DNA conjugates-DNA-protein conjugates-micro array technologies-Micro nanotechnology- micro fabrication-nanofabrication-interaction between biological materials, molecular motors- biomolecules and nanomaterials.

UNIT IV**9**

Nanobiotechnology-introduction-DNA nanotechnology-structural DNA assembly-Nanopore and nanoparticles-biological arrays- nanoprobes for analytical applications-nanosensors-nanoscale organization-characterization-quantum size effects-nanobiosensors-sensors of the future.

UNIT V**9**

Microscopies-SEM-TEM-modern advances-microanalysis-optical detection of single molecules-applications in single molecules spectroscopy- single molecule DNA detection, sorting, sequencing-DNA nanoparticles studies by AFM-DNA computer-PCR amplification of DNA fragments-Molecular surgery of DNA.

TOTAL: 45 PERIODS**TEXT / REFERENCE BOOKS:**

1. Nano: The Essentials: Pradeep.T, 2007, Tata McGraw-Hill Publishing Company Ltd.
2. Nanoparticles Assemblies and Superstructures: Nicholas A.Kotov, 2006, CRC Press.
3. Nanoscale Technology in Biological Systems: Editors: Ralph et al, 2005, CRC-Press.
4. Micromachines as Tools for Nanotechnology: H.Fujita, 2003, Springer Verlag.
5. Nanobiotechnology: Concepts, Applications and Perspectives, C.M.Niemeyer & C.A.Mirkin, 2004, Wiley VCH Verlag GMBH & co.
6. Bio Materials : An Introduction 1992 By Park JB,Lakes R.S.
7. Advances in Biomaterials, Drug Delivery and Bionanotechnology-AICHE.J 2003,49(12):2990-3006.

NO9315

COMPUTER PROGRAMMING IN C AND C++

L T P C

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UNIT I PROGRAMMING IN C

9

Identifiers and Keywords - Constants, Variables and Data types - Operators and expressions - Data Input and Output - Control Structures - if and switch statements - while, do-while and for statements - goto statement - Arrays - Character strings - Simple programs.

UNIT II FUNCTIONS AND POINTERS

9

User defined Functions - Defining and accessing functions - Passing arguments - Function prototypes - Recursion - Pointer Declarations - Passing pointers to functions - Operations on pointers.

Unit III STRUCTURES, UNIONS AND DATA FILES

9

User defined data types - Structures - Declaring structures and Accessing members - Array of structures - Unions – files – sequential file processing – random access file processing.

UNIT IV PROGRAMMING IN C++

9

Object Oriented Programming (OOP) - Basic concepts and applications - Structure of C++ program - variable declaration - Differences between C and C++ - Functions in C++ - Function overloading/polymorphism - Classes and objects - Constructors and destructors - Operator overloading - Simple programs.

UNIT V INHERITANCE, POINTERS AND DATA FILES

9

Extending classes - Inheritance and its types - Single level, multilevel, multiple and hybrid inheritance - Pointers to objects and derived classes - Virtual functions.

TOTAL: 45 PERIODS

TEXT / REFERENCE BOOKS:

1. E.Balagurusamy, Object-Oriented Programming with C++, Tata McGraw-Hill, 1995
2. Byron S. Gottfried, Schaum's outline of Theory and Problems of Programming with C, Tata McGraw-Hill, 1991.
3. Robert Lafore, Object-Oriented Programming in Turbo C++, Galgotia Publications, 1991
4. Brain W. Kernighan and Dennis. M. Ritchie, The C Programming Language, Second Edition, Printice-Hall of India, 1988.
5. Bjarne Stroustrup, The C++ Programming Language, Second Edition, Addison-Wesley, 1991
6. Bjarne Stroustrup and Margaret A.Ellis, The Annotated C++ Reference Manual, Addison-Wesley, 1990

NO9316

SYNTHESIS AND PREPARATION OF NANOMATERIALS

L T P C
0 0 4 2

1. Preparation of nanomaterials – chemical reduction method (Laser Raman)
2. Preparation of nanoparticles – Solvent Saturation
3. Synthesis of nanocomposite materials
4. Effect of particle size on physical/ chemical properties
5. Synthesis of nanoparticles/nanofilm – Spin coating
6. Imaging of nanoparticles - AFM
7. Metal Nano wires –Potentiostat
8. Nanofibers – Diffused reflectance

TOTAL: 60 PERIODS