Curriculum & Syllabus

of

M.Tech. Nanoscience and Technology

(For the batches admitted in 2008-09 and 2009-10)

K.S.RANGASAMY COLLEGE OF TECHNOLOGY
TIRUCHENGODE – 637 215

(An Autonomous Institution affiliated to Anna University of Technology Coimbatore and approved by AICTE New Delhi)

K.S. Rangasamy College of Technology - Autonomous Regulation	R 2008
Department	Nanoscience and Technology
Programme Code & Name	51 : M.Tech. Nanoscience and Technology

K.S. Rangasamy College of Technology, Tiruchengode 637 215								
Curriculum for the programs under Autonomous Scheme								
Regulation	R 2008							
Department	Department of Nanoscience and Technology							
Program Code & Name	51 : M.Tech. Nanoscience and Technology							
Semester I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
THEORY								
08510101C	Applied Numerical Methods	3	1	0	4	50	50	100
08510102C	Introduction to Quantum Concept	3	1	0	4	50	50	100
08510103C	Introduction of Nano Scale Science & Technology	3	0	0	3	50	50	100
08510104C	Advanced Materials Technology	3	1	0	4	50	50	100
08510105C	Introduction of Biomaterials	3	0	0	3	50	50	100
08510106C	Computer Programme in C and C++	3	0	0	3	50	50	100
PRACTICAL								
08510107P	Synthesis of Nanomaterials Laboratory	0	0	3	2	50	50	100
	Total	18	3	3	23	700		
Semester II								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
THEORY								
08510201C	Advanced Characterisation Techniques	3	1	0	4	50	50	100
08510202C	Nanomaterials and Nanomedicine	3	0	0	3	50	50	100
08510203C	Industrial Nanotechnology	3	0	0	3	50	50	100
08510204C	Nanoelectronics	3	1	0	4	50	50	100
08510205C	Nanolithography	3	0	0	3	50	50	100
08510206C	Advanced Nanobiotechnology	3	0	0	3	50	50	100
PRACTICAL								
08510207P	Characterisation of Nanomaterials Laboratory	0	0	3	2	50	50	100
08510208P *	Technical Report Preparation and Presentation I	0	0	2	0	100	00	100
	Total	18	2	5	22	800		

* This course is applicable only for the students who joined in the year 2009-2010 onwards

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Curriculum for the programs under Autonomous Scheme								
Regulation	R 2008							
Department	Department of Nanoscience and Technology							
Program Code & Name	51 : M.Tech. Nanoscience and Technology							
Semester III								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
THEORY								
08510301C	Nanodevices	3	0	0	3	50	50	100
085103**E	Elective I	3	0	0	3	50	50	100
085103**E	Elective II	3	0	0	3	50	50	100
PRACTICAL								
08510304P	Project Work - Phase I	0	0	12	6	100	00	100
08510305P	Technical Report Preparation and Presentation II *	0	0	2	0	100	00	100
	Total	9	0	14	15	500		
Semester IV								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510401P	Project Work - Phase II	0	0	40	20	50	50	100
	Total	0	0	40	20	100		

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Regulation	R 2008							
Department	Department of Nanoscience and Technology							
Program Code & Name	51 : M.Tech. Nanoscience and Technology							
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
Electives I								
08510341E	Micro Electro Mechanical System (MEMS) and Nano Electro Mechanical System (NEMS)	3	0	0	3	50	50	100
08510342E	Nano Biophysics	3	0	0	3	50	50	100
Electives II								
08510351E	Nanosafety and Environmental Issues	3	0	0	3	50	50	100
08510352E	Intellectual Property Rights	3	0	0	3	50	50	100

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Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510101C	APPLIED NUMERICAL METHODS	3	1	0	4	50	50	100
Objective(s)	With the present development of the computer technology, it is necessary to develop efficient algorithms for solving problems in science, engineering and technology. This course gives a complete procedure for solving different kinds of problems that occur in engineering numerically. At the end of the course the students would be acquainted with the basic concepts in numerical methods and their uses.							
1	SOLUTION OF EQUATION				Total Hrs	09		
Bisection Method - Method of False Position, Iteration Method, Secant Method and Muller's Method.								
2	SOLUTION OF EQUATION AND EIGEN VALUE PROBLEM				Total Hrs	09		
Solution of Linear Systems: Matrix Inversion Method, Gauss Elimination Method, Gauss-Jordan Method, Gauss - Seidal iteration Method, Solution of Tridiagonal Systems, Eigen value Problems- Eigen values of a symmetric Tridiagonal Matrix, Householder Method, QR Method.								
3	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS				Total Hrs	09		
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.								
4	BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS				Total Hrs	09		
Laplace's Equation: Jacobi's Method, Gauss-Seidal Method ADI method, Parabolic Equations, and Hyperbolic Equations.								
5	NUMERICAL INTEGRATIONS				Total Hrs	09		
Numerical integrations by Trapezoidal and Simpson's 1/3 and 3/8 rules, Two and three point Gaussian quadrature formulas, Double intergrades using trapezoidal and Simposon's rules. Finite Element Method- Rayleigh-Ritz Method, Galerkin Method.								
Total hours to be taught						45		
Reference(s) :								
1	S.S. Sastry, "Introductory Methods of Numerical Analysis", Prentice-Hall of India, PVT. LTD,							
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 Gunavathy "Numerical Methods" S. Chand & Company Ltd, New Delhi, 2005.							
4	B.S. Grewal, "Numerical Methods in Engineering & Science with Programs in FORTAN 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 Isacc and A. Somasundram, "Numeric Methods Second Edition", SCITECH Publications (India) PVT.LTD, Chennai, 2001.							

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Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510102C	INTRODUCTION TO QUANTUM CONCEPT	3	1	0	4	50	50	100
Objective(s)	Impart the basic knowledge about the Quantum Concepts and understand the various parameters like operator, Eigen function, angular momentum, the variation principles and approximate methods. Understand the quantum concept and apply the nanostructured materials.							

1	INTRODUCTION	Total Hrs	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 rotor.			
2	WAVE MECHANICS	Total Hrs	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 - Metrics representations of wave functions.			
3	OPERATORS AND COMPUTATION LAWS	Total Hrs	9
The angular momentum operators - Eigen values and Eigen functions of Land L - Eigen values J and J-spin angular momentum – Addition of angular momenta – Clebsh - Gordan coefficients - Computations.			
4	VARIATION PRINCIPLES	Total Hrs	9
The variation principle - Variation method for excited states - The ground state of Helium, hydrogen molecule – Deuteron - First orders perturbation – Harmonic perturbation-Transition to continuous states.			
5	APPROXIMATION METHODS	Total Hrs	9
Klein-Gordon 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 equation for an electron in general potential - many electrons atoms - Hatree equations - Hatree- Fock equation.			
Total hours to be taught			45

Reference(s) :

1	G. Aruldhass, "Quantum Mechanics", Prentice Hall of India pvt. Ltd. New Delhi, 2004.
2	M.B. Mathew and K. Venkateshan, "A Text Book Quantum Mechanics", Tata McGraw Hill publications, New Delhi, 2007.
3	I.L. Schiff, "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

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Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510103C	INTRODUCTION OF NANO SCALE SCIENCE & TECHNOLOGY	3	0	0	3	50	50	100
Objective(s)	Impart the basic knowledge on Nanoscience and Technology. Understand the various process techniques available for the processing of Nanostructured materials. Impart knowledge on the exotic properties of nanostructured materials at their nanoscale lengths. Acquire the knowledge above the various nanoparticles process methods and their skills. Study the reactive merits of various process techniques.							
1	INTRODUCTION				Total Hrs	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.								
2	NANOMATERIAL SYNTHESIS METHODS				Total Hrs	9		
Introduction to Nano scale materials - Synthesis and processing, method of nano structured materials preparation – mechanical grinding, wet chemical synthesis – sol-gel processing, gas phase synthesis, gas condensation processing, chemical vapor condensation – nano composite synthesis – processing.								
3	NANOMATERIAL PROPERTIES				Total Hrs	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.								
4	QUANTUM DOTS AND NANOTUBES				Total Hrs	9		
Quantum dots - Nano wires-Nano tubes 2D and 3D films Nano and mesopores, micelles, bilayers, vesicles, bio-nano machines-biological membranes.								
5	PHYSICAL PROPERTIES OF NANOSTRUCTURED MATERIALS				Total Hrs	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 hours to be taught						45		
Reference(s) :								
1	Mick Wilson, Kamali Kannargare., Geoff Smith, “Nano technology: Basic Science and Emerging technologies”, Overseas Press, 2005.							
2	Charles P. Poole, Frank J. Owens, “Introduction to Nanotechnology”, Wiley Interscience, 2003.							
3	Mark A. Ratner, Daniel Ratner, “Nanotechnology: A gentle introduction to the next Big Idea”, Prentice Hall P7R:1st Edition, 2002.							

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Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510104C	ADVANCED MATERIALS TECHNOLOGY	3	1	0	4	50	50	100
Objective(s)	Understand the basic ideas about the materials and impart the knowledge about the properties and various applications of dielectric materials magnetic, superconducting material.etc. Impart the knowledge about the new materials like smart materials, shape memory alloys and acquire the various physico-chemical properties of various materials.							
1	STRUCTURE & BONDS OF SOLIDS				Total Hrs	9		
Bonding in solids-Ionic bonding-bond energy of NaCl molecule- Properties of Ionic solids-Covalent bond-Properties of Covalent compounds-Metallic bond-Properties of metallic crystals-Intermolecular bonds-Dispersion bonds-dipole bonds-hydrogen bonds structure of solids. Introduction-Lattice Points-Space lattice-basis - crystal structure-unit cell-Lattice Parameter- Primitive cell crystal systems - simple cubic - body centered-Face centered -hexagonal-crystal symmetry-Miller indices. Imperfection-Point defect-Vacancy- Schotty defect-Fresnel defect-Line imperfection-Screw dislocation-Burger vector-Reciprocal lattice.								
2	DIELECTRIC MATERIALS				Total Hrs	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.								
3	MAGNETIC MATERIALS				Total Hrs	9		
Magnetic materials: Dia and Paramagnetic materials-Quantum theory of paramagnetic materials-Paramagnetic susceptibility of conduction electrons-Ferro-anti ferromagnetic materials-Superconducting materials.								
4	SEMI CONDUCTING & SUPERCONDUCTING MATERIALS				Total Hrs	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.								
5	NEW MATERIALS				Total Hrs	9		
New Materials: Smart materials-shape memory alloys-shape memory effects- Martensitia Transformation functional properties-processing-texture and its nature.								
Total hours to be taught						45		
Reference(s) :								
1	V. Rajendran, Material Science, Tata McGraw Hill, New Delhi, 2009.							
2	A.J. Dekker, Solid state Physics.							
3	S.O. Pillai, Solid state Physics, 2007 Revised Edition							
4	C. Kittle, Introduction to Solid State Physics.							
5	Funakuho Shape Memory Alloys, Gorden and Breach, New York, 1984.							

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Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510105C	INTRODUCTION OF BIOMATERIALS	3	0	0	3	50	50	100
eObjective(s)	Understand the basic properties of biomaterials and the classes of biomaterials implant the knowledge about DNA nanotechnology and nanosensors and understand basic Characterisation techniques related to DNA Nanotechnology. Understand the applications of biomaterials for implant applications.							
1	INTRODUCTION				Total Hrs	9		
Biomaterials and biological materials- examples and use - First generation biomaterials-General characteristics naturally occurring biomaterials- pure metals-alloys ceramics-polymer-composites.								
2	SECOND GENERATION BIOMATERIALS				Total Hrs	9		
Second generation bio materials and their properties - Bioactive and biodegradable ceramics-biodegradable polymers-hydro gels.								
3	THIRD GENERATION BIOMATERIALS				Total Hrs	9		
Third generation biomaterials - Characteristics-biomaterials in tissue engineering enzyme conjugate DNA conjugates-micro array technologies-Micro nanotechnology micro fabrication-nanofabrication between biological materials, molecular motors biomolecules and Nanomaterials.								
4	NANOBIOTECHNOLOGY				Total Hrs	9		
Introduction-DNA nanotechnology-structural DNA assembly-Nano pore and nano particles-biological arrays-nano probes for analytical applications-nano sensors- nanoscale organization-characterization-quantum size effects nanobiosensors of the future.								
5	MICROSCOPY				Total Hrs	9		
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 hours to be taught						45		
Reference(s) :								
1	Raplph et al, “Nanoscale Technology in Biological Systems”, CRC Press, 2005.							
2	C.M. Niemyer & C.A. Mirkin, “Nanobiotechnology: Concepts, Applications and Perspectives”, Wiley VCH Verlag GMBH & Co, 2004.							
3	Joon B. Park, R.S. Lakes, “Bio Materials: An Introduction”, Birkhäuser 2nd Edition 1992							
4	Advances in biomaterials, drug delivery and Bionanotechnology-AICHE.J 2003, 49(12): 2990-3006.							

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Semester I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510106C	COMPUTER PROGRAMME IN C AND C++	3	0	0	3	50	50	100
Objective(s)	Impart the basic programming in C & C++.							

1	BASIC CONCEPTS IN C	Total Hrs	9
Identifiers and Keywords - Constant 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.			
2	FUNCTION & POINTERS	Total Hrs	9
User defined Functions - Defining and accessing functions – Passing arguments – Functions prototypes – Recursion – Pointer Declarations – Passing pointers to functions – Operations on pointers.			
3	STRUCTURE & ARRAYS	Total Hrs	9
User defined data types - Structures – Declaring structures and Accessing members – Array of structures – Unions – files – sequential file processing – random access file processing.			
4	BASIC CONCEPTS IN C++	Total Hrs	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.			
5	TYPES OF CLASSES	Total Hrs	9
Extending classes - Inheritance and its types – Single level, multilevel, multiple and hybrid inheritance – Pointers to Objects and derived classes – Virtual functions.			
Total hours to be taught			45
Reference(s) :			
1	E. Balagurusamy, “Object – Oriented Programming with C++”, Tata McGraw – Hill		
2	Robert Lafore, “Object-Oriented Programming in Turbo C++” , Galgotia Publications,1995		
3	W. Kernighan Brain and M. Ritchie Dennis, “The C Programming Language”, 2nd Edition, Prentice Hall of India.		
4	Bjarne Stroustrup, “Programming: Principles and practice using C++:, Addison-Wesley professional.		

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510107P	SYNTHESIS OF NANOMATERIALS-LABORATORY	0	0	3	2	50	50	100
Objective(s)	Understand the different methods to prepare the nanoparticles and technical skill on the process method. Study the various properties of the nanostructured materials at their nanoscale.							
1. Preparation of nanoparticles – Chemical reduction method 2. Preparation of nanoparticles – sol-gel method 3. Preparation of nanoparticles- Sonochemical Reactor 4. Preparation of nanoparticles – Ball milling 5. Synthesis of nano composite materials – Spray Pyrolyser 6. Effect of particle size on Physical / Chemical properties 7. Synthesis of Nano particles – Spray Pyrolyser 8. Imaging of Nano particles – AFM 9. Nano patterning – AFM								
					Total Hrs	45		

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Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510201C	ADVANCED CHARACTERISATION TECHNIQUES	3	1	0	4	50	50	100
Objective(s)	Understand the relative methods of various characterisation techniques and the basic knowledge about the different characterisation techniques. Impart the knowledge about the characterisation techniques and study each and every technique and acquire the knowledge to use the technique.							

1	OPTICAL MICROSCOPY	Total Hrs	9
Optical absorption and emission spectroscopy – Basics - AAS – ICP OES – Electron Microscopy: Scanning electron microscopy – Transmission electron microscopy – Scanning tunneling electron microscopy – Image collection in electron microscopes – Environmental transmission electron microscopy – Electron energy loss spectroscopy at the nanometer scale – In-situ nano measurements.			
2	SCANNING PROBE MICROSCOPY	Total Hrs	9
Scanning Probe microscopy – Atomic manipulations – Atomic force microscopy – Scanning probe lithography – Optical microscopy – Confocal microscopy – Scanning near field optical microscopy – Secondary ion mass (SIMS) spectrometry – Matrix assisted laser desorption ionization mass spectrometry (MALDIMS).			
3	SPECTROSCOPY	Total Hrs	9
Spectroscopy of semiconductors – Excitons – Infrared surface spectroscopy – Raman spectroscopy – Brillouin spectroscopy – Dynamic Light Scattering (DLS) – NMR Spectroscopy – ESR spectroscopy – Mossbauer spectroscopy – Thermo gravimetric Analysis (TGA) – Differential Scanning Calorimetry (DSC) – Thermo mechanical Analysis (TMA).			
4	MECHANICAL CHARACTERISATION	Total Hrs	9
Mechanical Characterization – Modulus and load carrying capability of nano region/ compression - micro hardness – Fatigue – Abrasion and wear resistance – Super plasticity – Nano indentation – Nano tribology – Nano tribometre – Surface Force apparatus – Quartz crystal microbalance – Friction force microscope.			
5	DIFFRACTOMETER	Total Hrs	9
Neutron and X- ray diffraction – Debye Scherrer formula – Dislocation density – Micro strain macromolecular crystallography using synchrotron radiation – Role for neutron scattering in nano science - Photoluminescence - Thermo luminescence – X-ray absorption Fine Structure (XAFS) – Extended X- ray absorption fine structure (EXAFS) – Electron scattering for chemical Analysis (ESCA).			
Total hours to be taught			45

Reference(s) :

1	T.Pradeep, “Nano: The Essentials”,Tata McGraw Hill, New Delhi, 2007.
2	Charles P Poole Jr and Frank J Ownes, “Introduction to Nanotechnology”, John Wiley Sons, 2003.
3	Pulickel M.Ajayan, Linda S.Schadler, Paul V.Braun, “Nanocomposite Science and Technology”, Wiley – VCH Verlag, weiheim, 2003.
4	Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkar Raguse, “Nanotechnology: Basic sciences and emerging technologies”, Overseas Press, 2005.
5	Willard, “Instrumental Methods of Analysis”, 2000.
6	Ewing. Etal, “Instrumental Methods for Chemical Analysis”, 2000.

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Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510202C	NANOMATERIALS AND NANOMEDICINE	3	0	0	3	50	50	100
Objective(s)	Understand the principle behind nanomedicine and understand the application of Nanomaterials in medicine. Impart knowledge about drug delivery systems and nanosensors. Impart the knowledge to apply the Nanomaterials in different medical applications and gain the knowledge for the solution of right nanomaterials for biomedical applications.							
1	BASIC OF NANOBIOMOLECULES				Total Hrs	9		
Structure property relationship of Biological Materials: Nano Structure of proteins and Polysaccharides – Structure property relationship of tissues, bones and teeth - Collagen rich tissues - elastic tissues - Preparation of nano biomaterials – Polymeric scaffolds collagen – Elastins – Mucopolysaccharides – Proteoglycans - Cellulose and derivates – Dextrans – Alginates – Pectins - Chitin.								
2	TYPES OF NANOBIOMOLECULES				Total Hrs	9		
. Introduction - Development of nano medicines – Nano Shells – Nano pores – Tectodendrimers – Nano particle drug system for oral administration – Drug system for nasal administration – Drug system for ocular administration – Nanotechnology in diagnostic application.								
3	DNA - NANOBIOTECHNOLOGY				Total Hrs	9		
Introduction – Antibody conjugated nanoparticles – Conjugated nanoparticles interaction with biological surfaces – Biomedical nanoparticles – Liposome's – Dentrimers – Different types of drug loading – Drug release – Biodegradable polymers – Applications.								
4	NANOSTRUCTURED MATERIALS IN MEDICINE				Total Hrs	9		
Gold and Silver nanoparticles in cancer targeting and treatment – Nanoparticles in treatment of breast cancer – Chemotherapy – Active and Passive cancer tissue targeting – Micro fluidics – Chemotherapeutic agents – Immunotherapy – Vaccine immunotherapy – Radiotherapy – Thermotherapy – Photo dynamic therapy – Nano particulate targeting.								
5	NANOSENSORS				Total Hrs	9		
Introduction to nano sensors – Organization techniques – Ion sensing at nano particle surface – Cation sensing – Anion sensing – Surface confined chemical sensors – Nanoparticles sensors – Calorimetric sensing – Vapor phase sensing – Raman sensing at surfaces – Electro analytical sensing – Plasma and optical sensing.								
Total hours to be taught						45		
Reference(s) :								
1	J. B Park, "Biomaterials Science and Engineering", Plenum Press, New York, 1984.							
2	T. Pradeep, "Nano: The essentials" , McGrew – Hill, 2007							
3	J.J. Davis, Dekker, "Encyclopedia of Nanoscience and nanotechnology"							
4	Natalie P. Praetories and Tarun K. Mandal, Recent Patents on Drug Delivery& Formulation							
5	Y. Lu, S.C. Chen, Advanced Drug Delivery Reviews.							

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Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510203C	INDUSTRIAL NANOTECHNOLOGY	3	0	0	3	50	50	100
Objective(s)	Understand the applications of nanomaterials in industries and study the relative methods of various principles and their industrial applications							

1	SEMICONDUCTING NANOPARTICLES	Total Hrs	9
Semiconductor physics - Fabrication techniques - Electronic structure and physical processes in semiconductor nanostructures - Principles and performance of semiconductor nanostructure based electronic and electro - Optical devices.			
2	MAGNETIC NANOPARTICLES	Total Hrs	9
Revision of magnetism in solids – Property - Nanostructure relationships - Fabrication and properties of nanostructured magnets - Probes of nanomagnetic properties - Electronic magneto – Transport - Micro magnetic modeling.			
3	NEMS & MEMS	Total Hrs	9
Micro and Nano-Electromechanical systems - Fabrication process - Choice of materials - Calculations - The performance of different structures - Advantages and disadvantages of different approaches - Thermal – Radiation - Magnetic, chemical, and mechanical sensors - Micro actuators.			
4	MOLECULAR ELECTRONICS	Total Hrs	9
Hybridization – Conjugation – Excitations - Molecular crystals - Conducting vs. semiconducting polymers - Organic electroluminescent displays injection – Transport - Exciton formation – Light emission - Influence of supermolecular order: excimers - H- and J- aggregates – Liquid crystallinity.			
5	APPLICATION OF NANOPARTICLES IN INDUSTRY	Total Hrs	9
Nanoparticles and Micro – Organism, Nano-materials in bone substitutes & Dentistry, Food and Cosmetic applications, Textiles, Paints, Catalysis, Drug delivery and its applications.			
Total hours to be taught			45

Reference(s) :

1	J. Verdeyen, “Laser Electronics”, II Edition, Prentice Hall, 1990.
2	C.W. Turner, T. Van Duzer, “Principles of Superconductive Devices and Circuits”, 1981
3	Reynolds, M.Pomeranty, “Electroresponsive molecules and polymeric systems”, Skotheim T. Marcel Dekker New York, 1991.
4	A . Yariv, “Principles of Optical Electronics”, John Wiley, New York, 1984
5	M C Petty, M R Bryce, D Bloor (eds.), ’Introduction to Molecular Electronics’, Edward Arnold, London, 1995 (ISBN 0-340-58009-7)
6	G Hadziioannou, P F van Hutten, ’Semiconducting Polymers: Chemistry, Physics, and Engineering’, Wiley-VCH, 2000 (ISBN 3-527-29507-0)
7	D. D. C Bradley, Current Opinion in Solid State & Materials Science Vol. 1, 789 (1996)

K.S. Rangasamy College of Technology - Autonomous Regulation								R 2008
Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510204C	NANOELECTRONICS	3	1	0	4	50	50	100
Objective(s)	Understand the basic about the semiconductor & magnetic materials. Impart the knowledge about the nanostructured semiconducting materials. Understand the different applications of nano semiconductor & nanomagnetic particles in different areas.							
1	BASICS OF NANOELECTRONICS				Total Hrs	9		
Physical fundamentals – Quantization of action, charge and flux – electrons in potential well – photons interacting with electrons in solids – diffusion processes – basic information theory – data & bits – data processing - Size Effects on structure and Morphology of free or Supported Nanoparticles – Size and confinement Effects – Fraction of surface atoms – Specific surface energy and surface stress.								
2	QUANTUM CONCEPTS IN NANOELECTRONICS				Total Hrs	9		
Size dependent absorption spectra - Blue shift with smaller sizes - Phonons in nanostructures - Contacts at Nano level – AFM, ISTM tip on a surface - Electronic states in crystal energy bands - Concepts of 2D nanostructures (quantum wells) - 1 D nanostructures (quantum wires) OD nanostructures (quantum dots) - Artificial atomic clusters - Size dependent properties.								
3	NANOMATERIALS PROCESSING				Total Hrs	9		
Nanosystems Synthesis - Molecular beam epitaxy – MOCVD - Chemical routes - Nanoparticles on polymers - Pulsed laser deposition - Ion beam assisted techniques including embedded nanoparticles - RF sputtering.								
4	PROPERTIES OF NANOPARTICLES				Total Hrs	9		
Charging of quantum dots - Coulomb blockade - Quantum mechanical treatment of quantum wells - Wires and dots - Widening of band gap in quantum dots - Strong and weak confinement - Properties of coupled quantum dots - Optical scattering from nano defects.								
5	NANOCOMPOSITES				Total Hrs	9		
Nanocomposites Electronic and atomic structure of aggregates and nanoparticles Theory and modeling of nanoparticles fictionalization processes – Nanoelectronics with super conducting devices – Microscopic characteristics and model – Switching devices – Application of super conducting devices.								
Total hours to be taught						45		
Reference(s) :								
1	Keith Barnham, Dimitri Dimitrievich Vvedensky, "Low-dimensional semiconductor structures: fundamentals and device applications", Cambridge University Book, 2001.							
2	L.Banyai and S.W.Koch, "Semiconductor Quantum Dots", World Scientific, 1993.							
3	J.H. Davies, "An introduction to the physics-at low dimensional semiconductors", Cambridge Press, 1998.							
4	Karl Goser, Peter Glosekotter, Jan Dienstuhl, "Nanoelectronics and Nanosystems", Springer, 2004.							

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Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510205C	NANOLITHOGRAPHY	3	0	0	3	50	50	100
Objective(s)	Understand the basic about nanolithography and impart the knowledge for the different lithography techniques. Impart knowledge about the lithography application of different industries and study the use of AFM in nano lithography							
1	BASICS IN LITHOGRAPHY				Total Hrs	9		
Lithography – Printing – Chemical process – Refinements – The modern process – Optical, micro, nanolithography – Lithography in artistic medium – Nanometer design for electronic circuits – Applications of nanolithography.								
2	OPTICAL LITHOGRAPHY				Total Hrs	9		
Optical lithography – Light sources – Photo mask and alignment - Resolution in projection systems – Positive and negative photo resists – Ultraviolet lithography – X ray Lithography - Proximity printing – X ray masks – X ray sources – Synchrotron radiation – X ray projection – X ray resists.								
3	ION BEAM LITHOGRAPHY				Total Hrs	9		
Ion beam lithography - Focused ion beam – Point sources of Ion – Ion column – Beam writing – Masked Ion Beam Lithography – Ion projection Lithography - Electron Lithography – Electron optics – Raster scan and vector scan – Electron proximity / Projection Printing - Electron resists – Electron Beam Applications.								
4	MICROLITHOGRAPHY				Total Hrs	9		
Microlithography – Microchips - Immersion lithography – Semiconductor processing – MEMS design - Nanolithography - Nanosphere lithography – Molecular self-assembly nanoimprint lithography - Dip-pen nanolithography - Soft lithography - Stereo -lithography - Nanoscale 3D shapes – NEMS design.								
5	NANOLITHOGRAPHY TOOLS				Total Hrs	9		
Tools for nanolithography - Molecular manipulation by STM and AFM - LB film resists - Nanopattern synthesis – Nano scratching – Resist & imaging layers.								
Total hours to be taught						45		
Reference(s) :								
1	James R. Sheats, Bruce W. Smith, “Microlithography Sciences and Technology”, CRC Press, 1998.							
2	M.Gentili, Carlo Giovannella, Stefano Selci, “Nanolithography: A Borderland between STM, EB, IB, and X-Ray Lithographies”, 1st edition, Springer, 1994.							
3	P. Rai-Choudhury, “Handbook of microlithography, micromachining, and micro fabrication”, IET, 1997.							
4	W.R.Fahrner, “Nanotechnology and Nanoelectronics – Materials, Devices, Measurement Techniques”, Springer, 2006.							
5	David G.Bucknall, ”Nanolithography and Patterning techniques in microelectronics”, CRC Press, 2005.							

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Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510206C	ADVANCED NANOBIOTECHNOLOGY	3	0	0	3	50	50	100
Objective(s)	Understand the basic knowledge of Nanobiotechnology and DNA structures. Understand the application of nanomaterials in biotechnology and acquire the knowledge about the DNA, proteins, amino acids, drug delivery, biomedicine etc.,							
1	INTRODUCTION				Total Hrs	9		
Interdisciplinary areas of Biotech and Nanoscience - Biological systems – Cells – Cellular components - Nucleis acids and proteins refinement and application of instruments – To generate and manipulate nanostructured materials to basic and applied studies.								
2	INTERPHASE SYSTEMS				Total Hrs	9		
Interphase systems of devices for medical implants – Microfluidic systems – Microelectronic silicon substrates – Nano-biometrics – Introduction – Lipids as nano-bricks and mortar: self assembled nanolayers.								
3	PROTEIN BASED NANOSTRUCTURES				Total Hrs	9		
Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers of biomolecular recognition events – Nanobioelectronic devices and polymer nanocontainers – Microbial production of inorganic nanoparticles – Magnetosomes.								
4	DNA BASED NANOSTRUCTURES				Total Hrs	9		
DNA based nanostructures – Topographic and Electrostatic properties of DNA and proteins – Hybrid conjugates of gold nanoparticles – DNA oligomers – Use of DNA molecules in nanomechanics and Computing.								
5	APPLICATION OF NANOBIOTECHNOLOGY				Total Hrs	9		
Semiconductor (metal) nanoparticles and nuclic acid and protein based recognition groups – Application in optical detection methods – Nanoparticles as carrier for genetic material – Nanotechnology in agriculture – Fertiliser and pesticides.								
Total hours to be taught						45		
Reference(s) :								
1	CM, Niemeyer, C.A. Mirkin, “Nanobiotechnology: Concepts, Applications and Perspectives”, Wiley – VCH, 2004.							
2	T. Pradeep, “Nano: The Essentials”, McGraw – Hill education, 2007.							
3	Challa, S.S.R. Kumar, Josef Hormes, Carola Leuschaer,”Nanofabrication Towards Biomedical Applications, Techniques, Tools, Applications and Impact”, Wiley – VCH, 2005.							
4	Nicholas A. Kotov, “Nanoparticle Assemblies and Superstructures”, CRC, 2006.							

<table>
<tr><td colspan="7">K.S. Rangasamy College of Technology - Autonomous Regulation</td><td>R 2008</td></tr>
<tr><td>Department</td><td colspan="2">Nanoscience and Technology</td><td colspan="2">Program code & Name</td><td colspan="3">51 : M.Tech - Nanoscience and Technology</td></tr>
<tr><td colspan="8">Semester II</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="2">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>ES</td><td>Total</td></tr>
<tr><td>08510207P</td><td colspan="2">CHARACTERISATION OF NANOMATERIALS - LABORATORY</td><td>0</td><td>0</td><td>3</td><td>2</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Objective(s)</td><td colspan="7">Understand the different characterisation techniques and acquire knowledge on the various characterisations of nanostructured materials.</td></tr>
<tr><td colspan="8">• Particle size determination – XRD*
• Particle size determination – (DLS/ SLS)
• Determination of surface area – porosity - nanoparticles
• Morphological study of nano particles – SEM/ TEM*
• Surface Topographic study of Nanoparticles - AFM
• Identification of functional group of nanoparticles - FTIR
• Nano lithography*
* Field study at any one of the Research Labs / Centres</td></tr>
<tr><td colspan="7">Total Hrs</td><td>45</td></tr>
</table>

K.S. Rangasamy College of Technology - Autonomous Regulation								R 2008
Department	Nanoscience and Technology		Program code & Name		51 : M.Tech - Nanoscience and Technology			
Semester II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510208P	TECHNICAL REPORT PREPARATION AND PRESENTATION I	0	0	2	0	100	00	100
Objective(s)	To provide exposure to the students to refer, read and review the research articles in referred journals and conference proceedings. To improve the technical report writing and presentation skills of the students.							
Methodology	• Each student is allotted to a faculty of the department by the HOD • By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student. • The students have to refer the Journals and conference proceedings and collect the published literature. • The student is exposed to collect at least 20 such Research papers published in the last 5 years. • Using OHP/Power point, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion. • The student has make two presentations, one at the middle and the other near the end of the semester. • The student has to write a Technical report for about 30-50 pages (Title page, One page Abstract, review of research paper under various subheading, Concluding remarks and List of References). The technical report has to b submitted to the HOD one week before the final presentation, after the approval of the faculty guide.							

Execution	Week	Activity
	I	Allotment of Faculty Guide by the HOD
	II	Finalizing the topic with the approval of Faculty Guide
	III-IV	Collection of Technical papers
	V – VI	Mid semester presentation
	VII – VIII	Report writing
	IX	Report Submission
	X-XI	Final presentation

Evaluation	• 100 % Continuous Assessment • 3hrs/week and 2 credits	
	Component	Weightage
	Phase – I Presentation	25 %
	Phase – II Presentation	25 %
	Report preparation and Submission	30 %
	Final presentation	20 %
	Total	100%

K.S. Rangasamy College of Technology - Autonomous Regulation								R 2008
Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Semester III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510301C	NANODEVICES	3	0	0	3	50	50	100
Objective(s)	To understand the development of nanoelectronics. To study the principle behind the nanodevices. To explore the application of nanodevices. To understand and study the molecular and bioelectronics on nano application.							

1	QUANTUM DEVICES	Total Hrs	9
Quantum Electronic devices – upcoming electronic devices – Electrons in mesocopic structures – Short-channel MOS Transistor – split Gate Transistor – Electron wave transistor – Electron spin transistor – Quantum cellular Automata – Quantum Dot array – Quantum computer- Bit and Qubit – Coherence and Entanglement – Quantum Parallelism.			
2	TUNNELING DEVICES	Total Hrs	9
Tunneling element – Tunnel Effect and Tunneling Elements-Tunneling Diode – Resonant Tunneling Diode – Three -Terminal Resonate Tunneling Devices-Technology of RTD-Digital circuits design based on RTDs – Memory Applications – Basics Logic Circuits – Dynamic Logic Gates - Digital circuits design based on RTBT – RTBT Mobile – RTBT Threshold Gate – RTBT Multiplexer – Single Electron Transistor(SET) – Principle – Coulomb Blockade- Performance – Technology- Circuit Design- Writing and Drivers – Logic and Memory Circuits – SET adder as an Example of a Distributed Circuit – Comparison between FET and SET.			
3	SUPERCONDUCTING DEVICES AND PHOTONICS	Total Hrs	9
Basics - Macroscopic characteristics – Macroscopic model- Super conducting switching Devices – Cryotron-Josephson Tunneling Devices- Elementary circuits – Associative or Content – Addressable Memory - SQUID – Flux Quantum device –LC –Gate – Magnetic Flux Quantum – Quantum cellular Automata- Quantum computer with Single Flux devices – SFQD- RSFQD – Application of superconducting devices – Intergrated Electronices – Comparison of FET Electronics. Introduction to Photonics - Principle- Fabrication –application.			
4	UNCERTAINTY OF NANODEVICES	Total Hrs	9
Limits of Integrated Electronics- Survey of Limits – Replacement of Technologies – Energy Supply and Heat Dissipation – Parameter Spread as Limiting Effect – Limits due to Thermal Particle motion- Debye Length – Thermal Noise- Reliability of as Limiting Factor – Physical limits – Thermodynamic Limits - Relativistic Limits – Equal Failure Rates by Tunneling and Thermal Noise – Final Objectives of Integrated Electroc Systems - Removal of uncertainty by Nanomachines – Uncertainties in Nanosystems- Uncertainties in the Development of Nanoelectronices.			
5	MOLECULAR AND BIOELECTRONICS	Total Hrs	9
Bioelectronics – molecular processor – DNA Analyser molecular electronics – switches based on fullerenes and nanotubes – polymer electronic – self Assembling circuits – optical molecular memories – DNA computer – Information Processing with chemical reaction – Nanomachines – Parallel Processing - Drexler – Smalley debate – realistic projection- Synergy of Nano-Bio-Info.			
Total hours to be taught			45

Reference(s) :

1	K. Goser, P. Glosekotter and J. Dienstuhl, “Nanoelectronics and Nanosystems-From Transistors to Molecular Quantum Devices” , Springer, 2004.
2	Herve Rigneault, Jean-Michel Lourtioz, Claude Delalande, Ariel Levenson, “Nanophotonics”, ISTE.
3	W.R.Fahrner, “Nanotechnology and Nanoelectronics – Materials, Devices and Measurement Techniques” Springer, 2006.

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Semester III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510304P	PROJECT WORK - PHASE I	0	0	12	6	100	00	100
Objective(s)	To exposure the students with Innovative Ideas. To provide exposure to the students to new areas of nanotechnology Introduction to solve a scientific problem in both practically and theoretically							
Methodology	• Each student is allotted to a faculty of the department by the HOD • By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student. • The students have to refer the Journals and conference proceedings and collect the published literature. • The student is exposed to collect at least 25 such Research papers published in the last 5 years. • Using Power point, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion. • The student has make two presentations, one at the middle and the other near the end of the semester. • The student has to write a mini project report for about 30-50 pages (Title page, One page Abstract, review of research paper under various subheading, Concluding remarks and List of References). The project report has to be submitted to the HOD one week before the final presentation, after the approval of the faculty guide.							

Execution	Week	Activity
	I	Allotment of Faculty Guide by the HOD
	II	Finalizing the topic with the approval of Faculty Guide
	III-IV	Collection of Scientific papers
	V – VI	Mid semester presentation
	VII – VIII	Report writing
	IX	Report Submission
	X-XI	Final presentation

Evaluation	• 100 % Continuous Assessment • 3 hrs/week and 2 credits	
	Component	Weightage
	Phase – I Presentation	25 %
	Phase – II Presentation	25 %
	Report preparation and Submission	30 %
	Final presentation	20 %
	Total	100%

K.S. Rangasamy College of Technology - Autonomous Regulation								R 2008
Department	Nanoscience and Technology		Program code & Name		51 : M.Tech - Nanoscience and Technology			
Semester III								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510305P	TECHNICAL REPORT PREPARATION AND PRESENTATION II	0	0	2	0	100	00	100
Objective(s)	To provide exposure to the students to refer, read and review the research articles in referred journals and conference proceedings. To improve the technical report writing and presentation skills of the students.							
Methodology	• Each student is allotted to a faculty of the department by the HOD • By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student. • The students have to refer the Journals and conference proceedings and collect the published literature. • The student is exposed to collect at least 20 such Research papers published in the last 5 years. • Using OHP/Power point, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion. • The student has make two presentations, one at the middle and the other near the end of the semester. • The student has to write a Technical report for about 30-50 pages (Title page, One page Abstract, review of research paper under various subheading, Concluding remarks and List of References). The technical report has to b submitted to the HOD one week before the final presentation, after the approval of the faculty guide.							

Execution	Week	Activity
	I	Allotment of Faculty Guide by the HOD
	II	Finalizing the topic with the approval of Faculty Guide
	III-IV	Collection of Technical papers
	V – VI	Mid semester presentation
	VII – VIII	Report writing
	IX	Report Submission
	X-XI	Final presentation

Evaluation	• 100 % Continuous Assessment • 3hrs/week and 2 credits	
	Component	Weightage
	Phase – I Presentation	25 %
	Phase – II Presentation	25 %
	Report preparation and Submission	30 %
	Final presentation	20 %
	Total	100%

K.S. Rangasamy College of Technology - Autonomous Regulation								R 2008
Department	Nanoscience and Technology		Program code & Name		51 : M.Tech - Nanoscience and Technology			
Semester IV								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510401P	PROJECT WORK - PHASE II	0	0	40	20	50	50	100
Objective(s)	To make the students with Innovative Ideas. To provide exposure to the students to new areas of nanotechnology. To solve a scientific problem in both practically and theoretically							
Methodology	• Each student is allotted to a faculty of the department by the HOD • By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student. • The students have to refer the Journals and conference proceedings and collect the published literature. • The student is exposed to collect at least 50 such Research papers published in the last 5 years. • Using Power point, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion. • The student has make two presentations, one at the middle and the other near the end of the semester. • The student has to write a project report for about 30-50 pages (Title page, One page Abstract, review of research paper under various subheading, Concluding remarks and List of References). The project report has to be submitted to the HOD one week before the final presentation, after the approval of the faculty guide.							

Execution	Week	Activity
	I	Allotment of Faculty Guide by the HOD
	II	Finalizing the topic with the approval of Faculty Guide
	III-IV	Collection of Scientific papers
	V – VI	Mid semester presentation
	VII – VIII	Report writing
	IX	Report Submission
	X-XI	Final presentation

Evaluation	• 50 % Continuous Assessment and 50 % End semester exam • 30 hrs/week and 20 credits	
	Component	Weightage
	Phase – I Presentation	15 %
	Phase – II Presentation	15 %
	Report preparation and Submission	20 %
	Viva - Voce	50 %
	Total	100%

K.S. Rangasamy College of Technology - Autonomous Regulation								R 2008
Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Elective I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510341E	MICRO ELECTRO MECHANICAL SYSTEMS (MEMS) AND NANO ELECTROMECHANICAL SYSTEMS (NEMS)	3	0	0	3	50	50	100
Objective(s)	To explore the knowledge on Silicon Technology. To understand the principle, architecture, fabrication and application of MEMS. To study the properties of materials used for MEMS design. To explore the basic principle and fabrication and application of NEMS. To explore the application of NEMS & MEMS							

1	POTENTIAL OF SILICON TECHNOLOGY	Total Hrs	9
Development of microelectronics – nanostructure region – complexity problem – challenges in nanoelctronics - Semiconductor as based materials – band diagram of semiconductor – inhomogeneous semiconductor band diagram - different types of transistor integration -microminiaturization process-methods and limits- scaling – milestone of silicon technology – limits - microelectronic and mechanical systems (MEMS) – micromechanics technology – micromechanics for nanoelctronics – integrated optoelectronics.			
2	MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)	Total Hrs	9
Silicon micromachining – bulk micromachining – surface micromachining - Microsystems fabrication techniques – photolithography – ion implantation – diffusion – oxidation – CVD – PVD – sputtering – single crystal reactive etching – LIGA – x-ray based fabrication – packaging of MEMS devices – three level microsystem packaging – device level packaging – system level packaging – interface in microsystem packaging – packaging technology – sealing – 3D packaging – assembly of microsystem - selection of packaging materials.			
3	MATERIALS AND DESIGN OF MEMS	Total Hrs	9
Single crystal silicon - Poly silicon – silicon dioxide – silicon nitride – germanium based materials-metals-silicon carbide-diamond - III-V materials – piezoelectric materials. Design – considerations – selection of materials – selection of manufacturing process – process design – photolithography – thin film fabrication – geometry shaping – mechanical design – thermo mechanical loading thermo mechanical stress analysis – dynamic analysis – interfacial fracture analysis – mechanical designing methods – computer aided designing.			
4	APPLICATION OF MEMS AND NEMS	Total Hrs	9
Inertial sensors – accelerometer – gyroscope - micromechanical pressure sensors – pizo resistive – capacitive - micro robotics – micro channel heat sinks – optical MEMS – visual display – precision optical platform – optical data switching – RF MEMS – MEMS variable capacitors – MEMS switches – Resonators.			
5	NANO ELECTROMECHANICAL SYSTEMS (NEMS)	Total Hrs	9
Introduction – nano machining of NEMS based upon electron beam lithography – Nano electromechanical systems fabrication – nano imprint lithography – polymeric nano fiber templates – focused ion beam doping wet chemical etching – stencil lithography and sacrificial etching – large scale integration – future challenges - applications.			
Total hours to be taught			45

Reference(s) :

1	K. Goser, P. Glosekotter and J. Dienstuhl, “Nanoelectronics and Nanosystems - From Transistors to Molecular Quantum Devices” Springer, 2004.
2	Tai –Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw-Hill publication, 2001.
3	P. Rai-Choudhury, “MEMS and MOEMS technology and applications”, PHI learning private Ltd, 2009.
4	Mohamed Gad-el-Hak, “The MEMS Handbook”, CRC Press, 2002.

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Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Elective I								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510342E	NANO BIOPHYSICS	3	0	0	3	50	50	100
Objective(s)	To provide exposure to the students on biophysics in nanotechnology. To explore the cancer therapy and drug delivery system. To study the various devices used for nanotechnology							
1	IMAGING TECHNIQUES				Total Hrs	9		
Medical diagnostics – Imaging – MRI – Principal, Instrumentation, Operation and Imaging - NMR – Principal, Instrumentation, Operation and imaging - Nanotechnology based diagnostics including imaging - Applications.								
2	NANO BIOACTIVE GLASSES				Total Hrs	9		
Introduction - Nano Bioactive glasses – Preparation – Methods - Nanobioactive glass powders – Properties – Mechanical-measurement of bioactivity – *In vitro* studies - coating on metallic implant – Characterisation - Implant applications.								
3	CANCER TREATMENT				Total Hrs	9		
Gold and Silver nanoparticles in cancer targeting and treatment - Nanoparticles in treatment of breast cancer – Chemotherapy: Active and Passive cancer tissue targeting – micro fluidics – Chemotherapeutic agents – Immunotherapy – Vaccine immunotherapy – Radiotherapy – Thermotherapy – Photo dynamic therapy – Nano particulate targeting.								
4	DRUG DELIVERY				Total Hrs	9		
Introduction, Antibody conjugated nanoparticles – Conjugated nanoparticles interaction with biological surfaces – Biomedical nanoparticles – Liposomes - Dentrimers - Different types of drug loading, drug release and Biodegradable polymers – Applications.								
5	NANOSENSORS				Total Hrs	9		
Introduction to nano sensors – Organization techniques **–** Ion sensing at nano particle surface – cation sensing – anion sensing – surface confined chemical sensors – nanoparticle sensors – calorimetric sensing – vapor phase sensing – Raman sensing at surfaces – electro analytical sensing – plasma and optical sensing.								
Total hours to be taught						45		
Reference(s) :								
1	Dimiter S. Dimitrov, Colloids and Surfaces A: Physicochem. Eng. Aspects							
2	James A. Schwarz, Cristian I. Contescu, Karol Putyera, “Dekker encyclopedia of nanoscience and nanotechnology” CRC Press, 2004.							
3	Natalie P. Praetorius and Tarun K. Mandal, *Recent Patents on Drug Delivery & Formulation*							
4	Maksym V Yezhelyev, Xiaohu Gao, Yun Xing, Ahmad Al-Hajj, Shuming Nie, Ruth M O’Regan, *Lancet Oncol*							
5	Y. Lu, S.C. Chen, “Micro and nano-fabrication of biodegradable polymers for drug delivery” Advanced Drug Delivery Reviews, 56 (1621-1633) 2004.							
6	Wei Xia and Jiang Chang, Preparation and characterization of nano-bioactive-glasses (NBG) by a quick alkali-mediated sol–gel method, Materials letters, 61 (3251-3253) 2007.							

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Elective II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510351E	NANOSAFETY AND ENVIRONMENTAL ISSUES	3	0	0	3	50	50	100
Objective(s)	To provide exposure to the students on safety and environmental issues of nano science and technology. To explore the toxic effects of nanotechnology on human health and life. To analyze the various issues on environmental effects and explore suitable remedial measures.							

1	NANOSAFETY – INTRODUCTION	Total Hrs	9
Identification of Nano - Specific Risks- Responding to the Challenge -Human health hazard – Risk reduction – Standards – Safety – transportation of NP– Emergency responders. Risk assessment –Environmental Impact – Predicting hazard – Materials Characterization. Risk Assessment related to nanotechnology – Environmental and policy making- Ecotoxicity measurement of Polychlirinated biphenyl and intermediates in their degradation			
2	NANOTOXICOLOGY	Total Hrs	9
Inhalation of nanomaterials – Overview. Introduction- Inhalation deposition and Pulmonary clearance of Insoluble Solids – Bio –persistence of Inhaled solid material. Systemic Trenslocation of inhaled Particles. Pulmonary effects of SWCNT- Pulmonary Inflammatory Responses to SWCNTs *In Vivo* - Interactions of pulmonary Inflammation with oxidative stress – Interactions of SWCNTs with Macrophages			
3	EXPERIMENTAL AND FIELD ISSUES	Total Hrs	9
Nanoparticle exposure and systematic cardiovascular effects – experimental data – respiratory particulate matter exposure and cardiovascular toxicity, Nanoparticles – Hypothesis and research approaches. SWCNT – Experimental data. Toxicity of polymeric nanoparticles with respect to their application as drug carriers. Particle exposure through the indoor air environment –Measurement of indoor of PM and experimental study.			
4	NANOSAFETY	Total Hrs	9
Needs for regulations, training and education for health protection and environmental security of nanotechnologies – definitions and essence – general benefits – benefits for health and medical practice – potential risks – The approaches to assessment of exposure to the nanotechnology. Bioethics and legal aspects of potential health and environmental risks in nanotechnology – Legal regulatory considerations of nanotechnology.			
5	CHALLENGES AND FUTURES	Total Hrs	9
Nanotechnology – the frame of worker training, public education, and participation – Introduction – Nanotoxicity – Workers protection – International documents – protection of medical staff – Nurses education – Public information. Occupational risk assessment and management – focus on nanomaterials.			
Total hours to be taught			45

Reference(s) :

1	P.P. Simeonova, N. Opopol and M.I. Luster, “Nanotechnology - Toxicological Issues and Environmental Safety”, Springer 2006.
2	Vinod Labhasetwar and Diandra L. Leslie, “Biomedical Applications of nanotechnology”, A John Willy & son Inc,NJ, USA, 2007 .
3	Miyawaki, J.; *et.al* Toxicity of Single-Walled Carbon Nanohorns. *ACS Nano 2* (213–226) 2008.
4	Hutchison, J. E. Green Nanoscience: A Proactive Approach to Advancing Applications and Reducing Implications of Nanotechnology. *ACS Nano 2*, (395–402) 2008.
5	Mo-Tao Zhu *et.al* Comparative study of pulmonary responses to nano- and submicron-sized ferric oxide in rats Toxicology, 21 (102-111) 2008.
6	Dracy J. Gentleman, Nano and Environment: Boon or Bane? Environmental Science and technology, *43* (5), P1239, 2009.

K.S. Rangasamy College of Technology - Autonomous Regulation								R 2008
Department	Nanoscience and Technology	Program code & Name			51 : M.Tech - Nanoscience and Technology			
Elective II								
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	ES	Total
08510352E	INTELLECTUAL PROPERTY RIGHTS	3	0	0	3	50	50	100
Objective(s)	To provide awareness about IP Rights. To provide exposure to protect the Intellectual property.							

1	INTRODUCTION	Total Hrs	9
Introduction - Invention and Creativity - Intellectual Property (IP) - Importance - Protection of IPR - Basic types of property (i. Movable Property ii. Immovable Property and iii. Intellectual Property).			
2	PATENTS REGISTRATION	Total Hrs	9
IP - Patents - Copyrights and related rights - Trade Marks and rights arising from Trademark registration - Definitions - Industrial Designs and Integrated circuits - Protection of Geographical Indications at national and International levels - Application Procedures.			
3	INTELLECTUAL PROPERTY	Total Hrs	9
International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities - History - General Agreement on Trade and Tariff (GATT).			
4	STRATEGIES	Total Hrs	9
Indian Position Vs WTO and Strategies - Indian IPR legislations - commitments to WTO-Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.			
5	CASE STUDIES	Total Hrs	9
Case Studies on - Patents (Basumati rice, turmeric and Neem) - Copyright and related rights - Trade Marks - Industrial design and Integrated circuits - Geographic indications - Protection against unfair competition.			
Total hours to be taught			45

Reference(s) :

1	N.R. Subbaram," Handbook of Indian Patent Law and Practice ", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.
2	Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1794.
3	Intellectual Property Today: Volume 8, No. 5, May 2001, [www.iptoday.com].