SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

B.Tech. (Full Time) – Nanotechnology

Curriculum & Syllabus

2009- 2010

Faculty of Engineering & Technology
SRM University
SRM Nagar, Kattankulathur – 603 203

SRM UNIVERSITY
B.TECH. NANOTECHNOLOGY
CURRICULUM AND SYLLABUS
2009-2010

Semester – I

Code	Category	Course	L	T	P	C
Theory						
LE0101	G	English	1	0	2	2
MA0101	B	Mathematics – I	3	2	0	4
PH0101	B	Physics	3	0	0	3
CY0101	B	Chemistry	3	0	0	3
GE0101	E	Basic Engineering – I	4	0	0	4
Practical						
PD 0101	G	Personality Development – I*	0	0	2	0
GE 0107	G	NSS/NCC/NSO/YOGA	0	0	2	1
GE0105	B	Computer Literacy	0	0	2	1
PH0103	B	Physics Laboratory	0	0	2	1
CY0103	B	Chemistry Laboratory	0	0	2	1
ME0120/ME0130	E	Workshop Practice / Engineering Graphics	0/1	0	4	2/3
		Total	**14/15**	**2**	**16**	**22/23**
		Total Contact Hours	**32/33**			

Semester – II

Code	Category	Course	L	T	P	C
Theory						
GE0108	G	Value Education	1	0	0	1
MA0102	B	Mathematics – II	3	2	0	4
PH0102	B	Materials Science	2	0	2	3
GE0102	B	Biology for Engineers	2	0	0	2
GE0104	B	Principles of Environmental Science	2	0	0	2
GE0106	E	Basic Engineering – II	4	0	0	4
NT0102	P	Elements of Nanoscience and Nanotechnology	3	0	0	3
Practical						
PD0102	G	Personality Development – II*	0	0	2	0
CS0140	B	Computer Practice	1	0	2	2
ME0130/ME0120	E	Engineering Graphics / Workshop Practice	1/0	0	4	3/2
		Total	**19/18**	**2**	**10**	**24/23**
		Total Contact Hours	**31/30**			

G: General programme comprising language/communication skills, humanities and social sciences, economics and principles of management, and NSS/NCC/NSO/YOGA.

B: Basic sciences comprising Computer Literacy with Numerical Analysis, Mathematics, Physics, and Chemistry.

E: Engineering Sciences and Technical Arts comprising Engineering Graphics, Workshop Practice, Basic Engineering, etc.

P: Professional subjects corresponding to the Branch of Studies, which will include core subjects, electives, and project work.

* Audit course

Semester – III

Code	Category	Course	L	T	P	C
Theory						
LE0201/ LE0203/LE0205	G	German / Japanese / French Language Phase – I	2	0	0	2
MA0211	B	Mathematics – III	3	2	0	4
NT0201	E	Basic Engineering-III	4	0	0	4
NT0203	P	Statistical Mechanics and Thermodynamics	3	0	0	3
NT0205	P	Fundamentals of Solid State Technology	3	0	0	3
NT0207	P	Instrumentation Techniques	3	0	0	3
NT0209	P	Properties of Nanomaterials	3	0	0	3
Practical						
PD0201	G	Personality Development – III	0	0	2	1
NT0211	P	Instrumentation Lab – I	0	0	3	2
NT0213	P	Properties of Materials Lab	0	0	3	2
		Total	**21**	**2**	**8**	**27**
		Total Contact Hours	**31**			

Semester – IV

Code	Category	Course	L	T	P	C
Theory						
LE0202/ LE0204 /LE0206	G	German / Japanese / French Language Phase – II	2	0	0	2
MA0232	B	Probability and Random Processes	3	2	0	4
NT0204	P	Synthesis of Nanomaterials	3	0	0	3
NT0206	P	Quantum Mechanics	3	0	0	3
NT0208	P	Bio Nanotechnology	3	0	0	3
NT0210	P	Advanced Electronics and Instrumentation	3	0	0	3
NT0212	E	Basic Engineering –IV	4	0	0	4
Practical						
PD0202	G	Personality Development – IV	0	0	2	1
NT0214	P	Instrumentation Lab – II	0	0	3	2
NT0216	P	Materials Synthesis Lab	0	0	3	2
NT0218	P	Comprehension –I[#]	0	2	0	1
		Total	**21**	**4**	**8**	**28**
		Total Contact Hours	**33**			

Review of the core subjects studied up to the current semester

Semester – V

Code	Category	Course	L	T	P	C
Theory						
MB0301	G	Engineering Economics and Management	3	0	0	3
NT0315	P	Nanophotonics	3	0	0	3
NT0317	P	Micro and Nano Fluidics	3	0	0	3
NT0319	P	Characterization Techniques	3	0	0	3
NT0321	P	Nanotoxicology	3	0	0	3
NT0323	P	Surface and Interfaces	3	0	0	3
Practical						
PD0301	G	Personality Development – V	1	0	2	2
NT0325	P	Characterization Lab	0	0	3	2
NT0327	P	Surface Science Lab	0	0	3	2
NT0329	P	Industrial Training –I*	0	0	2	1
		Total	**19**	**0**	**10**	**25**
		Total Contact Hours	**29**			

* An industrial training of minimum two weeks has to be undergone by the student in the winter/summer vacation of the III/IV semester.

Semester – VI

Code	Category	Course	L	T	P	C
Theory						
NT0320	P	Applications of Nanotechnology	3	0	0	3
NT0322	P	Molecular Nanoelectronics	3	0	0	3
NT0324	P	Polymer and Nanocomposites	3	0	0	3
	P	Elective I	3	0	0	3
Practical						
PD0302	G	Personality Development – VI	1	0	2	2
NT0326	P	Nanoelectronics simulation Lab	0	0	3	2
NT0328	P	Polymer Science Lab	0	0	3	2
NT0330	P	Comprehension – II#	0	2	0	1
NT0332	P	Computer Skills	1	0	2	2
		Total	**14**	**2**	**10**	**21**
		Total Contact Hours	**26**			

Review of the core subjects studied up to the current semester

Semester – VII

Code	Category	Course	L	T	P	C
Theory						
NT0431	P	Spintronics	3	0	0	3
NT0433	P	Thin Film Technology	3	0	0	3
	P	Elective II	3	0	0	3
	P	Elective III	3	0	0	3
Practical						
NT0435	P	Thin Film Technology Lab	0	0	3	2
NT0437	P	Industrial Training – II**	0	0	2	1
NT0439	P	Seminar	0	0	2	1
		Total	**12**	**0**	**7**	**16**
		Total Contact Hours	**19**			

** An industrial training of minimum two weeks has to be undergone by the student in the winter/summer vacation of the V/VI semester.

Semester – VIII

Code	Category	Course	L	T	P	C
Theory						
	P	Elective IV	3	0	0	3
	P	Elective V	3	0	0	3
Practical						
NT0434	P	Project Work	0	0	17	8
		Total	**6**	**0**	**17**	**14**
		Total Contact Hours	**23**			

Summary Table

Semester	I	II	III	IV	V	VI	VII	VIII	Total	%
Total	22	24	27	28	25	21	16	14	177	100
G	3	1	3	3	5	2	0	0	17	9.6
B	13	13	4	4	0	0	0	0	34	19.2
E	6	7	4	4	0	0	0	0	21	11.9
P	0	3	16	17	20	19	16	14	105	59.3

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE:	**177**

LIST OF ELECTIVES

Code	Category	Course	L	T	P	C
NT0001	P	Micro / Nano Devices and Sensors	3	0	0	3
NT0002	P	Functionalization of CNT and Metallic Nanoparticles	3	0	0	3
NT0003	P	Nanorobotics	3	0	0	3
NT0004	P	Advanced drug delivery systems	3	0	0	3
NT0005	P	Lithography techniques and fabrication	3	0	0	3
NT0006	P	Nanomagnetism	3	0	0	3
NT0007	P	Nanotechnology in Health Care	3	0	0	3
NT0008	P	Product Design, Management Techniques and Entrepreneurship	3	0	0	3
NT0009	P	Intellectual Property Rights, Innovation and Technology	3	0	0	3
NT0010	P	Societial Implications of Nanotechnology	3	0	0	3
NT0011	P	MEMS/NEMS	3	0	0	3
NT0012	P	Nanotechnology For Energy Systems	3	0	0	3
NT0013	P	Operation Research	3	0	0	3
NT0014	P	Microelectronics and VLSI	3	0	0	3

ELEC

NOTE:

All electives having odd numbers shall be offered only during odd semesters, others during even semesters.

SYLLABUS

SEMESTER – I

		L	T	P	C
LE 0101	**ENGLISH**	**1**	**0**	**2**	**2**
	Prerequisite				
	Nil				

PURPOSE

To provide an adequate mastery of communicative English Language training primarily - reading and writing skills, secondarily listening and speaking skills.

INSTRUCTIONAL OBJECTIVES
To provide language training to the engineering students which will enable them to understand and acquire knowledge in technical subjects.

LISTENING
Listening Practice – Hints on Listening – Listening Practice
Note Taking: Note Taking Strategies

SPEAKING
Definitions: Expressing Opinions (agreement / disagreement)-Offering Suggestions – Technical Definitions – Describing Objects – speaking practice.
Phonetics: Pronunciation-Phonetic Transcription-Stress-Intonation

READING
Comprehension: Skimming-scanning-close reading-Comprehension – Transferring Information – Exercise – An unseen passage should be given and questions may be asked in the form of True or False statements, MCQ, short answers.
Transcoding : Interpreting tables, flow charts, pie chart, bar diagram, tree diagram, graphs.

WRITING
Art of Writing: Writing Language – Rules for effective writing – Technical Essay Writing – Exercise
Report Writing: Technical Writing – Lab Report – Exercise
Letter Writing : Formal Letters – Letter to the Editor – Letter Inviting Dignitaries – Letter of Application Curriculum Vitae – Placing an Order.
Dialogue Writing

FOCUS ON AND COMMUNICATION AND "COMPUNICATION"
Communication : Basic Concepts – Process – Kinds – Routes – Forms – Factors – Barriers – Triangles Communication (Communicate through Computers – Power Point & Tele Conference).

INTERNAL ASSESSMENT
Based on the submission of Assignments and test performance of the students marks will be awarded.

TEXT BOOKS
1. Abraham Benjamin Samuel *"Practical Communication Communicative English LSRW2000"* – SRMEC – June 2006 Revised Edition.
2. Staff of the Department of Humanities and Social Science, Anna University, *"English for Engineers / Technologist,"* Vol.-I. Orient Longman, 1990.

REFERENCE BOOKS
1. Herbert. A. J. "*The structure of Technical English",* Orient Longman 1995.
2. Pickett and Laster, "*Technical English, Writing, Reading and Speaking"*, New York Harper and Row Publications, 1997.
3. "*Interactive course in phonetics and spoken English"* published by Acoustics Engineers (ACEN) 2002.
4. Munter, Mary, *"Business Communication Strategy and Skill",* Prentice Hall Inc, New Jersey, 1987.

		L	T	P	C
MA 0101	**MATHEMATICS –I**	**3**	**2**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE
To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES
At the end of the course, student should be able

1. To apply advanced matrix knowledge to Engineering problems.
2. To improve their ability in solving geometrical applications of differential calculus problems.
3. To equip themselves familiar with the functions of several variables.
4. To familiarize with the applications of differential equations.
5. To expose to the concept of three dimensional analytical geometry.

MATRICES
Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties of eigen values – Caley-Hamilton theorem – Orthogonal reduction of a symmetric matrix to diagonal form – Orthogonal matrices – Reduction of quadratic form to canonical form by orthogonal transformations.

GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS
Curvature – Cartesian and polar coordinates – Circle of curvature – Involutes and Evolutes – Envelopes – Properties of envelopes.

FUNCTIONS OF SEVERAL VARIABLES
Function of two variables – Partial derivatives – Total differential – Taylor's expansion – Maxima and Minima – Constrained Maxima and Minima by Lagrangean Multiplier method – Jacobians

ORDINARY DIFFERENTIAL EQUATIONS
Simultaneous first order linear equations with constant coefficients – Linear equations of second order with constant and variable coefficients – Homogeneous equation of Euler type – Equations reducible to homogeneous form.

THREE DIMENSIONAL ANALYTICAL GEOMETRY
Direction cosines and ratios – Angle between two lines – Equation of a plane – Equation of a straight line – Co-planar lines – Shortest distance between skew lines – Sphere – Tangent plane – Plane section of a sphere – Orthogonal spheres.

TEXT BOOK

1. Grewal B.S, Higher Engg Maths, Khanna Publications, 38th Edition., Veerajan, T., "*Engineering Mathematics"*, Tata McGraw Hill Publishing Co., New Delhi,2000.
2. Dr.V.Ramamurthy & Dr. Sundarammal Kesavan, "*Engineering Mathematics",*– Vol I & II Anuradha Publications, Revised Edition 2006.

REFERENCE BOOKS

1. Kreyszig.E, "*Advanced Engineering Mathematics"*, 8th edition, John Wiley & Sons. Singapore,2001.
2. Kandasamy P etal. "*Engineering Mathematics"*, Vol.I (4th revised edition), S.Chand &Co., New Delhi,2000.
3. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., "*Advanced Mathematics for Engineering students"*, Volume I (2nd edition), S.Viswanathan Printers and Publishers, 1992.
4. Venkataraman M.K., "*Engineering Mathematics*" – First Year (2nd edition), National Publishing Co., Chennai,2000.

		L	T	P	C
PH 0101	**PHYSICS**	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE
The purpose of this course is to develop scientific temper and analytical capability through learning physical concepts and their applications in engineering and technology. Comprehension of some basic physical concepts will enable the students to logically solve engineering problems.

INSTRUCTIONAL OBJECTIVES
At the end of the course, the student will be able to:
Understand the general scientific concepts required for technology,
Apply the concepts in solving engineering problems,
Explain scientifically the new developments in engineering and technology, and
Get familiarized with the concepts, theories, and models behind many technological applications.

PROPERTIES OF MATTER AND SOUND
Properties of Matter: Hooke's law – Twisting couple on a cylinder – Shafts – Torsion pendulum – Bending of beams – Bending moment – Uniform bending and non-uniform bending – I shape girder. **Sound:** Shock waves – Mach number (simple problems) – Ultrasonic production (magnetostriction and piezoelectric methods) and application – Acoustics of buildings – Sources and impacts of noise – Sound level meter – Control of noise pollution.

ELECTROMAGNETISM AND MICROWAVES
Electromagnetism: Divergence, curl and gradient – Maxwell's equations – Wave equation for electromagnetic waves – Propagation in free space – Poynting vector – Rectangular and circular wave guides. **Microwaves:** Properties and applications – Generation by magnetron and reflex klystron oscillator – Traveling wave tube – Biological effects.

OPTICS

Photometry: Principles and Lummer-Brodhun photometer. **Lasers:** Principles and characteristics – Types of lasers (CO_2, excimer, NdYAG, GaAs, free electron) – Holographic mass storage. **Optical Fiber:** Principles – Physical structure and types – Optical fiber communication. **Photo elasticity:** Theory and applications.

CRYSTAL PHYSICS AND CRYOGENICS

Crystal Physics: Crystal directions – Planes and Miller indices – Basic symmetry elements – Translational symmetry elements – Reciprocal lattice – Diamond and HCP crystal structure – Imperfections in crystals. **Cryogenics:** Methods of liquefaction of gases (cascade process, Linde's process, and adiabatic demagnetization process) – Measurement of cryogenic temperatures.

ENERGY PHYSICS

Introduction to non-conventional energy sources – Solar cells – Thermoelectric power generators – Thermionic power generator – Magneto hydrodynamic power generator – Fuel cells (H_2O_2) – Solid state batteries (Lithium) – Low voltage and high voltage nuclear cells – Thermocouple based nuclear cell – Ultra capacitors.

TEXT BOOKS

1. Arumugam, M., "*Engineering Physics"*, 2nd edition, Anuradha Publishers, Kumbakonam, 2003.
2. Gaur and Gupta, "*Engineering Physics*", 7th edition, Dhandapani and Sons, New Delhi, 1997.
3. Thiruvadigal, J. D., Ponnusamy, S., Vasuhi, P. S. and Kumar, C., "*Physics for Technologists"*, 5th edition, Vibrant Publication, Chennai, 2007.

REFERENCE BOOKS

1. Vasudeva, A. S., "*Modern Engineering Physics"*, revised edition, S. Chand and Company Ltd., New Delhi, 2004.
2. Vasudevan, D. N., "*Fundamentals of Magnetism and Electricity"*, 11th edition, S. Chand and Company Ltd., New Delhi, 1983.
3. Nair, K. P. R., "*Atoms, Molecules and Lasers"*, Narosa Publishing House, New Delhi, 2006.
4. Pillai, S. O., "*Solid State Physics"*,5th edition, New Age International (P) Ltd., New Delhi, 2004.
5. Khan, B. H., "*Non-Conventional Energy Resources"*, Mechanical Engineering Series, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.

		L	T	P	C
CY 0101	**CHEMISTRY**	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

INSTRUCTIONAL OBJECTIVES

The students should be conversant with

The role of applied chemistry in the field of engineering.
The knowledge of water quality parameters and the treatment of water.
The principles involved in corrosion and its inhibitions.
Important analytical techniques, instrumentation and the applications.
Knowledge with respect to the phase equlibria of different systems.

TECHNOLOGY OF WATER

Water quality parameters: Physical, Chemical & Biological - Hardness of water – estimation of hardness (EDTA method & O. Hehner"s method), Alkalinity – determination – disadvantages of using hard water in boilers: Scale, sludge formation – disadvantages – prevention – treatment: Internal conditioning – phosphate, calgon and carbonate conditioning methods – External: Zeolite, ion exchange methods - desalination – reverse osmosis and electrodialysis - domestic water treatment.

CORROSION AND ITS CONTROL

Corrosion: Basic concepts – principles, mechanism of chemical, electrochemical corrosion – Pilling Bedworth rule – galvanic corrosion – differential aeration corrosion - pitting corrosion - stress corrosion - factors influencing corrosion.
Corrosion control: cathodic protection – sacrificial anodic method – corrosion inhibitor. Protective coatings: surface preparation for metallic coatings - electro plating and electroless Plating - chemical conversion coatings – anodizing, phosphating & chromate coating.

PHASE EQUILIBRIA
Phase rule: Statement – explanation of the terms involved - one component system (water system only). Condensed phase rule - thermal analysis – two component systems: simple eutectic, Pb-Ag; Br, Cd - solid solution Cu-Ni and compound formation Mg-Zn - applications of eutectics.

POLYMERS AND REINFORCED PLASTICS
Classification of polymers – types of polymerization reactions – mechanism of addition polymerization: free radical, ionic and ziegler – Natta - effect of structure on the properties of polymers – strength, plastic deformation, plastics elasticity and physical nature –Preparation and properties of important resins:- Polyethylene, PVC, PMMA, Polyester, Teflon Bakelite, Epoxy resins, compounding of plastics, moulding methods - injection, extrusion, compression and calendaring - reinforced plastics – FRP – Carbon, Graphite, Glass– applications.

INSTRUMENTAL METHODS OF ANALYSIS
Basic principles, instrumentation of potentiometry, flame photometry – applications. Elementary theory – principle – instrumentation of UV – visible spectroscopy and atomic absorption spectroscopy and infrared spectroscopy.

TEXT BOOKS

1. Jain.P.C and Monika Jain, "*Engineering Chemistry*", Danpat Raj publishing company (P) Ltd, New Delhi – 2002.
2. Dara.S.S, "*Text book of Engineering Chemistry"*, S. Chand & Company Ltd, New Delhi 2003.
3. Willard H.A., Merit L.L and Dean J.A., *"Instrumental methods of analysis*" 6th Edition Van Nostrand, 1986.

REFERENCE BOOKS

1. Kuriacose J.C. and Rajaram J. "*Chemistry in Engineering and Technology"*, Volume II, Tata McGraw Hill p.b. Co., 1988.
2. Jeyalakshmi.R & Ramar. P, "*Engineering Chemistry*", 1st Edition, Devi Publications, Chennai 2006.
3. Kamaraj.P & Arthanareeswari. M, "*Applied Chemistry"*, 2nd Edition, Sudhandhira Publications, 2003.
4. Arivalagan. K, "*Engineering Chemistry*", 1st Edition, Mass publications, 2007.
5. P.Kamatchi, "*Applied Chemistry-I"*, Ponnuswamy publications, Chennai.
6. Dr. Helen P Kavitha , "*Engineering Chemistry* – I" ILA Publications, 2002

		L	T	P	C
GE 0101	**BASIC ENGINEERING – I**	**4**	**0**	**0**	**4**
	Prerequisite				
	Nil				

PART A - CIVIL ENGINEERING

PURPOSE
To get exposed to the glimpses of Civil Engineering topics that is essential for an Engineer.

INSTRUCTIONAL OBJECTIVES
To know about different materials and their properties.
Engineering aspects related to buildings.
To know about importance of surveying.
To know about the transportation systems.
To get exposed to the rudiments of engineering, related to Dams, Water Supply, Transportation system and Sewage Disposal.

BUILDING MATERIALS AND THEIR PROPERTIES
Introduction - Civil Engineering – Building Materials – Brick, Stone, Cement, Steel, Concrete, timber – Properties – Uses. Units – Stress, strain and three modulii of elasticity – factor of safety - Centre of Gravity and Moment of Inertia for rectangle and circular section – simple problems.

BUILDINGS AND THEIR COMPONENTS
Buildings – Classification - Components of buildings and their functions Foundations - functions – classification of foundations – Bearing capacity Floorings – functions - Types - Cement Concrete flooring – Mosaic flooring - Marble flooring Roofs - Types – Requirements – Madras Terrace roof. Tall structure – types of structural systems.

UTILITY AND SERVICES

Surveying - Objective – Principles – Classification – Instruments used for Surveying. Dams - Purpose – Selection of site – Classification – Gravity dam (cross-section details only) Transportation system - Classification – Roadway - components – classification of roads - Railway – Cross-section of permanent way- components parts and functions. Docks and Harbour – classification – Terminology Bridges –components of a bridge - types of bridges. Water supply - Sources - Standards of drinking water (BIS) – elementary treatment methods – RO System Sewage disposal – Septic tank – function and components.

TEXT BOOKS

1. Raju K.V.B., Ravichandran P.T., "*Basics of Civil Engineering"*, Ayyappa Publications, Chennai, 2000.
2. Ramesh Babu, "*Civil Engineering* ", VRB Publishers, Chennai, 2000.

REFERENCE BOOKS

1. Rangwala,S.C., "*Engineering Materials"*, Charotar Publishing House, Anand, 1980.
2. National Building Code of India, Part V, "*Building Materials"*, 2005
3. Surendra Singh, "*Building Materials"*, Vikas Publishing Company, New Delhi, 1996

PART B MECHANICAL ENGINEERING

PURPOSE

To familiarize the students with the basics of Mechanical Engineering.

INSTRUCTIONAL OBJECTIVES

To familiarize with

The basic machine elements
The Sources of Energy and Power Generation
The various manufacturing processes

MACHINE ELEMENTS

Springs: Helical and leaf springs – Springs in series and parallel. **Cams:** Types of cams and followers – Cam profile. **Power Transmission:** Gears (terminology, spur, helical and bevel gears, gear trains). Belt drives (types). Chain drives. **Simple Problems.**

ENERGY

Sources: Renewable and non-renewable (various types, characteristics, advantages/disadvantages). **Power Generation:** External and internal combustion engines - Hydro and nuclear power plants (layouts, element/component description, advantages, disadvantages, applications). **Simple Problems.**

MANUFACTURING PROCESSES

Sheet Metal Work: Introduction – Equipments – Tools and accessories – Various processes (applications, advantages / disadvantages). **Welding:** Types – Equipments – Tools and accessories – Techniques employed (applications, advantages / disadvantages (gas and arc welding only)) – Gas cutting – Brazing and soldering. **Lathe Practice:** Types - Description of main components – Cutting tools – Work holding devices – Basic operations. **Simple Problems**. **Drilling Practice:** Introduction – Types – Description – Tools. **Simple Problems**.

TEXT BOOKS

1. Kumar, T., Leenus Jesu Martin., and Murali, G., "*Basic Mechanical Engineering"*, Suma Publications, Chennai, 2007.
2. Prabhu, T. J., Jai Ganesh, V., Jebaraj, S., "*Basic Mechanical Engineering"*, Scitech Publications, Chennai, 2000.

REFERENCE BOOKS

1. Hajra Choudhary, S.K. and Hajra Choudhary, A. K., "*Elements of Manufacturing Technology",* Vols. I & II, Media Publishers, 1986.
2. Nag, P.K., "*Power Plant Engineering"*, Tata McGraw-Hill, New Delhi, 2006.
3. Palanichamy, M.S., "*Basic Civil & Mechanical Engineering"*, Tata McGraw-Hill , New Delhi 1991.
4. Nagpal G. R., "*Power Plant Engineering"*, Khanna Publisher, Delhi,2004

		L	T	P	C
PD 0101	**PERSONALITY DEVELOPMENT - I**	**0**	**0**	**2**	**0**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential.

INSTRUCTIONAL OBJECTIVES

1. To guide thought process.
2. To groom student's attitude.
3. To develop communication skill.
4. To build confidence.

METHODOLOGY

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation
5. Empirical Learning

Self-analysis SWOT - Time management - Creative chain story telling
Vocabulary games I – Attitude - Interpersonal skills
Motivation I - Vocabulary games II - Article review
Team building exercise - Critical thinking - Event Management
Business situation - Leadership Qualities - Review

SCHEME OF INSTRUCTION

Marks allocated for regular participation in all oral activities in class

SCHEME OF EXAMINATION

Complete internal evaluation on a regular basis.

		L	T	P	C
GE0107	**NSS/NCC/NSO/YOGA**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

I. YOGA SYLLABUS

	PRACTICE	LECTURE
I	Meditation – Agnai, Asanas, Kiriyas, Bandas, Muthras	Benefits of Agnai Meditation
II	Meditation Santhi Physical Exercises (I & II)	Benefits of santhi Meditation
III	Kayakalpa Yoga Asanas, Kiriyas, Bandas, Muthras	Lecture & Practice
IV	Meditation Santhi Physical Exercises III & IV	Analysis of Thought
V	Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras	Benefits of Thuriyam
VI	Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras	Attitude
VII	Meditation Thuriyam Kayakalpa Asanas, Kiriyas, Bandas, Muthras	Importance of Arutkappy & Blessings
VIII	Meditation Santhi Kayakalpa Asanas, Kiriyas, Bandas, Muthras	Benefits of Blessings
		Hours = 30

TEXT BOOKS:

1. Vedatri Maharshi , *"Yoga for Modern Age"*
2. Vedatri Maharshi, " *Simplified Physical Exercises"*

NATIONAL SPORTS ORGANISATION (NSO)

Each student must select two of the following games and practice for two hours per week. An attendance of 80% is compulsory to earn the credits specified in the curriculum.

List of games:

	Basket Ball
	Football
	Volley Ball
	Ball Badminton
	Cricket
	Throw ball

NATIONAL CADET CORPS (NCC)

Any student enrolling as a member of National Cadet Corps (NCC) will have to attend sixteen parades out of twenty parades each of four periods over a span of an academic year.

Attending eight parades in first semester will qualify a student to earn the credits specified in the curriculum.

IV. NATIONAL SERVICE SCHEME (NSS)

A student enrolling as member of NSS will have to complete 60 hours of training / social service to be eligible to earn the credits specified in the curriculum.

		L	T	P	C
GE0105	**COMPUTER LITERACY**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

This Lab Course will enable the students to understand the basics of computer and to know the basics of MS-Office.

INSTRUCTIONAL OBJECTIVES

1. To learn the basics of computer.
2. To work on MS-Word, MS-Excel, MS-Power Point and MS-Access

EXPERIMENTS TO IMPLEMENT

Study experiment on evolution of computer programming languages.
Suggest some of the Network Topologies that can be incorporated in your campus. Justify your choice.
Experiments to demonstrate directory creation and file creation.
Create a document with all formatting effects.
Create a document with tables.
Create labels in MS word.
Create a document to send mails using mail merge option.
Create an Excel File to analyze the student's performance. Create a chart for the above data to depict it diagrammatically.
Create Excel sheet to use built-in-function.
Create Excel sheet to maintain employee information and use this data to send mails using mail merge.
Create a Power Point presentation for your personal profile with varying animation effects with timer.
Consider student information system which stores student personal data, mark information and non academic details.

* Use MS-Access to create Tables and execute SQL queries to do this following
* Display all student records.
* Display student details with respect to his identity.
* Delete some records from the table.
* Find total marks obtained by student in each list.

TEXT BOOK

"*Introduction to Information Technology"* ITL Education Solutions Ltd., Pearson 2nd Edition, 2006.

		L	T	P	C
PH 0103	**PHYSICS LABORATORY**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to develop scientific temper and analytical capability among the engineering students.

INSTRUCTIONAL OBJECTIVES

At the end of the course, the student will be able to:

Understand scientific concepts in measurement of different physical variables
Develop the skill in arranging and handling different measuring instruments
Get familiarized with the errors in various measurements and planning / suggesting how these contributions may be made of the same order so as to make the error in the final result small.

LIST OF EXPERIMENTS

Determination of Young's Modulus of the material – Uniform bending
Determination of Rigidity Modulus of the material – Torsion Pendulum
Determination of velocity of Ultrasonic waves in liquids
Determination of dispersive power of a prism using spectrometer
Determination of laser parameter – Divergence and wavelength for a given laser source – laser grating
Particle size determination using laser
Study of attenuation and propagation characteristics of optical fiber cable
Calibration of voltmeter using potentiometer.
Calibration of ammeter using potentiometer.
Construction and study of regulation properties of a given power supply using IC

REFERENCE BOOKS

1. Chattopadhyay, D., Rakshit, P. C. and Saha, B., "*An Advanced Course in Practical Physics*", 2nd edition, Books & Allied Ltd., Calcutta, 1990.
2. Chauhan and Singh, "*Advanced Practical Physics"*, revised edition, Pragati Prakashan, Meerut, 1985.
3. Thiruvadigal. J. D., Ponnusamy. S., Vasuhi. P. S. and Kumar. C, "*Hand Book of Practical Physics"*, 5th edition, Vibrant Publication, Chennai, 2007.

		L	T	P	C
CY 0103	**CHEMISTRY LABORATORY**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

An integrated laboratory course consists of experiments from applied chemistry and is designed to illustrate the underlying principles of measurement techniques, synthesis, dynamics and chemical transformation.

INSTRUCTIONAL OBJECTIVES

Students should be able to understand the basic concept and its applications.

LIST OF EXPERIMENTS

Preparation of standard solutions.
Estimation of total hardness, permanent and temporary hardness by EDTA method.
Conductometric titration – determination of strength of an acid.
Estimation of iron by potentiometer – titration.
Determination of molecular weight of polymer by viscosity average – method.
Determination of dissolved oxygen in a water sample by Winkler"s method
Determination of Na / K in water sample by Flame photometry.
Estimation of Copper in ore.
Estimation of nickel in steel.
Determination of total alkalinity and acidity of a water sample.

REFERENCE

1. Chemistry department manual, Edition, 2003.

		L	T	P	C
ME 0120	**WORKSHOP PRACTICE**	**0**	**0**	**4**	**2**
	Prerequisite				
	Nil				

PURPOSE

To provide the students with, hands on experience on different trades of engineering like fitting, carpentry, smithy, welding and sheet metal.

INSTRUCTIONAL OBJECTIVES

To familiarize with

The basics of tools and equipments used in fitting, carpentry, sheet metal, welding and smithy.
The production of simple models in the above trades.

LIST OF EXPERIMENTS

EMPHASIS TO BE LAID ON REAL LIFE APPLICATIONS WHEN FRAMING THE EXERCISES.

FITTING

Tools & Equipments – Practice in Filing and Drilling.
Making Vee Joints, Square, dovetail joints, Key Making.

CARPENTARY

Tools and Equipments- Planning practice. Making Half Lap, dovetail, Mortise & Tenon joints, a mini model of a single door window frame.

SHEET METAL

Tools and equipments - Fabrication of a small cabinet, Rectangular Hopper, etc.

WELDING

Tools and equipments - Arc welding of butt joint, Lap Joint, Tee Fillet. Demonstration of Gas welding, TIG & MIG.

SMITHY

Tools and Equipments –Making simple parts like hexagonal headed bolt, chisel.

TEXT BOOK

1. Gopal, T.V., Kumar, T., and Murali, G., *"A first course on workshop practice – Theory, practice and work book",* Suma Publications, 2005.

REFERENCE BOOKS

1. Kannaiah,P. & Narayanan,K.C. "*Manual on Workshop Practice"*, Scitech Publications, Chennai, 1999.
2. Venkatachalapathy, V.S. "*First year Engineering Workshop Practice"*, Ramalinga Publications, Madurai, 1999.

		L	T	P	C
ME 0130	**ENGINEERING GRAPHICS**	**1**	**0**	**4**	**3**
	Prerequisite				
	Nil				

(Only First Angle Projection is to be followed)

PURPOSE

To draw and interpret various projections of 1D, 2D and 3D objects.
To prepare and interpret the drawings of buildings.

INSTRUCTIONAL OBJECTIVES

To familiarize with

The construction of geometrical figures
The projection of 1D, 2D & 3D elements
Sectioning of solids and development of surfaces
Preparation and interpretation of building drawing

FUNDAMENTALS OF ENGINEERING GRAPHICS
Lettering, two dimensional geometrical constructions, conics, representation of three-dimensional objects – principles of projections – standard codes – projection of points.

PROJECTION OF LINES AND SOLIDS
Projection of straight lines, projection of solids – auxiliary projections

SECTIONS AND DEVELOPMENTS
Sections of solids and development of surfaces.

PICTORIAL PROJECTIONS
Conversion of projections: Orthographic projection, isometric projection of regular solids & combination of solids.

BUILDING DRAWING
Building Drawing – plan, elevation and section of single storied residential (or) office building with flat RCC roof and brick masonry walls having not more than 3 rooms (planning / designing is not expected in this course).

TEXT BOOKS

1. Jeyapoovan, T., *"Engineering Drawing and Graphics using AutoCAD 2000",* Vikas Publishing house Pvt Ltd, NewDelhi, 2005.
2. Narayanan, K.L & Kannaiah, P., *"Engineering Graphics"*, Scitech Publications, Chennai, 1999.

REFERENCE BOOKS

1. Bhatt, N.D., "*Elementary Engineering Drawing (First Angle Projection)",* Charotar Publishing Co., Anand, 1999.
2. Venugopal, K. "*Engineering Drawing & Graphics"*, New Age international Pvt. Ltd., 2001.
3. Natarajan, K.V. "*Engineering Drawing & Graphics"*, Private Publication, Chennai, 1990.
4. Shah, M.B. and Rana, B.C., "*Engineering Drawing"*, Pearson Education (Singapore) Pvt. Ltd., Delhi – 110 092, 2005.

II SEMESTER

		L	T	P	C
GE 0108	**VALUE EDUCATION**	**1**	**0**	**0**	**1**
	Prerequisite				
	Nil				

PURPOSE
To provide guiding principles and tools for the development of the whole person recognizing that the individual is comprised of Physical, Intellectual, Emotional and Spiritual dimensions.

INSTRUCTIONAL OBJECTIVES
To help individuals think about and reflect on different values.
To deepen understanding, motivation and responsibility with regard to making personal and social choices and the practical implications of expressing them in relation to themselves, others, the community and the world at large.
To inspire individuals to choose their own personal, social, moral and spiritual values and be aware of practical methods for developing and deepening

Value Education—Introduction – Definition of values – Why values? – Need for Inculcation of values – Object of Value Education – Sources of Values – Types

Values:

Personal values
Social values
Professional values
Moral and spiritual values
Behavioral (common) values

Personal values – Definition of person – Self confidence – Self discipline – Self Assessment – Self restraint – Self motivation – Determination – Ambition – Contentment – Humility and Simplicity - Sympathy and Compassion – Gratitude -Forgiveness – Honesty – Courtesy.

Social values – Definition of Society – Units of Society - Individual, family, different groups – Community – Social consciousness – Equality and Brotherhood – Dialogue – Tolerance – Sharing – Responsibility – Co-operation Freedom – Repentance and Magnanimity.

Professional values – Definition – Competence – Confidence – Devotion to duty –Efficiency – Accountability – Respect for learning /learned – Willingness to learn-Open and balanced mind – Team spirit – Professional Ethic – Willingness for Discussion – Aims – Effort – Avoidance of Procrastination and slothfulness –Alertness.

Behavioral values – Individual values and group values – Good manners at home and outside – Equality – Purity of thought, speech and action – Understanding the role of religion – Faith – Understanding the commonness of religions – respect for other faiths – unity in diversity – Living together – Tolerance – Non-violence – Truthfulness – Common aim – Unified effort towards peace – Patriotism.

REFERENCE BOOKS

1. Dr. S. Ignacimuthu S. J., *"Values for life"*, Better yourself Books, Bandra Mumbai-600 050 (1999).
2. *"Values(Collection of Essays)"*., Published by : Sri Ramakrishna Math., Chennai—4.,(1996)
3. Prof. R.P.Dhokalia., "*Eternal Human Values*", NCRT –Campus Sri Aurobindo Marg., New Delhi - 110 011.
4. Swami Vivekananda., "*Education*", Sri Ramakrishna Math., Chennai-4(1957)
5. "*Tirukural*" (English Translation by Dr.G.U.Pope).
6. "*The Bible*"
7. "*The Kuran*"
8. "*The Bagavath Geetha*"

		L	T	P	C
MA0102	**MATHEMATICS II**	**3**	**2**	**0**	**4**
	Prerequisite				
	MA0101				

(Common to all Branches of Engineering except BT, BP, BI, BME, FPE, & GE)

PURPOSE

To impart analytical ability in solving mathematical problems as applied to the respective branches of Engineering.

INSTRUCTIONAL OBJECTIVES

At the conclusion of the course, students should have understood Multiple Integrals , Laplace Transforms, Vector Calculus and Functions of a complex variable including contour integration and able to apply to all their Engineering problems.

MULTIPLE INTEGRALS

Double integration in Cartesian and polar coordinates – Change of order of integration – Area as a double integral – Triple integration in Cartesian coordinates.

LAPLACE TRANSFORMS

Transforms of simple functions – Basic operational properties – Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – periodic functions – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only.

VECTOR CALCULUS

Gradient, divergence, curl – Solenoidal and irrotational fields – Vector identities (without proof) – Directional derivatives – Line, surface and volume integrals – Statements of Green's, Gauss divergence and Stroke's theorems only – Verification and applications to cubes and parallelopipeds only.

ANALYTIC FUNCTIONS

Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions - Determination of harmonic conjugate – Milne-Thomson's method – Conformal mappings: 1/z, az az+b and bilinear transformation.

COMPLEX INTEGRATION

Line integral – Cauchy's integral theorem (without proof) – Cauchy's integral formulae (with proof) – application of Cauchy's integral formulae – Taylor's and Laurent's expansions (statements only) – Singularities – Poles and Residues – Cauchy's residue theorem (with proof) - Evaluation of line integrals.

TEXT BOOK

1. Grewal B.S, "*Higher Engg Math"s*, Khanna Publications, 38th Edition.
2. Veerajan, T., "*Engineering Mathematics"*, Tata McGraw Hill Publishing Co., New Delhi, 2000.
3. Dr.V.Ramamurthy & Dr. Sundarammal Kesavan, "*Engineering Mathematics – Vol I & II",* Anuradha Publications, Revised Edition 2006.

REFERENCE BOOKS

1. Kreyszig.E, "*Advanced Engineering Mathematics",* 8th edition, John Wiley & Sons. Singapore,2001.
2. Kandasamy P etal. "*Engineering Mathematics, Vol.I"* (4th revised edition), S.Chand &Co., New Delhi,2000.
3. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., "*Advanced Mathematics for Engineering students, Volume I",* (2nd edition), S.Viswanathan Printers and Publishers, 1992.
4. Venkataraman M.K., "*Engineering Mathematics – First Year",* (2nd edition), National Publishing Co., Chennai, 2000.

		L	T	P	C
PH 0102	**MATERIALS SCIENCE**	**2**	**0**	**2**	**3**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to develop comprehension of the rapidly changing technological scenario and the requisite expertise for appropriate selection of materials for specific engineering applications.

INSTRUCTIONAL OBJECTIVES

At the end of the course, the student will be able to:

1. Understand electrical properties of materials,
2. Understand the properties and applications of semi conducting materials,
3. Understand general properties and applications of magnetic and dielectric materials,
4. Understand the behavior of materials on exposure to light,
5. Understand general properties and application of modern engineering and bio materials, and
6. Get familiarized with the concepts of Nano Science and Technology.

ELECTRONIC AND PHOTONIC MATERIALS

Electronic materials: Importance of Classical and Quantum free electron theory of metals – Fermi energy and Fermi Dirac distribution function – Variation of Fermi level with temperature in intrinsic and extrinsic semiconductors – Hall effect – Dilute Magnetic Semiconductors (DMS) and their applications – High temperature Superconductivity. Photonic materials: LED and LCD materials – Photo conducting materials – Nonlinear optical materials (elementary ideas) and their applications.

MAGNETIC, DIELECTRIC AND MODERN ENGINEERING MATERIALS

Magnetic materials: Ferrites and garnets – Magnetic bubbles and their applications – Giant Magneto Resistance (GMR) – Colossal Magneto Resistance (CMR).

Dielectric materials: Various polarization mechanisms in dielectrics (elementary ideas) and their frequency and temperature dependence – Dielectric loss – Piezo electric and ferro electric materials and their applications. **Modern engineering materials:** Shape memory alloys – Metallic glasses – Advanced ceramics and composites.

BIO MATERIALS

Classification of biomaterials – Comparison of properties of some common biomaterials – Effects of physiological fluid on the properties of biomaterials – Biological responses (extra and intra vascular system) – Metallic, Ceramic and Polymeric implant materials – Introduction to bio sensors and tissue engineering.

NANO MATERIALS AND NANOTECHNOLOGY

Basic concepts of Nano science and technology – Quantum wire – Quantum well – Quantum dot – Properties and technological advantages of Nano materials – Carbon Nanotubes and applications – Material processing by Sol – Gel method, Chemical Vapour deposition and Physical Vapour deposition – Microwave Synthesis of materials – Principles of SEM, TEM and AFM .

MECHANICAL PROPERTIES OF MATERIALS

Stress Strain diagram for different engineering materials – Engineering and true stress strain diagram – Ductile and brittle material – Tensile strength – Hardness – Impact strength – Fatigue – Creep – Fracture (Types and Ductile to brittle transition) – Factors affecting mechanical properties.

PRACTICALS

1. Band gap determination using Post office box.
2. Dielectric constant measurement.
3. Photoconductivity measurement.
4. Resistivity determination for a semiconductor wafer using Four probe method.
5. Determination of Hall coefficient and carrier type for a semiconductor material.
6. To trace the hysteresis loop for a magnetic material.
7. Magnetic susceptibility – Quincke's method.
8. Determination of thermal conductivity – Lee's Disc method
9. Visit to Nano Technology Laboratory (optional)

TEXT BOOKS

1. S.O. Kasap, "*Principles of Electronic Materials and Devices",* Tata McGraw Hill Edition, New Delhi, 2002.
2. Van Vlack, L.H., "*Material Science for Engineers"*, 6th edition, .Addision Wesley, 1985.
3. Thiruvadigal, J. D., Ponnusamy, S. and Vasuhi.P. S., "*Materials Science"*, 5th edition, Vibrant Publications, Chennai, 2007.

REFERENCE BOOKS

1. Rolf E. Hummel, "*Electronic Properties of materials"*, Narosa Publishing House, New Delhi, 1994.
2. Raghavan.V., "*Materials Science & Engineering – A First Course"*, 5th edition, Prentice Hall of India, New Delhi,2005.
3. Khanna. O. P., "*A Text Book of Material Science & Metallurgy"*, Revised edition, Dhanpat Rai Publications, New Delhi,2006.
4. Sujata V. Bhat, "*Biomaterials"*, 2nd edition, Narosa Publishing House, New Delhi, 2006.
5. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, "*Nano Technology – Basic Science and Emerging Technologies"*, 1st edition, Overseas Press,New Delhi,2005.

		L	T	P	C
GE 0102	**BIOLOGY FOR ENGINEERS**	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

To provide a basic understanding of biological mechanisms from the perspective of engineers.

INSTRUCTIONAL OBJECTIVES

To familiarize the students with the basic organization of organisms and subsequent building to a living being. With this knowledge, the student will be then imparted with an understanding about the machinery of the cell functions that is ultimately responsible for various daily activities. Nervous and immune systems will be taught as examples of this signaling machinery.

FROM ATOMS TO ORGANISMS

The Cell: the Basic Unit of Life - Molecular Components of Cells - Expression of Genetic Information - Protein Structure and Function- Cell Metabolism - Cells Maintain Their Internal Environments - Cells Respond to Their External Environments - Cells Grow and Reproduce - Cells Differentiate

THE MOLECULAR DESIGN OF LIFE

Biochemistry and the Genomic Revolution- . DNA Illustrates the Relation between Form and Function- Biochemical Unity Underlies Biological Diversity-. Chemical Bonds in Biochemistry -. Biochemistry and Human Biology-. Protein Synthesis Requires the Translation of Nucleotide Sequences Into Amino Acid Sequences-.2. Aminoacyl-Transfer RNA Synthetases Read the Genetic Code- A Ribosome Is a Ribonucleoprotein Particle (70S) Made of a Small (30S) and a Large (50S) Subunit-Protein Factors Play Key Roles in Protein Synthesis-. Eukaryotic Protein Synthesis Differs from Prokaryotic Protein Synthesis Primarily in Translation Initiation

CATALYTIC STRATEGIES
Proteases: Facilitating a Difficult Reaction-. Making a Fast Reaction Faster: Carbonic Anhydrases-. Restriction Enzymes: Performing Highly Specific DNA-Cleavage Reactions- Nucleoside Monophosphate Kinases: Catalyzing Phosphoryl Group Exchange between Nucleotides Without Promoting Hydrolysis- metabolism-anabolism and catabolism-photosynthesis and carbon fixation- biological energy production.

MECHANOCHEMISTRY
How Protein Motors Convert Chemical Energy into Mechanical Work- Brief Description of ATP Synthase Structure- The F1 Motor: A Power Stroke-A Pure Power Stroke- Coupling and Coordination of Motors- Measures of Efficiency- F1-Motor of ATP synthase- The Bacterial Flagellar Motor- Motor Driven by H_ and Na_ Ion Flux- Proton Motive Force, Sodium-motive Force, Ion Flux- Molecular Motor Directionality- Chimeric Kinesin Motors- Backwards Myosins- Chimeric Myosin Motors- Bidirectional Dyneins?

SENSORY AND IMMUNO SYSTEMS
General Principles of Cell Signaling-Signaling via G-Protein-linked Cell-Surface Receptors-Signaling via Enzyme-linked Cell-Surface Receptors-Target-Cell Adaptation-The Logic of Intracellular Signaling: Lessons from Computer-based "Neural Networks"-The Cellular Basis of Immunity-The Functional Properties of Antibodies-The Fine Structure of Antibodies-The Generation of Antibody Diversity-T Cell Receptors and Subclasses-MHC Molecules and Antigen Presentation to T Cells- Cytotoxic T Cells-Helper T Cells and T Cell Activation-Selection of the T Cell Repertoire

TEXT BOOKS
1. J.M.Berg, J.L.Tymosczko and L.Sryer. "*Biochemistry"*, W.H. Freeman Publications.
2. "*STUDENT COMPANION to accompany Biochemistry*", Fifth Edition -Richard I. Gumport
3. Frank H. Deis, Nancy Counts Gerber, Roger E. Koeppe, II, *"Molecular motors* ".

REFERENCE BOOKS:
1. Alberts, 2003, "*Molecular Biology of the cell*" Garland Science.
2. Lodish, 2004, *"Molecular cell biology"* FREEMAN.

		L	T	P	C
GE0104	**PRINCIPLES OF ENVIRONMENTAL SCIENCE**	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE
The course provides the comprehensive knowledge in environmental science, environmental issues and the management.

INSTRUCTIONAL OBJECTIVES
The importance of environmental education, ecosystem and ethics.
Knowledge with respect to biodiversity and its conservation.
To create awareness on the various environmental pollution aspects and issues.
To educate the ways and means to protect the environment.
Important environmental issues and protection

ENVIRONMENT AND ECOSYSTEMS
Environmental education: definition - scope - objectives and importance. Concept of an ecosystem – types (terrestrial and aquatic ecosystems) – structure and function – ecological succession - food chains, food webs and ecological pyramids

BIODIVERSITY
Introduction: definition - genetic, species and ecosystem diversity - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife - endangered and endemic species of India, Conservation of biodiversity: in-situ and ex-situ conservations.

POLLUTION AND WASTE MANAGEMENT
Air and water pollution – classification of pollutants and their effects – control measures of air pollution. Waste water treatment (general) – primary, secondary & tertiary stages.
Solid waste management: causes - effects of municipal waste, hazardous waste, bio medical waste - process of waste management.

CURRENT ENVIRONMENTAL ISSUES

Environmental ethics -issues and possible solutions- population explosion, climatic change, ozone layer depletion, global warming, acid rain and green house effect.

Sustainable development: definition, objectives and environmental dimensions of sustainable development- environmental audit for sustainable development.

ENVIRONMENTAL PROTECTION

National and international concern for environment: Important environmental protection acts in India – water, air (prevention and control of pollution) act, wild life conservation and forest act – functions of central and state pollution control boards - international effort – key initiatives of Rio declaration, Vienna convention, Kyoto protocol and Johannesburg summit.

TEXT BOOKS

1. Sharma.B.K. and Kaur, "*Environmental Chemistry",* Goel Publishing House, Meerut, 1994.
2. De.A.K., "*Environmental Chemistry"*, New Age International, New Delhi, 1996.
3. Kurian Joseph & R. Nagendran, "*Essential of Environmental Studies",* Pearson Education, 2004.

REFERENCE BOOKS

1. Dara S.S., "*A Text Book of Environmental Chemistry and pollution control",* S.Chand & Company Ltd., New Delhi, 2004.
2. Jeyalakshmi.R, "*Principles of Environmental Science"*, 1st Edition, Devi Publications, , Chennai 2006.
3. Kamaraj.P & Arthanareeswari.M, "*Environmental Science – Challenges and Changes"*, 1st Edition, Sudhandhira Publications, 2007.
4. Arivalagan.K, Ramar.P & Kamatchi.P, "*Principles of Environmental Science"*, 1st Edition, Suji Publications, 2007.

		L	T	P	C
GE 0106	**BASIC ENGINEERING – II**	**4**	**0**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE

This course provides comprehensive idea about circuit analysis, working principles of machines and common measuring instruments. It also provides fundamentals of electronic devices, transducers and integrated circuits.

INSTRUCTIONAL OBJECTIVES

At the end of the course students will be able

To understand the basic concepts of magnetic circuits, AC & DC circuits.

To explain the working principle, construction, applications of DC & AC machines and measuring instruments.

To gain knowledge about the fundamentals of electric components, devices, transducers and integrated circuits.

PART A - ELECTRICAL ENGINEERING

ELECTRICAL MACHINES

Definition of mmf, flux and reluctance, leakage flux, fringing, magnetic materials and B-H relationship. Problems involving simple magnetic circuits, Faraday's laws, induced emfs and inductances, brief idea on Hysteresis and eddy currents. Working principle, construction and applications of DC machines and AC machines (1-phase transformers, 3-phase induction motors, single phase induction motors – split phase, capacitor start and capacitor start & run motors).

AC & DC CIRCUITS

Circuit parameters, Ohms law, Kirchhoff's law. Average and RMS values, concept of phasor representation. RLC series circuits and series resonance, RLC parallel circuits (includes simple problems in DC & AC circuits)

Introduction to three phase systems – types of connections, relationship between line and phase values. (qualitative treatment only)

WIRING & LIGHTING

Types of wiring, wiring accessories, staircase & corridor wiring, Working and characteristics of incandescent, fluorescent, SV & MV lamps. Basic principles of earthing, simple layout of generation, transmission & distribution of power.

TEXT BOOKS

1. Muthusubramanian.R, Salivahanan.S, Muraleedharan.K.A, "*Basic Electrical, Electronics and Computer Engineering*", Tata McGraw - Hill, 1999.
2. Mehta V K , "*Principles of Electronics*", S Chand & Co,1980

REFERENCE BOOKS

1. Kothari D P and Nagrath I J , "*Basic Electrical Engineering* ", Tata McGraw Hill,1991
2. Mithal G K , "*Electronic Devices and Circuits*", Khanna Publications,1997

PART B - ELECTRONICS ENGINEERING

ELECTRONIC COMPONENTS AND DEVICES

Passive components: Resistors- Inductors and Capacitors and their types.
Semiconductor: Energy band diagram- Intrinsic and Extrinsic semiconductors- PN junction diodes and Zener diodes – characteristics.
Transistors: PNP and NPN transistors – theory of operation – Transistor configurations – characteristics – comparison.
Special semiconductor devices: FET – SCR – LED – V I characteristics – applications.
Rectifiers: Half wave and full wave rectifier – capacitive filter – wave forms – ripple factor – regulation characteristics.

TRANSDUCERS AND MEASURING INSTRUMENTS

Transducers: General features and classification of transducers, Resistive Transducers – Potentiometer, Unbonded strain gauge-Bonded strain gauge-Load cell, Inductive transducers – Differential output transducers – LVDT, Flow transducers, Temperature Transducers – Thermistors, Thermocouple and pyrometers.
Measuring Instruments: Basic principles and classification of instruments, Moving coil and Moving iron instruments, CRO – Principle of operation.

DIGITAL ELECTRONICS & LINEAR ICs

Digital Fundamentals: Number systems – Boolean Theorems – DeMorgan's Theorem - Logic gates – Implementation of Boolean Expression using Gates.
Integrated Circuits: IC fabrication – Monolithic Technique- Function of Operational Amplifier.

TEXT BOOKS

1. Muthusubramanian.R, Salivahanan.S, Muraleedharan.K.A, "*Basic Electrical, Electronics and Computer Engineering*", Tata McGraw - Hill, 1999.
2. Metha V.K, "*Principles of Electronics*", S. Chand & Co., 1980.
3. Kalsi H S, "*Electronics Instrumentation*", ISTE publication,1995

REFERENCE BOOKS

1. Kothari D. P and Nagrath IJ, "*Basic Electrical Engineering*", Tata McGraw- Hill, 1991.
2. Thomas L.Floyd "*Electronic devices*", Addison Wesley Longman (Singapore) Pvt . Ltd., 5th Edition.

NT0102	ELEMENTS OF NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

Enabling the Engineering Students to learn the basic of Nanotechnology.

INSTRUCTIONAL OBJECTIVES

The objective of this course is to make students familiar with the important concepts in Nanotechnology.

FUNDAMENTALS AND OVERVIEW OF NANOSCIENCE

Nanorevolution of the XX century, Properties at nanoscale (optical, electronic and magnetic). Theory, definitions and scaling.

DIFFERENT CLASSES OF NANOMATERIALS

Metal and Semiconductor Nanomaterials, Quantum Dots, Wells and Wires, Molecule to bulk transitions
Bucky balls and Carbon Nanotubes.

SYNTHESIS OF NANOMATERIALS

Top-down (Nanolithography, CVD),Bottom-up (Sol-get processing, chemical synthesis). Wet Depositiontechniques, Self-assembly (Supramolecular approach), Molecular design and modeling.

CHARACTERIZATION

TEM, SEM and SPM technique, Fluorescence Microscopy and Imaging.

APPLICATIONS

Solar energy conversion and catalysis, Molecular electronics and printed electronics Nanoelectronics,Polymers with a special architecture, Liquid crystalline systems,Linear and nonlinear optical and electrooptical properties, Applications in displays and other devices, Advanced organic materials for data storage,Photonics, Plasmonics ,Chemical and biosensors,Nanomedicine and Nanobiotechnology.

TEXT BOOK

1. Hari Singh Nalwa, "*Nanostructured Materials and Nanotechnology*", Academic Press, 2002

REFERENCE BOOKS

1. A.Nabok, "*Organic and Inorganic Nanostructures*", Artech House, 2005
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: "*Nanotechnologies and Nanophysics*", Springer-Verlag Berlin Heidelberg, 2007

		L	T	P	C
PD 0102	**PERSONALITY DEVELOPMENT - II**	**0**	**0**	**2**	**0**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential

INSTRUCTIONAL OBJECTIVES

1. To guide thought process.
2. To groom student's attitude.
3. To develop communication skill.
4. To build confidence.

METHODOLOGY

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Puzzles I - Poster design/Caption/Slogan writing (Social issues) - Bone of contention I – debate

Bone of contention II - Puzzle II - Survey and Reporting (favorite channel, music, food)

Interpretation of Visuals of I & II - Vocabulary games III

Book Review - Quiz I - Presentation Skills I

Presentation Skills II - Analytical Thinking - Review

EVALUATION
1. Activities assessed by both group and individual participation
2. Continuous assessment based on daily participation

SCHEME OF INSTRUCTION
Marks allocated for regular participation in all oral activities in class

SCHEME OF EXAMINATION
Complete internal evaluation on a regular Basis

		L	T	P	C
CS0140	**COMPUTER PRACTICE**	**1**	**0**	**2**	**2**
	Prerequisite				
	Nil				

PURPOSE:
To introduce programming languages, C and C++ as tools to solve problems and to provide hands on training.

INSTRUCTIONAL OBJECTIVES:
After completing the course, the students should be able to
Understand the program development life cycle
Design algorithms to solve simple problems using computers
Convert algorithms into C and C++ programs and execute

PROGRAMMING FUNDAMENTALS
Computer Basics; Program Development Life Cycle: Flow Chart, Algorithm, Compilation and Execution; Introduction to C Language: program structure, variables, keywords, data types; Input / Output functions: scanf, printf; simple programs.

DECISION AND LOOP CONTROL STRUCTURE
Logical operators; Decision statements: if/else, switch/case statements; Loop control statements – for, while, do/while.

ARRAYS AND FUNCTIONS
Arrays:
Introduction to arrays; one dimensional arrays: declaration, reading and printing array elements, sorting and searching.
Functions:
Definition; declaration of functions; return statement; recursion.

INTRODUCTION TO OOP CONCEPTS
OOP concepts: data hiding, encapsulation, inheritance, overloading, polymorphism; classes and objects; constructor and destructor; simple program in C++.

INHERITANCE AND OVERLOADING
Inheritance – single, multiple, multilevel; Overloading – Function overloading, Operator overloading.

LIST OF EXERCISES

Note to the Instructors: Design exercise problems to demonstrate the use of C and C++ in the area of specialization.

1. Programs to demonstrate the use of scanf ( ) and printf( ) functions
2. Programs to evaluate arithmetic expressions
3. Programs using conditional statements
4. Programs using for, while , do…while
5. Programs on arrays
6. Programs to perform matrix addition and multiplication
7. Programs to implement functions
8. Programs to illustrate recursion
9. Program to create classes and objects using C++
10. Program to implement Constructor and Destructor in C++
11. Program to implement single inheritance in C++
12. Program to implement Function overloading in C++
13. Program to implement Operator overloading in C++

REFERENCE BOOKS

1. Computer Practice Laboratory Manual, SRM University.
2. Kanetkar P.Yashwant,"*Let us C*", BPB publications, 2002.
3. Ashok N.Kamthane, "*Programming with ANSI and Turbo C*", Pearson Education, 2006.
4. Herbert Schildt, "*The Complete Reference C++*", Tata McGraw Hill, 2001, 3rd Edition.
5. Robert Lafore, "*Object Oriented Programming in Microsoft C++*", The Waite Group, Galgotia Publications Pvt. Ltd., 2002.

		L	T	P	C
ME 0130	**ENGINEERING GRAPHICS**	**1**	**0**	**4**	**3**
	Prerequisite				
	Nil				

(Only First Angle Projection is to be followed)

PURPOSE

To draw and interpret various projections of 1D, 2D and 3D objects.
To prepare and interpret the drawings of buildings.

INSTRUCTIONAL OBJECTIVES

To familiarize with
The construction of geometrical figures
The projection of 1D, 2D & 3D elements
Sectioning of solids and development of surfaces
Preparation and interpretation of building drawing

FUNDAMENTALS OF ENGINEERING GRAPHICS

Lettering, two dimensional geometrical constructions, conics, representation of three-dimensional objects – principles of projections – standard codes – projection of points.

PROJECTION OF LINES AND SOLIDS

Projection of straight lines, projection of solids – auxiliary projections

SECTIONS AND DEVELOPMENTS

Sections of solids and development of surfaces.

PICTORIAL PROJECTIONS

Conversion of projections: Orthographic projection, isometric projection of regular solids & combination of solids.

BUILDING DRAWING

Building Drawing – plan, elevation and section of single storied residential (or) office building with flat RCC roof and brick masonry walls having not more than 3 rooms (planning / designing is not expected in this course).

TEXT BOOKS

1. Jeyapoovan, T., *"Engineering Drawing and Graphics using AutoCAD 2000",* Vikas Publishing house Pvt Ltd, NewDelhi, 2005.
2. Narayanan, K.L & Kannaiah, P., *"Engineering Graphics"*, Scitech Publications, Chennai, 1999.

REFERENCE BOOKS

1. Bhatt, N.D., "*Elementary Engineering Drawing (First Angle Projection)",* Charotar Publishing Co., Anand, 1999.
2. Venugopal, K. "*Engineering Drawing & Graphics"*, New Age international Pvt. Ltd., 2001.
3. Natarajan, K.V. "*Engineering Drawing & Graphics"*, Private Publication, Chennai, 1990.
4. Shah, M.B. and Rana, B.C., "*Engineering Drawing"*, Pearson Education (Singapore) Pvt. Ltd., Delhi – 110 092, 2005.

		L	T	P	C
ME 0120	**WORKSHOP PRACTICE**	**0**	**0**	**4**	**2**
	Prerequisite				
	Nil				

PURPOSE

To provide the students with, hands on experience on different trades of engineering like fitting, carpentry, smithy, welding and sheet metal.

INSTRUCTIONAL OBJECTIVES

To familiarize with

The basics of tools and equipments used in fitting, carpentry, sheet metal, welding and smithy.

The production of simple models in the above trades.

LIST OF EXPERIMENTS

EMPHASIS TO BE LAID ON REAL LIFE APPLICATIONS WHEN FRAMING THE EXERCISES.

FITTING

Tools & Equipments – Practice in Filing and Drilling.
Making Vee Joints, Square, dovetail joints, Key Making.

CARPENTARY

Tools and Equipments- Planning practice. Making Half Lap, dovetail, Mortise & Tenon joints, a mini model of a single door window frame.

SHEET METAL

Tools and equipments - Fabrication of a small cabinet, Rectangular Hopper, etc.

WELDING

Tools and equipments - Arc welding of butt joint, Lap Joint, Tee Fillet. Demonstration of Gas welding, TIG & MIG.

SMITHY

Tools and Equipments –Making simple parts like hexagonal headed bolt, chisel.

TEXT BOOK

1. Gopal, T.V., Kumar, T., and Murali, G., *"A first course on workshop practice – Theory, practice and work book",* Suma Publications, 2005.

REFERENCE BOOKS

1. Kannaiah,P. & Narayanan,K.C. "*Manual on Workshop Practice"*, Scitech Publications, Chennai, 1999.
2. Venkatachalapathy, V.S. "*First year Engineering Workshop Practice"*, Ramalinga Publications, Madurai, 1999.

SEMESTER III

		L	T	P	C
LE0201	**GERMAN LANGUAGE PHASE I**	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

Enabling the Engineering Students to one more Foreign Language, especially German, which is scientific and technical language. This may be useful in the field of employment opportunities as well as helping them to develop projects on browsing German websites.

INSTRUCTIONAL OBJECTIVES

Developing pronunciation so that they can read the text and e-mail during their employment, instructing them to write their own C V and developing a fundamental conversation with any German national

INTRODUCTION
German Language, Alphabets and Pronunciation.

THEMEN
Name, Land, Leute, Beruf, Familie geschwister, Einkaufen, Reisen, Zahlen, Haus, Freunden, Essen and Stadium, Fest, Zeit.

LISTENING
Listening to the cassette and pay special attention to the meaning and sounds. Listening Comprehension – Announcements / Airport / Station / General.

READING
Listening to the cassette and reading it allowed.
READING COMPRENSION BASICS / STATION / NEWS / NOTICE BOARDS.

GLOSSARY
Technical Words Lesson (1-5)

TEXT BOOK WITH CASSETTES

1. Grundkurs Deutsch
2. Momentmal (Max Mueller Bhavan – Goethe Institute, Germany).

SCHEME OF EVALUATION

Internal 50 = Listening – 10 Marks, Speaking – 20 Marks, Reading – 10 Marks and Writing = 10 Marks
External 50 – 3 hours final written exam

		L	T	P	C
LE0203	**JAPANESE LANGUAGE PHASE I**	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE
1. In view of globalization, learning Foreign Language by Engineering graduates enhances their employment opportunities.
2. Get awareness of understanding of International culture.
3. Widening the Linguistic Skills of the Students.

INSTRUCTIONAL OBJECTIVES
To learn the scripts of Japanese Languages namely Hiragana, Katakana and Kanji, Vocabularies etc. To learn basic grammar and acquire basic communication skills. To understand Japanese culture.

Alphabets (Hiragana), Self Introduction, Greetings, Classroom expressions, Numbers,
Conversation.

Alphabets Hiragana (continued),Vocabularies.
Counters .Time expression. Conversation

Katakana and related vocabulary.
Kanjis –introduction. conversation.

Lesson-1 Watashiwa Nihonjin desu. Grammar,Marume &Sentence pattern.Marume.
Conversation.

TEXT BOOKS
1. Nihongo Shoho I main Text sold in India by the Japanese Language Teachers Association Pune.
2. Hiragana and Katakana Work Book published by AOTS Japan
3. Grammar and Kotoba (Work Book)
4. Japanese for Dummies.(Conversation) CD.

SCHEME OF EVALUATION
Internal 50 = Listening – 10 Marks, Speaking – 20 Marks, Reading – 10 Marks and Writing = 10 Marks
External 50 – 3 hours final written exam

		L	T	P	C
LE0205	**FRENCH LANGUAGE PHASE I**	**2**	**0**	**0**	**2**
	Prerequisite				
	Nil				

PURPOSE

1. As language skills are as valuable as technical skills knowledge of French enables the engineering graduates in career orientation.
2. As a second international global Lang after English there is a wider choice of job opportunities in the international employment market and also multinationals in India and an understanding of French culture thro language.

INSTRUCTIONAL OBJECTIVES
Characterized by the Roman script, grammar, vocabulary and colloquial expressions are taught which enables them to communicate effectively with any native speaker.

INTRODUCTION AND PRONUNCIATION
Introduction of the French Language, Alphabets and Pronunciation, Greetings (Wishing, Thanking and Bidding good bye), Introducing oneself & someone Presenter quelqu'un et se presenter - conversational French sentences based on the topics discussed above.

VOCABULARY
Numbers and Dates, Days, Months and Seasons, Time, Nouns, Professions and Nationalities. Conversational sentences on weather, time, and professions.

GRAMMAR
Basic Verbs (Avoir, Etre, Aller, Faire) – Conjugation – Present tense, Affirmative, Negative, Interrogative, Adjectives (Qualitative), Subject Pronouns and Disjunctive Pronouns.

CONVERSATION AND LISTENING
Conversational sentences on physical description and expressions with verbs like avoir, etre and faire

GRAMMAR
Prepositions (a, de,dans, en, sur,sous, pour….),Contracted Articles, Question Tag
(Qui, Quel, Ou, ……etc)

TEXT BOOK:

1. Panorama – Goyal Publishers
2. Apprenons le Francais I, Sarawathy publication.

SCHEME OF EVALUATION
Internal 50 = Listening – 10 Marks, Speaking – 20 Marks, Reading – 10 Marks and Writing = 10 Marks
External 50 – 3 hours final written exam

		L	T	P	C
MA0211	**MATHEMATICS – III**	**3**	**2**	**0**	**4**
	Prerequisite				
	MA0101,MA0102				

PURPOSE
To equip the students with the knowledge of slightly advanced topics of mathematics.

INSTRUCTIONAL OBJECTIVES

After the completion of the course, the students should be able to apply

1. The rudiments of Fourier series
2. The theory and problems of PDE
3. The applications of PDE to boundary value problems.
4. Fourier transforms and to their branches of engineering**.**

FOURIER SERIES

Dirichlet's conditions – General Fourier series – Half range Sine and Cosine series – Parseval's identity – Harmonic Analysis.

PARTIAL DIFFERENTIAL EQUATIONS

Formation – Solution of standard types of first order equations – Lagrange's equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients - Classification of second order linear partial differential equations.

ONE DIMENSIONAL WAVE & HEAT EQUATION

Boundary and initial value problems - Transverse vibrations of elastic string with fixed ends – Fourier series solutions – One dimensional heat equation - Steady and transient states – problems.

TWO DIMENSIONAL HEAT EQUATION

Two dimensional heat equation – Steady state heat flow equation – Laplace Equation Cartesian form – Laplace equation in polar form – heat flow in circular plates including annulus - Fourier series solution.

FOURIER TRANSFORMS

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

TEXT BOOK

1. Grewal B.S., "*Higher Engineering Mathematics*"36th edition, Khanna Publishers, 2002.

REFERENCE BOOKS

1. Kreyszig.E, "*Advanced Engineering Mathematics*", 8th edition, John Wiley & Sons, Singapore, 2000.
2. Kandasamy P etal. "*Engineering Mathematics*", Vol. II & Vol. III (4th revised edition), S.Chand & Co., New Delhi, 2000.
3. Narayanan S., Manicavachagom Pillay T.K., Ramanaiah G., "*Advanced Mathematics for Engineering students*", Volume II & III (2nd edition), S.Viswanathan Printers and Publishers, 1992.
4. Venkataraman M.K., "*Engineering Mathematics*" – Vol.III – A & B (13th edition), National Publishing Co., Chennai, 1998.

NT0201	BASIC ENGINEERING –III	L	T	P	C
	Prerequisite	**4**	**0**	**0**	**4**
	Nil				

PURPOSE

To motivate students to gain knowledge in the field of Chemical engineering and Metallurgy.

INSTRUCTIONAL OBJECTIVES

The objective of the course is to make the students familiar with in the field of chemical methods, kinetics and principles of metallurgy

PART A –CHEMICAL ENGINEERING

INTRODUCTION TO CHEMICAL PROCESSES

Mechanical and Electromechanical operations-Basic laws- Cox chart, Dühring plot. Mathematical methods-Graphical representation, method of least squares, Triangular diagram-Units and dimensions-Definition of International units, Dimensional analysis, The Rayleigh method- Solutions-Solubility, boiling and freezing of solutions, osmosis -Hardness of water and water softening.

FLOW OF FLUIDS

Introduction-Nature of a fluid-viscosity, velocity profile-Flow field, Types of fluid motion, Laminar and turbulent flow-Conservation of mass and energy-Friction losses in laminar flow through a circular tube-Hagen-Poiseuille equation-Friction losses in turbulent flow-Fanning equation, special cases-losses in pipe fittings, frictional losses in coils.

CHEMICAL KINETICS AND MEASURING DEVICES

Introduction-Rate and order of a reaction-Determination of the rate equation-Effect of temperature on reaction rate-Catalysis- Specific Gravity-Pycnometer and hydrometer-Viscosity-Ostwald's viscometer-pH-Chemical indicators and potentiometric measurement-Chemical composition-Paper Chromatography -Flow meters-Orifice meter, Venturimeter.

TEXT BOOKS

1. Introduction to Chemical engineering-Solil K Ghosal,Shyamal K Sanyal,Siddhartha Datta,Tata McGraw Hill Publishers.
2. Introduction to Chemical engineering-Walter.L.Badger & Juliust T.Banchedo, Tata McGraw Hill Publishers.

REFERENCE BOOKS

1. Chemical engineering-JR Backhurst & JH Harker with JF Richardson, Elsevier Publisher.
2. Introduction to Chemical engineering-Robert D.Braun, International Students Edition.

PART B- PRINCIPLES OF METALLURGY

CHEMICAL METALLURGY

Extraction of Non-ferrous metals-Basic principles-Processing of ores and extractive techniques-Pyrometallurgy, Hydrometallurgy and electrometallurgy-Extraction of Copper, Aluminium, Zinc, Nickel and Magnesium.

PHYSICAL METALLURGY

Heat Treatment- Objectives and process-Types of heat treatment-Annealing, Spheroidizing, Normalising, Tempering-Surface hardening-Flame hardening, Induction hardening, Pack carburising,Solid Carburising, Cyaniding, Nitriding - Work(Strain) hardening.

MECHANICAL METALLURGY

Fundamentals of metal working-Classification of forming process-Mechanics of metal working-Metallurgical structure-Forging-Classification ,Forging Defects-Rolling-Classification, Defects in rolling-Extrusion-Classification, Deformation and defects -Drawing of Rods and Wires.

TEXT BOOKS

1. Principles of Engineering Metallurgy-L.Krishna Reddy, New Age International Publishers.
2. Engineering Materials and Metallurgy-Dr.J.T.Winowlin Jappes, A.Alavudeen, N.Venkateshwaran, Laxmi Publications (P) Limited.
3. Mechanical Metallurgy-George.E.Dieter

REFERENCE BOOKS

1. Physical Metallurgy-V.Raghavan,Prentice Hall of India Pvt Limited
2. Metallurgical engineering-O.P.Gupta.

NT0203	**STATISTICAL MECHANICS AND THERMODYNAMICS**	L	T	P	C
	Prerequisite	**3**	**0**	**0**	**3**
	Nil				

PURPOSE

To introduce to the students the basic principles of statistical mechanics and thermodynamics and to lay emphasis on the fundamentals .

INSTRUCTIONAL OBJECTIVES

The objective of this course is to make the students acquainted with the concepts of statistical mechanics and thermodynamics and to apply it to different systems

BASIC PRINCIPLES AND CLASSICAL STATISTICS
Macroscopic and microscopic states- Boltzmann Entropy equation- phase space- postulate of equal a priori probability-Ergodic hypothesis- density of distribution in phase space- Liouville theorem - condition of statistical equilibrium.

QUANTUM STATISTICS
.Transition to quantum statistics: Indistinguishability of particles and its consequences- classical and quantum limit on the basis of uncertainly principle- symmetry of wave function- effect of symmetry counting and degeneracy

STATISTICAL DISTRIBUTIONS
MaxwellBoltzmann-BoseEinstein and FermiDirac statistics- Fermi energy- . Comparison of three statistics Application of MB, BE and FD statistics (qualitative)

LAWS OF THERMODYNAMICS
.Thermal Equilibrium –Concept of temperature (Zeroth Law of Thermodynamics) – Concept of Heat and Work as a path function – First Law of Thermodynamics – Isothermal Process – Adiabatic Process – Isobaric process – Isochoric Process – Second Law of Thermodynamics – Entropy – Third Law of Thermodynamics

ENSEMBLE THEORY AND SIMULATION TECHNIQUES
Entropy as an ensemble average – the Uncertainity function – Molecular Thermodynamics – Relations between Microscopic and Macroscopic properties – Thermodynamic constraints and Ensembles – Biothermodynamics – Theories of simple liquids – Monte Carlo molecular Dynamics simulations

TEXTBOOKS
1. Elements of statistical thermodynamics - L. K. Nash, Addison Wesley
2. Richard E.Sonntag and Claus Borgnakke , Introduction to Engineering Thermodynamics , Wiley;2 edition (March 3, 2006) ,ISBN-10:0471737593

REFERENCE BOOKS
1. Statistical thermodynamics by B. J. McCelland, Chapman and Hall.
2. A Introduction to Statistical Thermodynamics by T. L. Hall Addison - Wesley
3. F. Reif, Fundamentals of Statistical and Thermal Physics (McGraw-Hill, 1965)
4 . F.W. Sears and G.L. Salinger, Thermodynamics, the Kinetic Theory of Gases, and Statistical Mechanics, 3rd edition (Addison-Wesley, 1975).

NT0205	FUNDAMENTALS OF SOLID STATE TECHNOLOGY	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE
The topic of the course is the field of physics that deals with the macroscopic and microscopic physical properties of matter.

INSTRUCTIONAL OBJECTIVES
The objective of this course is to develop the knowledge about the basic concepts of matters.

CRYSTAL PHYSICS
Crystal structure-Lattice representation-simple symmetry operations- structural features of NaCl,CsCl and ZnS-Diffraction-Bragg's law-Reciprocal lattice-X-ray diffraction methods--Rotation,Laue and powder methods-Brillouin Zones-Binding in crystals.

PHONON PHYSICS
Theory of elastic vibrations in monoatomic- Diatomic lattice-Phonons-Dispersion relations-Thermal Properties-Vibrational modes-Einstein model-Density of modes in 1 and 3 dimensions.

FREE ELECTRON FERMI GAS
Energy levels-Density of orbitals-Free electron gas in 3D- Fermi sphere and surface- Heat capacity of electron gas-Electrical and thermal conductivity in metals-Lorentz number.

ENERGY BANDS
Free electron models (overview only) –origin and magnitude of energy gap-block functions-Kronig Penny model-Wave equation of electron in a periodic potential-Crystal momentum of an electron-Empty lattice approximation.

FERMI SURFACES AND METALS
Reduced zone scheme- Periodic Zone scheme-Construction of Fermi surfaces- Electron orbitals- Hole orbitals and open orbitals-Experimental methods in Fermi surface studies- De Haas – Van Alphen effect.

TEXT BOOK
1. Kittel.C, "Introduction to solid state Ph7ysics", Wiley Eastern Ltd., New Delhi, 1994.

REFERENCE BOOKS
1. R.l. Singhal, Solid State Physics, 7th edition, Kedar Nath Ram, NAth & Co., Meerut, 1989.
2. Blakemore, Solid State Physics, 2nd edition,Cambridge University Press, 1974.

NT0207	INSTRUMENTATION TECHNIQUES	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE To introduce the students to the basics of the properties of nanomaterials

INSTRUCTIONAL OBJECTIVES
The objective of this course is to make the students familiar with the properties behavior and applications and implementation nanotechnology.

ABSORPTION AND EMISSION SPECTROSCOPY
Electromagnetic Radiation – Spectrum - Atomic Energy Levels - Raman Effects - Nuclear Spin Behavior - Electron Spin Behavior.

RAMAN SPECTROSCOPY
Theory of Raman Spectroscopy – Instrumentation - Sample Handling and Illumination -Diagnostic Structural Analysis - Polarization Measurements - Quantitative Analysis – Micro Raman.

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY
Basic Principles of NMRS - Continuous Wave NMR Spectrometers - Pulsed Fourier Transform NMR Spectrometer - Spectra & Molecular Structure – Quantitative Analysis.

ELECTRON SPIN RESONANCE SPECTROSCOPY
Electron Behavior - ESR Spectrometer - ESR Spectra - interpretation of ESR Spectra - Quantitative Analysis.

CHARACTERISATION TECHNIQUES
Ion Scattering Spectrometry (ISS) - Secondary Ion Mass Spectrometry (SIMS) - Auger Emission Spectroscopy (AES) - Electron Spectroscopy for Chemical Analysis (ESCA) - Low Energy Electron Diffraction (LEED) - Photoelectron Spectroscopy (PES).

TEXTBOOK
1. Willard, Merritt, Dean, Settle, " Instrumental Methods of Analysis ", CBS publishers & Distributors, Delhi, Sixth Edition, 1986.

REFERENCE BOOKS
1. Colin N. Banwell and Elaine M. McCash, Molecular Spectroscopy, Mcgraw-Hill College; 4 Sub edition (June 1, 1994), ISBN-10: 0077079760

NT0209	PROPERTIES OF NANOMATERIALS	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE To introduce the students to the basics of the properties of nanomaterials

INSTRUCTIONAL OBJECTIVES
The objective of this course is to make the students familiar with the properties behavior and applications and implementation nanotechnology.

PHYSICAL PROPERTIES
Melting point and phase transition processes- quantum-size-effect (QSE). Size-induced metal-insulator-transition (SIMIT)- nano-scale magnets, transparent magnetic materials, and ultrahigh-density magnetic recording materials-chemical physics of atomic and molecular clusters.

SURFACE PROPERTIES
Surface energy – chemical potential as a function of surface curvature-Electrostatic stabilization- surface charge density-electric potential at the proximity of solid surface-Van der Waals attraction potential.

CHEMISTRY ASPECTS
Photochemistry; Photoconductivity; Electrochemistry of Nanomaterials-Diffusion in Nanomaterials; Nanoscale Heat Transfer; Catalysis by Gold Nanoparticles; Transport in Semiconductor Nanostructures; Transition Metal Atoms on Nanocarbon Surfaces; Nanodeposition of Soft Materials; Nanocatalysis.

NANOSTRUCTURES
Electronic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, nanowires, nanostructured beams, and nanocomposites-artificial atomic clusters-Size dependent properties-size dependent absorption spectra-phonons in nanostructures.

MICROSTRUCTURAL PROPERTIES
Properties slightly dependent on temperature and grain size; properties strongly dependent on temperature and grain size; strengthening mechanisms; enhancement of available plasticity; grain size evolution and grain size control; Hall-Petch relation, microstructure – dislocation interactions at low and high temperatures; effects of diffusion on strength and flow of materials.

TEXT BOOKS

1. Joel I. Gersten, “The Physics and Chemistry of Materials”, Wiley, 2001.
2 A. S. Edelstein and R. C. Cammarata, “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Pub., 1998.

REFERENCE BOOKS

1. K.W. Kolasinski, “Surface Science: Foundations of Catalysis and Nanoscience”, Wiley, 2002.
2. S.Yang and P.Shen: “Physics and Chemistry of Nanostructured Materials”, Taylor & Francis, 2000.
3. G.A. Ozin and A.C. Arsenault, “Nanochemistry : A chemical approach to nanomaterials”, Royal Society of Chemistry, 2005.

		L	T	P	C
PD0201	PERSONALITY DEVELOPMENT - III	0	0	2	1
	Prerequisite				
	Nil				

PURPOSE
The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential.

INSTRUCTIONAL OBJECTIVES

1. To guide thought process.
2. To groom student's attitude.
3. To develop communication skill.
4. To build confidence.

METHODOLOGY

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Goal Setting - Problem Solving - Emotional Quotient
Assertiveness - Stress Management - Quiz II
Lateral Thinking (Situational) - Team Work (Role Plays) Impromptu - Text Analysis
Business plan presentation I - Business plan presentation II - Chinese Whisper
Picture Perfect - Case Studies – Review

SCHEME OF INSTRUCTION

Marks allocated for regular participation in all oral activities in class

SCHEME OF EXAMINATION

Complete internal evaluation on a regular basis.

NT0211	INSTRUMENTATION LAB – I	L	T	P	C
		0	0	3	2
	Prerequisite				
	Nil				

PURPOSE

This laboratory class will teach the student to know more about various instrumentation techniques available in nanotechnology.

INSTRUCTIONAL OBJECTIVES

The objective of this course is to make students familiar with different instrumentation techniques which are useful in finding physical, optical and biological properties of nanomaterials

LIST OF EXPERIMENTS

1. To determine the protein structure using NMR
2. To calculate the absorption coefficient from UV-Vis spectrometer
3. To do the peak analysis of IR transmission spectrum using FTIR spectrometer
4. Trace out the emission spectra for UV excited luminescent sample
5. To determine the particle size using UV spectra
6. To identify the elements using atomic absorption spectra
7. To determine the g-factor and other parameters from NMR spectrum

REFERENCE

1. Laboratory manual

NT 0213	PROPERTIES OF MATERIALS LAB	L	T	P	C
		0	0	3	2
	Prerequisite				
	Nil				

PURPOSE

This laboratory class will teach the student to learn more about different characterization techniques and their instrumentations.

INSTRUCTIONAL OBJECTIVES

The objective of this laboratory is to make students more familiar with different instrumentation techniques which are useful to know about surface, electrical conductivity and dielectric properties of nanomaterials.

LIST OF EXPERIMENTS

1. To identify the phase using search peak analysis from XRD pattern
2. To determine the dielectric parameters from dielectric constant instrument
3. To do I-V characteristic studies of electroplated sample using Impedance analyzer
4. To determine the Hall parameters from Hall effect set-up instrument
5. To determine the band gap from UV-Vis spectrometer
6. To calculate the refractive index and extinction co-efficient from UV-Vis spectrometer
7. To do the Nyquist plot using three electrode system

REFERENCE

1. Laboratory manual

SEMESTER IV

		L	T	P	C
LE0202	**GERMAN LANGUAGE PHASE - II**	**2**	**0**	**0**	**2**
	Prerequisite				
	LE0201				

PURPOSE

Enabling the Engineering Students to one more Foreign Language, especially German, which is scientific and technical language. This may be useful in the field of employment opportunities as well as helping them to develop projects on browsing German websites.

INSTRUCTIONAL OBJECTIVES

Developing pronunciation so that they can read the text and e-mail during their employment, instructing them to write their own C V and developing a fundamental conversation with any German national.

SPEAKING;

Dialogue – Questioning / Basic queries / Conversational with practical exposure.

GRAMMATIK (WRITING)

Verben, Wortstellung, Nomen, Pronomen, Artikel, Nominitativ, Akkusativ, Dativ, Adjective, Prasens, Perfect and Neben Satze.

GLOSSARY

Technical words. Lesson (6-10)

TEXT BOOK WITH CASSETTES

A. Grundkurs Deutsch
B. Mo`ntmal
(Prescribed by Max Mueller Bhavan – Goethe Institute, Germany).

SCHEME OF EVALUATION

Internal 50 = Listening – 10 Marks, Speaking – 20 Marks, Reading – 10 Marks and Writing = 10 Marks
External 50 – 3 hours final written exam

		L	T	P	C
LE0204	**JAPANESE LANGUAGE PHASE II**	**2**	**0**	**0**	**2**
	Prerequisite				
	LE0203				

PURPOSE

1. In view of globalization, learning Foreign Language by engineering graduates enhances their employment opportunities.
2. Get awareness of understanding of International culture.
3. Widening the Linguistic Skills of the Students.

INSTRUCTIONAL OBJECTIVES

To learn the scripts of Japanese Languages namely Hiragana, Katakana and Kanji, Vocabularies etc. To learn basic grammar and acquire basic communication skills. To understand Japanese culture.

Lesson 2-{Korewa Tsukue desu } – Grammar, Sentence pattern, Marume . Conversation
Lesson 3 – [Kokoni denwa ga arimasu] - Grammar, Sentence pattern, Marume .Copnversation
Lesson 4– {Asokoni hito ga imasu} - Grammar, Sentence pattern, Marume .
Lesson 5– {Akairingo wa ikutsu arimasu ka}-Grammar, Sentence pattern, Marume . Conversation.
Lesson 6– {Barano hana wa ippon ikura desu ka}- Grammar, Sentence pattern.Marume.Conversation

TEXT BOOKS

1. Nihongo Shoho Imain Text sold in India by the Japanese Language Teachers Association , Pune.
2. Hiragana and Katakana Work Book published by AOTS Japan
3. Grammar and Kotoba (Work Book)
4. Japanese for Dummies.(Conversation) CD.

SCHEME OF EVALUATION

Internal 50 = Listening – 10 Marks, Speaking – 20 Marks, Reading – 10 Marks and Writing = 10 Marks
External 50 – 3 hours final written exam

		L	T	P	C
LE0206	**FRENCH LANGUAGE PHASE II**	**2**	**0**	**0**	**2**
	Prerequisite				
	LE0205				

PURPOSE

1. As language skills are as valuable as technical skills knowledge of French enables the engineering graduates in career orientation.
2. As a second international global Lang after English there is a wider choice of job opportunities in the international employment market and also multinationals in India and an understanding of French culture thro language.

INSTRUCTIONAL OBJECTIVES

Characterized by the Roman script, grammar, vocabulary and colloquial expressions are taught which enables them to communicate effectively with any native speaker

Sports (Ski, natation, tennis, Tour de France), Cuisine (French dishes),Cinema
(Review of a film) – Articles on these topics and group discussion will be followed.

GRAMMAR

Possessive Adjectives, Demonstrative Adjectives, Past tense – Passé Compose(Verbe Auxiliare:.Etre et Avoir)
Culture and Civilization French Monuments (Tres celebres), French History (Jeanne d' Arc, Louis XIV,
Prise de la Bastille), Culture and Civilisation (vin, fromage, mode, parfums)

Transport system, government and media in France – articles on these topics.

Comprehension and Grammar Comprehension passages and conversational sentences in
different situations (at the restaurant, at the super market)

TEXT BOOK:

1. Panorama – Goyal Publishers
2. Apprenons le Francais II, Sarawathy Publications

SCHEME OF EVALUATION

Internal 50 = Listening – 10 Marks, Speaking – 20 Marks, Reading – 10 Marks and Writing = 10 Marks
External 50 – 3 hours final written exam

		L	T	P	C
MA0232	**PROBABILITY AND RANDOM PROCESSES**	**3**	**2**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE

To introduce the students to the idea of probability and random process, an important mathematical tool in signal processing.

INSTRUCTIONAL OBJECTIVES

At the end of the course, the students should be fully equipped with the knowledge of

1. Probability and Random variables
2. 2 – D Random variables
3. The concepts of Random process
4. The Correlation Functions and
5. The applications of Fourier Transforms like Spectral Density and others.

PROBABILITY AND RANDOM VARIABLES:

Probability theory – Random Variables – Moments – Moment generating function – Binomial, Poisson, Geometric, Exponential, Normal distributions, functions of Random Variables, Chebyshev inequality.

TWO DIMENSIONAL RANDOM VARIABLES

Two dimensional Random Variables – Marginal and conditional distributions – Transformation of Random Variables – central limit theorem – simple problems.

RANDOM PROCESSES

Classification of Random processes – Stationarity – WSS and SSS processes – Poisson Random process – Pure Birth process – Renewal Process – Markov Chain and transition probabilities.

CORRELATION FUNCTIONS:

Autocorrelation function and its properties – Cross Correlation function and its properties – Linear System with Random inspects.

SPECTRAL DENSITY

Power spectral Density Function – Properties – System in the form of convolution – Unit Impulse Response of the System – Einstein – Weiner-Khinchine Relationship – Cross Power Density Spectrum – Properties.

TEXT BOOK

1 T. Veerarajan, "*Probability, Statistics and Random Processes*", Tata McGraw – Hill Publishing Company Limited, New Delhi, 2004.

REFERENCE BOOK

1. Trivedi K S, " *Probability and Statistics with reliability, Queueing and Computer Science Applications*",Prentice Hall of India,New Delhi, 1984

NT0204	SYNTHESIS OF NANOMATERIALS	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE To introduce the students to the basics of the synthesis of nanomaterials for the future developments

INSTRUCTIONAL OBJECTIVES
The objective of this course is to make the students familiar with the different methods of synthesis for nanomaterials.

BULK SYNTHESIS
Synthesis of bulk nano-structured materials –sol gel processing –Mechanical alloying and mechanical milling- Inert gas condensation technique .

FABRICATION OF NANO FILM STRUCTURES
Fundamentals of film growth – Physical vapor Deposition (PVD) – Chemcial vapour Deposition (CVD) - Atomic layer Deposition (ALD) – Self Assembly- LB technique

LITHOGRAPHY
Photolithography – Nanomanipulation and Nano lithography – Soft Lithography – Assembly of Nanoparticles and Nanowires – Sol gel Lithography.

VAPOUR (OR SOLUTION) LIQUID – SOLID
Fundamental aspects of VLS and SLS growth – VLS growth of Nanowires – Control of the size of the nanowires – Precursors and catalysts – SLS growth – Stress induced recrystalization.

TEMPLATE BASED SYNTHESIS
Electrochemcial deposition – Electrophoretic deposition – Template filling – Electro spinning – Micro emulsion – Reverse micelles method.

TEXT BOOKS
1. Guozhong Cao ,"*Nanostructures and Nanomaterials , synthesis , properties and applications"* , Imperial College Press ,2004.

REFERENCE BOOKS
1. T. Pradeep , "*NANO The Essential , understanding Nanoscience and Nanotechnology"*. Tata McGraw-Hill Publishing Company Limited , 2007.
2.Charles P.Poole Jr. "*Introduction to Nanotechnology*", John Willey & Sons , 2003.

NT0206	QUANTUM MECHANICS	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE
To introduce students, the various opportunities in the emerging field of nanoscience and nanotechnology

INSTRUCTIONAL OBJECTTIVES
The objective of this course is to make students familiar with the important concepts of quantum mechanics.

BASIC PRINCIPLES OF QUANTUM MECHANICS
Classical Mechanics –Drawbacks - Quantum mechanics - The Schrödinger Equation – Schrodinger's Time Dependent/ Time Independent wave equations, Quantum mechanics postulates – applications (particle in a box, tunneling effect)

DISCRETE EIGEN VALUES
The Hydrogen Atom – Single atom and Many Electron Atoms systems - Harmonic oscillator–Hydrogen atom wave equations - space quantization-discussion of bound states-parity-Angular momentum- Eigen functions-Rigid rotator-application to diatomic molecules-energy level spacing

APPROXIMATE METHODS
Time independent and time dependent perturbation theory for non-degenerate and degenerate energy levels, the variational method, WKB approximation, adiabatic approximation, sudden approximation

SCATTERING THEORY
Kinematics of the scattering process- Wave mechanical picture- Green's fuction-Expression for scattering amplitude-The Born approximation-validity of the Born approximation-Application to the screened coulomb potential - Optical theorem-low energy scattering-resonance and non-resonance scattering-scattering length and effective range-Ramsauer-Townsend effect.

QUANTUM COMPUTATION
Concept of quantum computation, Quantum Qbits etc.

TEXT BOOK
1. P.M. Mathews & K.Venkatesan "Quantum mechanics" Tata McGraw Hill Publishing CO.Ltd, New Delhi-1975

REFERENCE BOOKS
1. Leonard I Schiff, "Quantum mechanics" III edition-McGraw Hill Book Company-Tokoyo-1968.
2. V.K.Thankappan, Quantum mechanics" II edition- New Age International (P) Ltd. Publishers-1996.
3. Satya Prakash, "Advanced Quantum mechanics" Pragfathi Prakashan publishing Limited-Meerut-1996.

NT0208	BIO NANOTECHNOLOGY	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE
To introduce to the students, the various opportunities in the emerging field of bioscience and nano-bioscience thro' Nanotechnology.

INSTRUCTIONAL OBJECTIVES
The objective of this course is to make students familiar with the important concepts applicable to bioscience and nano-bioscience devices and applications.

NANO BIOMATERIALS
Introduction-Biocompatibility – anti bacterial activity – principles involved – Applications.Biomaterial nanocircuitry; Protein based nanocircuitry; Neurons for network formation. DNA nanostructures for mechanics and computing and DNA based computation; DNA based nanomechanical devices.

NANO-BIOTECHNOLOGY
Interaction between bimolecules and naoparticle surface, Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, Application of nano in biology, nanoprobes for Analytical Applications-A new ethodology in medical diagnostics and Biotechnology, Current status of nano Biotechnology, Future perspectives of Nanobiology, Nanosensors.

NANOMEDICINES
Developing of Nanomedicines Nanosytems in use,Protocols for nanodrug Administration, Nanotechnology in Diagnostics applications, materials used in Diagnostics and Therapeutic applications - Molecular Nanomechanics, Molecular devices, Nanotribology, studying tribology at nanoscale,Nanotribology applications.

MOLECULAR AND CELLULAR BIOLOGY
Molecular and Cellular biology and Applications, 2-D electrophoresis and mass spectrometry of proteins, Protein microarrays (fabrication-fluorescence detection)-Binding assays and immunosensors- Integrated Nanobiotechnology systems.

BIOLOGICAL METHODS OF SYNTHESIS:
Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magnetotactic bacteria for natural spynthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the formation of nanostructured materials; Synthesis process and application, Role of plants in nanoparticle synthesis

TEXT BOOKS

1. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education.
2. Nanomaterials by A.K. Bandyopadhyay; New Age International Publishers

REFERENCE BOOKS

1. Bionanotechnology: Lessons from Nature by David S. Goodsell
2. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas
3. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology - Hari Singh Nalwa
4. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.
5. Nanocomposite Science & Technology Ajayan, Schadler & Braun
6. BioMEMS (Microsystems) - Gerald A. Urban
7. Introduction to Nanoscale Science and Technology (Nanostructure Science and Technology) -Massimiliano DiVentra
8. Nanosystems: Molecular Machinery, Manufacturing, and Computation - K. Eric Drexler
9. Springer Handbook of Nanotechnology - Bharat Bhusha
10. Nanobiotechnology; ed. C.M.Niemeyer, C.A. Mirkin.

NT0210	ADVANCED ELECTRONICS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To introduce to the students, the various opportunities in the emerging field of nano electronics and nano technologies.

INSTRUCTIONAL OBJECTIVES

The objective of this course is to make students familiar with the important concepts applicable to small electronic devices, their fabrication, characterization and application.

FEED BACK AMPLIFIERS

Classification and representation of amplifiers – The feedback concept- Ideal feedback amplifier – properties of negative – Feedback amplifiers – Impedance in Feedback amplifiers – Blackman's Impedance formula – General analysis of feed back amplifier – shunt – Feedback triple – shunt –series pair- Multiloop feedbach amplifiers.

LIMITATIONS OF CMOS

Fundamentals of MOSFET devices - Scaling of CMOS – Limitations – Alternative concepts in materials – **Structures of MOS devices:** SOI MOSFET, FINFETS, Dual Gate MOSFET, Ferro electric FETs.

PUMPING SYSTEMS

Basics of Pressure Range – Rotary – Diffusion – Roots – Turbo - Ion Pump - Titanium Sublimation Pump - UHV Techniques.

MORPHOLOGICAL AND ELEMENTAL ANALYSIS TECHNIQUES

Scanning Electron Microscope – WDX – EDX – EPMA - Transmission Electron Microscope - Scanning Transmission Electron Microscope - Scanning Probe Microscope (AFM, STM, MFM , SNOM)-Chromotography – Classifications of Chrromotagraphy-LCC-GCC.

MASS SPECTROMETRY & THERMAL ANALYSIS

Components of Mass Spectrometer – Resolution – Mass Spectrometers – Differential Thermal Analysis (DTA) – Differential Scanning Calorimetry (DSC) – Thermogravimetry (TG) – Methodology of DSC (DTA) & TG.

TEXT BOOKS

1. Rainer Waser (Ed.) , "*Nano electronics and information technology*", Wiley- VCH., Edition II, 2005.
2. Willard, Merritt, Dean & Settle, Instrumental Methods of Analysis, Wadsworth Publishing Company; 7 Sub edition (February 1988), ISBN-10: 0534081428.

REFERENCE BOOKS

1. Thomas Heinzel , "*A Microscopic Electronics in Solid State Nanostructure*" , Wiley- VCH.
2. Mick Wilson, Kamali Kannangara, Geoff Smith , Michelle Simmons and Burkhard Raguse "*Nanotechnology – (Basic Science and Emerging Technologies*)", Overseas Press.
3. P. J. Goodhew and F. J. Humphreys. Electron Microscopy and Analysis, 2rd Ed. Taylor and Francis, 1988.

		L	T	P	C
NT 0212	**BASIC ENGINEERING-IV**	**4**	**0**	**0**	**4**
	Prerequisite				
	Nil				

PURPOSE

To have broader aspects in understanding the basic concepts in manufacturing engineering and robotics technology.

INSTRUCTIONAL OBJECTIVES

At the end of this course the student should be able to understand the tools, equipment and principle of operation of primary and secondary manufacturing processes and robotics technology.

PART-A MANUFACTURING ENGINEERING

FABRICATIOIN PROCESSES

Welding – Classification of welding – Electric Arc Welding- Equipment – Consumables – processes – Gas Welding – Equipment – Processes – Resistance welding – Types of Resistance welding – Soldering & Brazing – Adhesive bonding – Welding Inspection – Defects, Causes & Remedies.

PROCESSING OF PLASTICS AND COMPOSITES

Types of plastics – Processing of thermo plastics – Extrusion, Inspection blow, Rotatromal moulding processes – Calendaring, Film blowing, Thermo forming – Processing of thermosets - Compression, Transfer, Jet Moulding processes – Bonding of thermoplastics- Laminated plastic — Composites- types- Fabrication Methods –advantages ,limitations and applications.

UNCONVENTIONAL METHODS OF MANUFACTURING

Introduction – Need –classification -Electro-Discharge Machining – Electro-Chemical Machining – Laser Beam Machining – Abrasive Jet Machining –Water jet Cutting – Ultrasonic Machining — High Velocity Forming of Metals – Explosive Fabrication – Hydro forming – Electro-hydraulic Forming – Magnetic pulse Forming – Electron Beam Machining.

TEXT BOOKS

1. S.Gowri, P.Hariharan, A.Suresh Babu “Manufacturing Technology-I”,Pearson Education, 2008
2. P.C.SHARMA, A Text book of Production Technology, S.Chand and Co., Ltd., 1999.

REFERENCE BOOKS

1. R.K.Rajput, “Manufacturing Technology (Manufacturing Processes), Latmi Publications Ltd., New Delhi,2007
2. D.K.Singh, “Fundamentals of Manufacturing Engineering”, Ane Books India, New Delhi,2008
3. R.B.Gupta, “Foundry Engineering”, Sataya Prakasham, New Delhi,2002
4. R.S.Parmar, “Welding Processes and Technology”, Khanna Publishers, New Delhi,2003

PART-B ROBOTICS TECHNOLOGY

FUNDAMENTALS OF ROBOT

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots

SENSORS IN ROBOTICS

Force sensing, touch and tactile sensors, proximity sensors, non contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism

Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques,

ROBOT KINEMATICS ,PROGRAMMING AND APPLICATIONS

Forward kinematics, inverse kinematics and the difference: forward kinematics and Reverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems.

Robot programming languages – VAL programming – Motion Commands, Sensors commands

Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TEXT BOOK

1. Mikell P. Groover, Industrial Robotics – Technology, Programming & Applications, McGraw-Hill International, 1996

REFERENCE BOOKS

1. Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1994
2. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.
3. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2002.

		L	T	P	C
PD0202	**PERSONALITY DEVELOPMENT - IV**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential

INSTRUCTIONAL OBJECTIVES

1. To guide thought process.
2. To groom student's attitude.
3. To develop communication skill.
4. To build confidence.

METHODOLOGY

The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.

1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Motivation II - Interpretation of Visuals of I & II
Humor in real life - Body language - Collage and poster designing and slogan writing
Brain Teasers – JAM - Current News Update I
Current News Update II - Enactment (SKIT –I) - Enactment (SKIT – II)
Survey and Reporting (heroes, sports persons etc.) - Quiz III – Review

EVALUATION:

1. Activities assessed by both group and individual participation
2. Continuous assessment based on daily participation

SCHEME OF INSTRUCTION

Marks allocated for regular participation in all oral activities in class

SCHEME OF EXAMINATION

Complete internal evaluation on a regular Basis

NT0214	**INSTRUMENTATION LAB – II**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**
	Prerequisite				
	Nil				

PURPOSE

This laboratory class will teach the student to learn more about different characterization techniques and their instrumentations.

INSTRUCTIONAL OBJECTIVES
The objective of this laboratory is to make students more familiar with different instrumentation techniques which are useful to know about surface, electrical conductivity and dielectric properties of nanomaterials.

LIST OF EXPERIMENTS

1. To study the CMOS behavior and its characteristics
2. To study the MOSFET behavior and its characteristics
3. To determine the grain size of nanostructured sample using AFM
4. To determine the crystallite size using XRD instrument
5. To observe the size and shape of the nanosized sample using SEM
6. To identify the heavy elements using XRF
7. To do the Bode plot using three electrode system

REFERENCE
1. Laboratory manual

NT 0216	MATERIALS SYNTHESIS LAB- II	L	T	P	C
		0	0	3	2
	Prerequisite				
	Nil				

PURPOSE
This laboratory class is more useful to students to understand different synthesis process for nanomaterials.

INSTRUCTIONAL OBJECTIVES
The prominent objective of this laboratory is that to fabricate nanomaterials with different temperatures and its characterization techniques.

LIST OF EXPERIMENTS

1. To synthesis the nanomaterials using combustion method
2. To synthesis the nano biomaterials using wet chemical method
3. To deposit the polymer matrix using spin coating method
4. To deposit the self assembly using LB film unit
5. To deposit the Carbon nanotube by RF-PECVD technique
6. To deposit the multi layer coating by electron beam technique

REFERENCE
1. Laboratory manual

		L	T	P	C
NT0218	**COMPREHENSION -1**	0	2	0	1
	Prerequisite				
	Nil				

PURPOSE
To provide a complete review of Nanotechnology topics covered in the first four semesters, so that a comprehensive understanding is achieved. It will also help students to face job interviews and competitive examinations**.**

INSTRUCTIONAL OBJECTIVES
1. To provide overview of all Nanotechnology engineering topics covered in the first four semesters.
2. To assess the overall knowledge level in the following topics of Nanotechnology

COMPREHENSION
A. Review of the topics covered upto IVth Semester
B. Seminar/group discussion
Students shall have seminar/group discussion sessions on the topics listed under A above under the guidance of staff.
(Evaluation is based on an end semester examination)

SEMESTER V

		L	T	P	C
MB0301	**ENGINEERING ECONOMICS AND MANAGEMENT**	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To provide engineering students with the management skills to enable them to assess, evaluate and take key management decisions by the application of management concepts.

INSTRUCTIONAL OBJECTIVES

At the end of the course, the students are expected to

1. Understand the various key concepts of micro economics.
2. Demonstrate the effect of time value of money and depreciation.
3. Apply the various project management techniques
4. Understand the various issues related to industrial safety.

Role and Importance of Economics for Engineers, Law of demand and supply, Break-even analysis, Pricing Policies.

Cost determination, Balance Sheet, Cost benefit analysis, Time Value of Money, Methods of Depreciation, Long Term and short term financing, Financial Institutions.

Management-Nature and functions, Project Management-Phases and Techniques, CPM, PERT, Human Aspects of Project Management-Issues and Problems, Managing-vs-leading a project.

Marketing Concepts, Marketing Mix, Product life cycle, Plant layout, Plant location, Material Handling, Productivity, Plant Maintenance and Industrial Safety.

Current Trends in financing, Role of Industrial Engineer and Applications of Industrial Engineering, Process of Project Management and the Future, Ethics and Project Management, E-Marketing-Ethical and legal issues.

TEXT BOOKS

1. R. Pannerselvam, "*Engineering Economics*", PHI, 2001.
2. O.P. Khanna, "*Industrial Engineering and Management*", Dhanpat Rai and sons, 1992.

REFERENCE BOOKS

1. Kotler, "*Marketing Management*", Pearson education, 12th edition.
2. Prasanna Chandra, "*Finance Sense for non-finance executives*", TMH.

NT0315	**NANOPHOTONICS**	L	T	P	C
	Prerequiste	**3**	**0**	**0**	**3**
	Nil				

PURPOSE

To introduce to the students the basic principles of Nanophotonics.

INSTRUCTIONAL OBJECTIVES

The objective of this course is to make the students acquainted with the concepts of Nanophotonics.

QUANTUM CONFINED MATERIALS

Quantum dots-Optical transitions-absorption-interband transitions-quantum confinement intraband transitions fluorescence/luminescence-photoluminescence /fluorescence optically excited emission electroluminescence emission

PLASMONICS

Internal reflection and evanescent waves –plasmons and surface plasmon resonance –Attenuated Total reflection – Grating SPR coupling –Optical waveguide SPR coupling-SPR dependencies and materials –plasmonics and nanoparticles

NEW APPROACHES IN NANOPHOTONICS
Near Field Optics-Apertureless near field optics-near field scanning optical microscopy (NSOM or SNOM)-SNOM based detection of plasmonic energy transport-SNOM based visualization of waveguide structures-SNOM in nanolithography-SNOM based optical data storage and recovery

BIOPHOTONICS
Interaction of light with cells –tissues-nonlinear optical processes with intense laser beams-photo induced effects in biological systems-generation of optical forces-optical trapping and manipulation of single molecules and cells in optical confinement-laser trapping and dissection for biological systems-single molecules biophysics-DNA protein interaction

PHOTONIC CRYSTALS
Important features of photonic crystals-Presence of photonic bandgap-anomalous group velocity dispersion-Microcavity-effects in Photonic Crystals-fabrication of photonic Crystals-Dielectric mirrors and interference filters-photonic crystal laser-PBC based LEDs-Photonic crystal fibers (PCFs)-Photonic crystal sensing.

TEXT BOOK
1 M.Ohtsu,K.Kobayashi,T.Kawazoe and T.Yatsui, *Principals of Nanophotonics (Optics and Optoelectronics),* University of Tokyo,Japan,2003

REFERENCE BOOKS
1. H.Masuhara,S Kawata and F Tokunga, *NanoBiophotoics*, Elsevier Science 2007
2. BEA Saleh and AC Teich, *Fundamentals of Photonics*, John Wiley and Sons,NewYork,1993
3. P.N.Prasad, *Introduction to Biophotonics*, John Wiley and Sons,2003

NT0317	MICRO AND NANO FLUIDICS	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE
To introduce to the students, the various opportunities in the emerging field of micro and nano fluids

INSTRUCTIONAL OBJECTIVES
The objective of this course is to make students familiar with the important concepts applicable to small electronic devices, their fabrication, characterization and application.

MICROFLUIDICS
MICROSCALE GAS FLOW
Introduction: Fundamentals of kinetic theory-molecular models, micro and macroscopic properties, binary collisions, distribution functions, Boltzmann equation and Maxwellian distribution functions-Wall slip effects and accommodation coefficients, flow and heat transfer analysis of microscale Couette flows, Pressure driven gas micro-flows with wall slip effects, heat transfer in micro-Poiseuille flows, effects of compressibility.

MICROSCALE LIQUID FLOW
Pressure driven liquid microflow, apparent slip effects, physics of near-wall microscale liquid flows, capillary flows, electro-kinetically driven liquid micro - flows and electric double layer (EDL) effects, concepts of electroosmosis, electrophoresis and dielectro-phoresis.

NANOFLUIDICS
TRANSPORTS OF ION, DNA POLYMERS AND MICROTUBULES IN THE NANOFLUIDS REGIME:
Ionic transport – polymer transport – microtubule trans port in nanotuble channels driven by Electric Fields and by Kinesin Biomolecular Motors.-Electrophoresis of individual nanotubules in microfluidic channels.

BIOMOLECULE SEPARATION, CONCENTRATION AND DETECTION USING NANOFLUIDIC CHANNELS
Introduction – Fabrication techniques for Nanofluidic channels – Biomolecules separation using Nanochannels - Biomolecules Concentration using Nanochannels – Confinement of Biomolecules using Nanochannels.

PARTICLE TRANSPORT IN MICRO AND NANOSTRUCTURED ARRAYS: ASYMMETRIC LOW REYNOLDS NUMBER FLOW

An introduction to hydrodynamics and particle moving in flow fields – Potential Functions in Low Renoylds Number Flow – Arrays of Obstacles and how particles Move in them: Puzzles and Paradoxes in Low Re Flow.

TEXT BOOKS

1. Henrik Bruus "Theoretical Microfluidics" Oxford Master Series in Physics, September 2007.
2.. Joshua Edel "Nanofluidics" RCS publishing, 2009.

REFERENCE BOOKS

1. Patric Tabeling "Introduction to Microfluids" Oxford U. Press , New York , 2005.
2. K. Sarit "Nano Fluids ; science and Technology",RCS Publishing, 2007.

NT0319	CHARACTERIZATION TECHNIQUES	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To introduce to the students, the various opportunities in the emerging field of nanotechnology.

INSTRUCTIONAL OBJECTIVES

The objective of this course is to make students familiar with the important concepts in characterization of nanomaterials by different methods.

PROBING MECHANICS AT NANOSCALE

Characterization of nanostructured materials - By scattering techniques - Proximal microscopy (AFM and STM) - Properties of Nanostructured materials - particle size, porosity, specific surface- chemical and supramolecular structures of Nanomaterials- Improvement of mechanical properties- super-plasticity of nano-structured materials- Structural- Magnetic and Electron transport properties of nanoparticles.

SPECTROSCOPIC AND MICROSCOPIC TECHNIQUES

Optical Microscope and their description, operational principle and application for analysis of nanomaterials- UV-VIS-IR Spectrophotometers -Principle of operation and application for band gap measurement.
Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, X-ray diffraction

LITHOGRAPHY TECHNIQUES

Nanolithography and nanomanipulation - E beam lithography and SEM based nanolithography and nanomanipulation, Ion beam lithography- Oxidation and metallization - Mask and its application - Deep UV lithography- X-ray based lithography.

SIZE CHARACTERIZATION

Introduction Effect of size on material properties - Quantum size effect and density of states - low dimensional systems and their applications - Introduction to microscopy – STM - AFM and their application in nanotechnology.

NANOINDENTATION

Nanoindentation principles- elastic and plastic deformation -mechanical properties of materials in small dimensions- models for interpretation of nanoindentation load-displacement curves-Nanoindentation data analysis methods- Hardness testing of thin films and coatings- MD simulation of nanoindentation.

TEXT BOOK

1. Microfabrication and Nanomanufacturing- Mark James Jackson.

REFERENCE BOOKS

1. Fabrication of fine pitch gratings by holography, electron beam lithography and nano-imprint lithography (Proceedings Paper) Author(s): Darren Goodchild; Alexei Bogdanov; Simon Wingar; Bill Benyon; Nak Kim; Frank Shepherd.

2. A Three Beam Approach to TEM Preparation Using In-situ Low Voltage Argon Ion Final Milling in a FIB-SEM Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830-831 Cambridge University Press.
3. Processing & properties of structural naonmaterials - Leon L. Shaw (editor)

NT0321	NANOTOXICOLOGY	L	T	P	C
	Prerequisite	**3**	**0**	**0**	**3**
	Nil				

PURPOSE
To introduce to the students the toxic effects of nanomaterials in the diverse fields and to study the risk assessment

INSTRUCTIONAL OBJECTIVE
The objective of this course is to make the students familiarize the effect of toxicology and their risk factors

INTRODUCTION
Concept of Nanotoxicology - Laboratory rodent studies - Ecotoxicologic studies – Methodology - for Nanotoxicology - *toxicity testing*

MECHANISM
Mechanism of nanosize particle toxicity - Reactive oxygen species mechanisms of NSP toxicity - Interactions between Nanoparticles and Living Organisms: Mechanisms and Health Effects - Interactions of Nanoparticles with Cells and their Cellular Nanotoxicology - Cytotoxicity of Ultrafine Particles - Cytotoxicity and Potential Mechanism of Nanomaterials

POLLUTION
Nanopollution – Nanomaterials in Environment - Toxicology of Airborne – Manufactured nanomaterials in the environment

HUMAN EXPOSURE TO NANOSIZED MATERIALS
Biological Activities of Nanomaterials and Nanoparticles - Respiratory Tract – Efficient deposition of inhaled NSPs. - Disposition of NSPs in the respiratory - Disposition of NSPs in the respiratory -Epithelial translocation - Translocation to the circulatory system - Neuronal uptake and translocation -Translocation of NSPs in the blood circulation to bone marrow in mice - Studies of neuronal translocation of UFPs from respiratory tract -Exposure via GI Tract and Skin

RISK ASSESSMENT AND EXECUTION
Portals of entry and target tissue – Risk assessment – Ethical – Legal and Social Implications - Nanoparticle Toxicology and Ecotoxicology, The Role of Oxidative Stress – Development of Test Protocols for Nanomaterials – Regulation of Engineered Nanomaterials in Europe and USA

TEXT BOOKS
1. Yuliang Zhao and Hari Singh Nalwa, 'Nanotoxicology: Interactions of Nanomaterials with Biological Systems, American Scientific Publishers, 2007
2. "Nanotoxicology - Interactions of Nanomaterials with Biological Systems", Ed Yuliang Zhao and Hari Singh Nalwa, June 2006

REFERNECE BOOKS
1. E P. Widmaier, H. Raff, K.T. Strang, Vander, Sherman and Luciano, 'Human Physiology: The Mechanisms of Body. Functions', 9th edition, McGraw Hill, New York, 2004
2. Gunter Oberdörster, Eva Oberdorster and Jan Oberdorster, *Environmental Health Perspectives*, Volume 113 Number 7 , July 2005
3. D. Drobne, 'Nanotoxicology for safe and Sustainable Nanotechnology', Nanotoxicology for safe and sustainable Nanotechnology , 58, pp. 471-478, December 2007
4. Monteiro-Riv, 'Nanotoxicology: Characterization, Dosing and Health Effects', Informa Healthcare publishers, 2007
5. A Reference handbook of nanotoxicology by M.Zafar Nyamadzi

NT0323	SURFACE AND INTERFACES	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE
To enlighten the students in the emerging field of Surfaces and interfaces and the futuristic opportunities

INSTRUCTIONAL OBJECTIVES
The objective of this course is to make students familiar with the recent advanced techniques

INTRODUCTION TO SURFACE AND INTERFACES
Introduction to surfaces and interfaces, definitions, Surface energy and surface states, surface tension. Surface, Interface and Bulk- Surface Crystallography-Surface electronic structure.

MECHANICS OF SURFACE BONDS
Binding of molecules to the surface, adsorption, diffusion, nucleation. Adsorption isotherms, kinetic model of sorption, potential model of sorption, two-dimensional gas. Stimulated desorption. Ideal and real surface, surface states.

METHODS OF SURFACE PREPARATION AND MODIFICATION
Electron emission, electron spectroscopy. Interaction of particles and radiation with surface, diffraction, secondary emission. Cathode sputtering, ion implantation. Surface ionization. Different properties of thin films and bulk, charge transport through thin films. Epitaxial growth. Diagnostic methods: microscopic techniques, electron and ion spectroscopies, diffraction methods (SAXS)

SPECTROSCOPIC TECHNIQUES FOR INTERFACE ANALYSIS
Instruments and methods of analysis of X-ray photoelectron spectroscopy (XPS), Auger electron microscopy (AES), Rutherford back scattering (RBS).

CLASSIFICATIONS OF MATERIALS
Minerals, ceramics and glasses- Phase structures, Surface structures, Surface sites, Grain boundaries and inter granular films and depth profiles. Composites-Surface analysis

TEXT BOOKS
1. Handbook of Surface and Interface analysis, J.C.Riviere and S.Myhra, Marcell Decker Inc.,1998
2. Introduction to solid state physics, Charles kittel, 7th Edition, John wiley pub, 2000

REFERENCE BOOKS
1. Handbook of Surface and Interface, A.A.Maradudin, R.F.Wallis and L.Dobrzynski eds.,STM Press 1980
2. Introduction to Surface and Thin Film Processes, John A. Venables, Cambridge University Press, 2003
3. ASM Handbook, Volume 5, Surface Engineering, ASM International Inc., 1998

		L	T	P	C
PD0301	**PERSONALITY DEVELOPMENT - V**	1	0	2	2
	Prerequisite				
	Nil				

PURPOSE
The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential

INSTRUCTIONAL OBJECTIVES
At the end of the course the students will be able to
1. Acquire the important soft skills for employment
2. Take part in group discussions and job interviews confidently
3. Appear for placement aptitude tests confidently
4. Gain self confidence to face the placement process

METHODOLOGY
The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.
1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Syllogism - Binary Logic [cause & effect] - Assertive & Counter Argument - Simple Interest - Time & Work - Time & Distance
Upstream &Downstream Reasoning - Verbal Comprehension I - Verbal Comprehension II- Compound Interest Logarithms - Surds & Indices
Verbal Reasoning I - Verbal Reasoning II - Verbal Reasoning III – Percentage – Test – Averages
Deductive Reasoning I - Deductive Reasoning II - Language Usage I - Decimal Fractions - Profit & Loss – Probability
Language Usage II - Logic Games I - Logic Games II – Area - Pipes & Cisterns – Test

SCHEME OF INSTRUCTION
Marks allocated for regular participation in all oral activities in class

SCHEME OF EXAMINATION
Complete internal evaluation on a regular Basis

NT 0325	CHARACTERIZATION LAB	L	T	P	C
		0	0	3	2
	Prerequisite				
	Nil				

PURPOSE
This laboratory class is more helpful to students to know different characterization techniques for nanomaterials

INSTRUCTIONAL OBJECTIVES
The objective of this course tells that how to characterize different nanomaterials with different novel instruments.

LIST OF EXPERIMENTS
1. To do the Electron beam lithography of a simple electrical circuit
2. To do imaging micron size particle using Optical microscope
3. To estimate the particle size from SEM
4. To analyze Bio samples using SEM
5. To calculate the R-parameters using AFM
6. To determine particle size analysis using XRD
7. To estimate the edge shift using UV

REFERENCE
1. Laboratory manual

NT 0327	SURFACE SCIENCE LAB	L	T	P	C
		0	0	3	2
	Prerequisite				
	Nil				

PURPOSE
This laboratory class is more helpful to students to know different surface analysis techniques for nanomaterials.

INSTRUCTIONAL OBJECTIVES
The objective of this course tells that how to analysis the various surface properties of nanomaterials.

LIST OF EXPERIMENTS

1. To do small angle X-ray diffraction analysis of nano materials
2. To do image analysis using transmission electron microscope spectrum
3. To estimate electron diffraction analysis from TEM image
4. To do roughness analysis of nanostructured sample using AFM
5. To do XPS analysis of sputter etched nano thin films
6. To estimate chemical valency identification using XPS data

REFERENCE

1. Laboratory manual

		L	T	P	C
NT0329	**INDUSTRIAL TRAINING - I**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To expose the students to the industrial working environment and make them industry ready.

IMPLEMENTATION

A minimum of 2 weeks in-plant training has to be undergone by the student after 3rd semester but before 5th semester. A certificate from the company to the effect that the student has undergone the training successfully is to be produced by the student. The student is required to present a report on the observations and knowledge gained during the training, which will be evaluated by a panel of senior faculty members.

SEMESTER VI

NT0320	**APPLICATIONS OF NANOTECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

To motivate the students to apply the concepts of Nanoscience and nanotechnology in various fields

INSTRUCTIONAL OBJECTIVE

The objective of the course is to make the students acquainted with the applications of nanotechnology in various fields such as nanoelectronics, industrial, biomedical and aerospace.

NANOELECTRONIC APPLICATIONS

Memory devices and sensors – Nano ferroelectrics – Ferroelectric random access memory –Fe-RAM circuit design – ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors –electronic noses – identification of hazardous solvents and gases – semiconductor sensor array

INDUSTRIAL NANOTECHNOLOGY

Solar cells - Thin film Si solar cells - Chemical semiconductor solar cells - Dye sensitized solar cells - Polymer solar cells - Nano quantum dot solar cells - Hybrid nano-polymer solar cells - Fuel Cells – principle of working – basic thermodynamics and electrochemical principle – Fuel cell classification – Fuel cell Electrodes and Carbon nano tubes – application of power and transportation.

BIOMEDICAL APPLICATIONS

Nanoparticles and Micro–organism, Nano-materials in bone substitutes & Dentistry, Drug delivery and its applications, Biochips- analytical devices, Biosensors- Natural nanocomposite systems as spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly.

Polymeric nanofibres – Implications in Neuro science, tissue engineering and cancer therapy. Poly electrolyte multilayers- coated colloids- smart capsules. Colloids and colloids assembly of bio nanotechnology. Micro emulsions in nanotechnology

AEROSPACE APPLICATIONS
Nano and pico satellites - Black box using nanosensors, CNT based electronic noses- CNT based lab on a chip/biochip- CNT in epoxy composites - fuel cells for onboard aircraft systems- functionalized carbon nanotubes in ballistic protection- Zyvere Nanocoatings- scratch, chemical and UV resistance.

BIO MOLECULAR MACHINES
Characterization of molecular mission- Molecular shuttle-Electrochemical Energy- Molecular Machines powered by Light energy- Molecular Switching- Chemical Switching and Electrochemical Switching- Self assembled nano reactors- Molecular nano reactors- Nano covalent system- Macro Molecular Nano reactions miscelles and Polymers- Bio macro nano molecular reactions- Protein cages

TEXT BOOKS
1. Springer handbook of nanotechnology by Bharat Bhushan
2. MEMS and nanotechnology – Based sensors and devices communication, Medical and Aerospace applications - A.R.Jha.

REFERENCE
1. Nanotechnology - A Gentle Introduction to the Next Big Idea, Ratner and Ratner, Prentice Hall PTR,1st edition (2002)
2. Handbook of Nanostructured materials (H.S. Nalwa)
3. Biomedical applications of nanotechnology edited by Vinod Labhasetwar and DiandraL.Lesie – Pelecky.
4. Nanotechnology: Fundamentals and Applications by Karkare.
5. David.S.Goodsell, Bio nanotechnology: lessons from nature, wiley – Liss.
6. Nanomaterials, nanotechnologies and design by Michael.F.Ashby, Daniel L.Schodek, Paulo J.Ferriera.

		L	T	P	C
NT 0322	**MOLECULAR NANOELECTRONICS**	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE
To have broader aspects in understanding the role of molecular electronics, and its application.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology for device architecture and interface engineering at atomic scales.

BACKGROUND
Recent past – the present – challenges – Future - Overview of basic Molecular Nanoelectronics.

MOLECULAR ELECTRONICS COMPONENTS
Electronic transport in 1, 2 and 3 dimensions – Quantum confinement - Energy subbands –Quantum wells – Quantum wires – Quantum dots – Device miniaturization.

NANODEVICES
Nanoelectronic and Nanocomputers – Quantum Mechanical Tunnel Devices – Characterization of switches – Complex molecular devices – Organic/inorganic based rectifying diode switches – LEDs, TFTs – Single Electron Devices – Consequences of Moore's law.

NANOELECTRONIC ARCHITECTURES
Nanofabrication – Nanopatterning of Metallic/Semiconducting nanostructures (e-beam/X-ray, Optical lithography, STM/AFM- SEM & Soft-lithography) – Nanophase materials – Self-assembled Inorganic/Organic layers – Molecular devices – Logic switches – Interface engineering – Properties (Self-organization, Size-dependent) – Limitations.

COMPUTATIONAL NANOTECHNOLOGY
Monte Carlo Simulations- Computational methods and Simulations from ab initio to multiscale Modeling- Modeling of Nanodevices- Applications and Example Problems

TEXT BOOK
1. Edward L. Wolf (2nd Ed.), *Nanophysics &Nanotechnology: An Introduction to Modern Concepts in Nanoscience*, WILEY-VCH, 2006, ISBN: 3-527-40651

REFERENCE BOOKS

1. Goser et al, "*Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices"*
2. Supriyo Datta, "*From Atom to Transistor*"
3. John H. Davies, *The Physics of Low Dimensional Semiconductors: An Introduction"*, Cambridge University Press, 1998.
4. Hari Singh Nalwa, "*Encyclopedia of Nanotechnology*"
5. A. A. Balandin and K. L. Wang, "*Handbook of Semiconductor Nanostructures & Nanodevices*"
6. Cao Guozhong, "*Nanostructures &Nanomaterials - Synthesis, Properties & Applications*"

NT0324	POLYMER AND NANOCOMPOSITES	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To introduce to the students, the various opportunities in the field of nano Polymers

INSTRUCTIONAL OBJECTIVES

The Objective of this course is to make students familiar with the important concept applicable to small Polymer based devices, their preparation, characterization and application.

INTRODUCTION TO NANO POLYMER

Types of Polymer – Natural polymer, Synthetic polymers – Degradable, Non- Degradable - Nomenclature –

CHAIN STRUCTURE AND CONFIGURATION

MW averages and Mw distribution – confirmation of chain – long range – short range. Sequention (Polymer and co-polymer) – NMR analysis of runs, Optical, geometric, substritutional, taticity(NMR analysis), Others – stars, rings interpenetrating, non-interpenetrating networks.

KINETICS OF POLYMERIZATION

Condensation – statistics, non stochiometric mixtures, gels and branching α and P. Radical chain addition polymerization – Inhibition and retardation, statistics, Transdroff effect, autocatalytic, kinetic run number Entropy and Enthalpy of polymerization – ionic polymerization, living polymers and co-rdination polymerization

POLYMER SOLUTIONS

Collogative properties – Boiling point and freezing point, Osmotic pressure – Mα, a) 2^{nd} viral co-efficients, b) Instrumentation - EMW Scattering – Theory gases (Polarization) – Mw 2^{nd} viral co-efficient means radius of gyration – turbichity, Zimm plot, P(6) scattering function – dissymmetry ration – Instrumentation - Viscosity – Definition, η, ηrel ηsp [η] measurement, Mark Houwiuk volume – Rg - Gel permentation chromatography theory measurement equipment [ηs] Ms = [ηy]My – Calculation of My

NANO PLASTICS AND NANO COMPOSITES

Introduction to plastics – types of plastics – Composites – Types of composities – Tribology of Polymeric Nano composites – Nano ceramic for Ultra high temperature MEMS – Optimizing nano filler performance in polymers - Preparation techniques – Tio_2 Nano Polymer preparation by sol-gel method – mechanical properties of nano MMT reinforced polymer composite – Clay Polymeric composite

TEXT BOOK

1. Fundamentals of Polymer Science An introductory text second edition, Michael m. Coleman, USA.

REFERENCE BOOKS

1. Chemistry and Physics of Modern Materials. 2^{nd} edition, John mckenzie Grant Cowie.
2. Introduction to Physical Polymer Science, L.H. Sperling. Wiley inter science.
3. Introduction to Polymer Chemistry, Prof.Dr. Ahmet Akar, 2th edition, 1989.
4. Principles of polymerization, George Odeon, John Wiley-Sons Inc., New York, 1991.
5. Polymer Chemistry, Bahattin Baysal,
6. Contemporary polymer chemistry , Harry allcock, Fred lamp and James Mark, 3^{rd} edition, Printice Hall, 2003.

		L	T	P	C
PD0302	**PERSONALITY DEVELOPMENT VI**	**1**	**0**	**2**	**2**
	Prerequisite				
	Nil				

PURPOSE
The purpose of this course is to build confidence and inculcate various soft skills and to help students to identify and achieve their personal potential

INSTRUCTIONAL OBJECTIVES
At the end of the course the students will be able to
1. Acquire the important soft skills for employment
2. Take part in group discussions and job interviews confidently
3. Appear for placement aptitude tests confidently
4. Gain self confidence to face the placement process

METHODOLOGY
The entire program is designed in such a way that every student will participate in the class room activities. The activities are planned to bring out the skills and talents of the students which they will be employing during various occasions in their real life.
1. Group activities + individual activities.
2. Collaborative learning.
3. Interactive sessions.
4. Ensure Participation.
5. Empirical Learning

Self Introduction - Narration - Current News Update – Numbers - Height & Distance - Square & Cube Roots
Current Tech Update - Verbal Aptitude Test I - GD –I - Odd man out series - Permutation & Combination - Problems on ages
GD –II - Resume Writing - Mock Interview I / reading comprehension - Problems on trains – Allegation of Mixtures - Test
Mock Interview II / reading comprehension - Mock Interview III/ reading comprehension - GD – III - Ratio & Proportion - Clocks - H.C.F & L.C.M
GD – IV - Verbal Aptitude Test II – Review – Partnership – Puzzles - Test

SCHEME OF INSTRUCTION
Marks allocated for regular participation in all oral activities in class

SCHEME OF EXAMINATION
Complete internal evaluation on a regular Basis

NT 0326	**NANOELECTRONICS SIMULATION LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**
	Prerequisite				
	Nil				

PURPOSE
This laboratory class is more helpful to students to know different simulation tools

INSTRUCTIONAL OBJECTIVES
The objective of this course tells that how to simulate the electronic, transport and operational characteristics of molecular/nanoelectronic devices

LIST OF EXPERIMENTS
1. MATLAB programme to plot the first four eigenfunctions of a one - dimensional rectangular potential well with infinite potential barrier.
2. Numerical solution of the Schrodinger wave equation for a rectangular potential well with infinite potential barrier using MATLAB programme.
3. Toy model in molecular electronics: IV characteristics of a single level molecule
4. Simulation of I-V Characteristics for a single Junction circuit with a single quantum Dot using MOSES 1.2 Simulator.
5. Study of Single Electron Transistor using MOSES1.2 Simulator.

REFERENCE

1. Laboratory manual

NT 0328	POLYMER SCIENCE LAB	L	T	P	C
		0	0	3	2
	Prerequisite				
	Nil				

PURPOSE

This laboratory class will teach the students to know about the various aspects of polymer science.

INSTRUCTIONAL OBJECTIVES

To learn and understand various synthesis methods and characterization techniques of polymers.

LIST OF EXPERIMENTS

1. To synthesis free radical, and condensation polymerization.
2. To investigate the polymer structure by nuclear magnetic resonance (NMR).
3. To investigate the polymer structure by infrared (IR) spectroscopy.
4. To estimate molecular weight characterization by gel permeation chromatography (GPC).
5. To characterize the polymers by X-ray diffraction.
6. To characterize the mechanical properties by tensile testing.
7. To determine the micro hardness values for thin film sample

REFERENCE

1. Laboratory manual

		L	T	P	C
NT0330	**COMPREHENSION – II**	**0**	**2**	**0**	**1**
	Prerequisite				
	NT0218				

PURPOSE

To provide a review of Nanotechnology topics covered up to VI semester, so that a comprehensive understanding is achieved. It will also help students to face job interviews and competitive examinations**.**

INSTRUCTIONAL OBJECTIVES

1. To provide overview of all Nanotechnology topics covered up to VI semester.
2. To assess the overall knowledge level in the following topics of Nanotechnology.

COMPREHENSION

A. Review of the topics

B. Seminar/group discussion

Students shall have seminar/group discussion sessions on the topics listed under A above under the guidance of staff.

(Evaluation is based on an end semester examination).

		L	T	P	C
NT0332	**COMPUTER SKILLS**	**1**	**0**	**2**	**2**
	Prerequisite				
	Nil				

PURPOSE

To acquire extramural knowledge on the computer implementation of various engineering solutions.

IMPLEMENTATION
The students are expected to undergo at least two computer courses from a list of courses provided from time to time by the departments of engineering and technology. Resources for conducting the courses will be found from in-house talents and outside professionals with expertise in the particular course. Certification will be done by both the university and the bodies notified for the purpose. The students are required to obtain a minimum grade for gaining the required credit.

SEMESTER – VII

		L	T	P	C
NT0431	**SPINTRONICS**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE
The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology and to explore their limitations.

OPTICAL PHENOMENA & BIPOLAR SPINTRONICS
Introduction - Optical properties of III-V-based MAS - Hole-mediated ferromagnetism - Optical properties - Photo-induced ferromagnetism - Photo-induced magnetization rotation effect of spin injection - Spin dynamics - Magnetization reversal by electrical spin injection - Concept of spin polarization - Optical spin orientation - Spin injection in metallic F/N junctions - Spin relaxation in semiconductors - Bipolar spin-polarized transport and applications - Magnetic p-n junctions.

SPIN EFFECTS IN QUANTUM DOTS
Introduction - Charge and spin in single quantum dots - Constant interaction model - Spin and exchange effect - Controlling spin states in single quantum dots - Charge and spin in double quantum dots - Hydrogen molecule model - Stability diagram of charge states - Spin relaxation in quantum dots - Spin blockade in single-electron tunneling - Cotunneling and the Kondo effect.

SPIN-DEPENDENT TRANSPORT IN SINGLE ELECTRON DEVICES
Single-electron transport - Model Hamiltonian - Metallic or ferromagnetic island - Quantum dot - Transport regimes - Weak coupling - Quantum dots, Non-Collinear geometry, Ferromagnetic islands, Metallic islands and Shot noise - Cotunneling - Strong coupling – Kondo effect in SEDs - RKKY interaction between quantum dots.

SPIN-TRANSFER TORQUES AND NANOMAGNETS
Spin-transfer torques - Intuitive picture of spin-transfer torques - The case of two magnetic layers - Spin-transfer-driven magnetic dynamics - Applications of spin transfer torques - Electrons in micro- and nanomagnets - Micron-scale magnets and Coulomb blockade - Ferromagnetic nanoparticles - Magnetic molecules and the Kondo effect - Spin-transfer torque and domain wall motion in magnetic nanostructures.

TUNNEL SPIN INJECTORS
Introduction - Magnetic tunnel junctions - Tunneling spin polarization - Giant tunneling using MgO tunnel barriers - Magnetic tunnel transistor - Hot electron devices – Energy dependent electron transport in the magnetic tunnel transistor - Tunnel-based spin injectors - Spin injection and spin transport in hybrid nanostructures.

TEXT BOOK

1. Sadamichi Maekawa. Concepts in Spin Electronics, Oxford University Press, ISBN 978–0198568216.

REFERENCE BOOKS

1. Serge Luryi, Jimmy Xu, Alex Zaslavsky. Future Trends in Microelectronics, Wiley-Interscience Publication, ISBN 978-0470081464.
2. Michael Ziese, Martin J. Thornton. Spin Electronics, Springer Publications, ASIN: B001BMGWNA.

NT0433	THIN FILM TECHNOLOGY	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE
To introduce to the students, the various opportunities in the emerging field of nanotechnology.

INSTRUCTIONAL OBJECTIVES
The objective of this course is to make students familiar with the important concepts in micro fabrication in thin film, characterization of thin film.

INTRODUCTION TO THIN FILMS
Nucleation growth - kinetics and thermodynamics of materials - Thin film nucleation and growth models (2D, 3D, and 2D-3D combination) - Epitaxial growth of thin films - Homoepitaxy and heteroepitaxy; Lattice matching epitaxy and domain matching epitaxy; Superlattice structures and quantum wells - Diffusions: inter-diffusion, grain boundary diffusions, reaction, and phase transformation,

CHEMICAL METHODS
Chemical methods-Electroplating- Preparation of Thin Films Spray pyrolytic process – Characteristic feature of the spray pyrolytic process – Chemical vapor deposition- Film formation –LPCVD, PECVD, APCVD&MOCVD – Spin coating – Slurry coating

PHYSICAL METHODS
Physical methods - Vacuum evaporation- Thermal, Electron and laser beam evaporation - Evaporation theory – Construction and use of vapour sources - Sputtering Methods – Reactive sputtering – RF sputtering - DC planar & Pulsed magnetron sputtering - Epitaxial thin films LPE, MBE - Ion plating

THICKNESS MEASUREMENT
Thickness measurement - electrical methods – optical interference methods – multiple beam interferometer – Fizeau – FECO methods – Quartz crystal thickness monitor - Theories of thin film nucleation – Four stages of film growth incorporation of defects during growth .

APPLICATIONS
Thin films for microelectronics - MEMS - Optical coatings – Photo detectors - Smart sensors - TFTs-Switching devices - Anti abrasive coatings - Solar cells-Superconducting and GMR devices, integrated optics - Bioelectronics devices etc.

TEXTBOOK
1. Hand book of Thin films Technology: L I Maissel and R Clang.

REFERENCE BOOKS
1. Thin film Phenomena: K L Chopra.
2. Physics of thin films, vol. 12, Ed George Hass and others.
3. Thin films solar cells – K L Chopra and S R Das.
4. Thin films processes – J L vilsan
5. Vacuum deposition of thin films – L Holland.
6. The use of thin films in physical investigation – J C Anderson.

NT 0435	THIN FILM TECHNOLOGY LAB	L	T	P	C
		0	0	3	2
	Prerequisite				
	Nil				

PURPOSE
This laboratory class is more helpful for the students to know different characterization techniques for thin films.

INSTRUCTIONAL OBJECTIVES
The objective of this course tells that how to analysis the various properties of thin films.

LIST OF EXPERIMENTS

1. To measure the film's thickness by optical ellipsometer
2. To measure the change of dielectric constant and dielectric loss with the change of signal frequency by Impedance analyzer
3. To do dip Coating of a poly thin film on glass substrates
4. To deposit the metal (Al) thin film on glass substrates by electron-beam method
5. To measure the curvature caused by the stress between the metal film and the substrates by Flexus (two-light beam reflection) method
6. To deposit polymer thin film by electrol spin technique
7. To measure D.C. resistivity by four Probe method

REFERENCE

1. Laboratory manual

		L	T	P	C
NT0437	**INDUSTRIAL TRAINING - II**	**0**	**0**	**2**	**1**
	Prerequisite				
	Nil				

PURPOSE

To expose the students to the industrial working environment and make them industry ready.

IMPLEMENTATION

A minimum of 2 weeks in-plant training has to be undergone by the student after 5th semester but before 7th semester. A certificate from the company to the effect that the student has undergone the training successfully is to be produced by the student. The student is required to preset a report on the observations and knowledge gained during the training, which will be evaluated by a panel of senior faculty members

SEMESTER VIII

NT0434	**PROJECT WORK**	**0**	**0**	**17**	**8**

ELECTIVES

		L	T	P	C
NT 0001	**MICRO/NANODEVICES AND SENSORS**	**3**	**0**	**0**	**3**
	Prerequisite				
	Nil				

PURPOSE

The ultimate aim of this course is to have deeper understanding of the contemporary and the recent researches of micro/Nano device fabrication, characterization and their strategies for its industrial/academia usages.

INSTRUCTIONAL OBJECTIVES

To understand the basic concepts involve in this technology and to explore their limitations in miniaturizing devices especially at sub-nanometric length scales

QUALITATIVE BACKGROUND

Different length scales (Macroscopic, Mesoscopic, Nanoscopic, Sub-Nanometic) - Quantum mechanical treatment - Quantum/classical regimes of electron transport, - Moore's law & its preservation - Electron mobility – Diffusion coefficient - Drift-diffusion model - Double barrier Resonant-Tunneling structures: Coherent/Sequential tunneling - Negative differential resistance - Single electron tunneling

TECHNICAL BACKGROUND OF MEMS/NEMS

Essential for photolithography - Etching methods - Deposition methods - Lithography-based micro/nano-machining - Surface/bulk machining processes - Non-lithographical micro/nano-machining (LIGA/Laser-assisted processing) - Process integration

TRANSPORT PROPERTIES

Electronic Transport in Micro/Nanostructures - Semiconductor devices - Molecular devices - Single electron Transistors - Present challenges

MICRO/NANO SCALE CHARACTERIZATION
Methods – Techniques - Philosophies of Micro/Nano electromagneto-mechanical systems – Material/mechanical property – Crystallographic/anisotropic properties – Optical/chemical properties – Emerging approaches

APPLICATIONS
Nanosensors – Sensing (piezoelectric, capacitive, magnetic, etc.) – Actuation (electrostatic, electromagnetic, thermal, piezoelectric, SMA, etc.) - IPR rights – Role - Integration in industry/academia.

TEXT BOOK
1. Ping Sheng (Ed.), "*Nanoscience & Technology: Novel structure & phenomena"*

REFERENCE BOOKS
1. H. Meixner, "*Sensors: Micro & Nanosensors*", Sensor Market trends (Part 1&2).
2. Michael Rieth, "*Nano Engineering in Science & Technology: An introduction to the world of nano design"* .
3. Balles, Brand, Fedder, Hierold, "*Enabling Technology for MEMS & Nano devices*"
4. P. Rai Choudhury, "*MEMS & MOEMS Technology & Applications*"

NT0002	FUNCTIONALIZATION OF CNT AND METALLIC NANOPARTICLES	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE
To introduce to the students, the various opportunities in the emerging field of nano electronics and nano technologies.

INSTRUCTIONAL OBJECTIVES
The objective of this course is to make students familiar with the important concepts applicable to small electronic devices, their fabrication, characterization and application.

THE GEOMETRY OF NANOSCALE CARBON
Introduction –Carbon molecules-nature of the carbon bond-new carbon structures-discovery of C60-structure of C60 and its crystal- From a Graphene Sheet to a Nanotube – Single wall and Multi walled Nanotubes - Zigzag and Armchair Nanotubes - Euler's Theorem in Cylindrical and Defective Nanotubes**.**

CARBON NANOTUBES
History Molecular and Super molecular Structure-Intrinsic propertries of individual carbon nano tubes-Synthesis - Arcing in the present and absent of catalys-laser method-Chemical Vapour Deposition -ball milling.

CHARACTERIZATIONTECHNIQUES
XRD- SEM-Raman Spectroscopy-TEM-AFM-TGA

METALLIC NANOPARTICLES
Introduction-Size dependent properties of metal nanoparticle-synthesis of metal nanoparticles by chemical methods-growth mechanism-Particle size estimation by XRD-Band gap measurement-Characterization techniques

FUNCTIONALIZATION AND APPLICATION OF CARBON NANOTUBES
Covalent modification of carbon nanotubes-physisorption of carbon nanotubes-filling of carbon nanotubes(SWCNT,MWCNT **)**-Nanotube for Storage applications-field emission displays-sensor application-thermal management applications-electronic applications-medical applications

TEXT BOOK
1. Massimiliano di Ventra.et.al. Introduction to NANOSCALE SCIENCE AND TECHNOLOGY", springer 2009

REFERENCE BOOKS
1. Mick Wilson,Kamali Kannagara.et.al.,"NANOTECHLOGY-basic science and emerging technologies,University of new south wales press ltd,2008.
2. Charles P.Poole Jr et.al.,"INTRODUCTION TO NANOTECHNOLGY" ,Wiley Student Edition,2008.

		L	T	P	C
NT0003	**NANOROBOTICS**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE
The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology and to explore their limitations.

INTRODUCTION
Micro/Nano-Robotic System Overview - Scaling Effects in The Physical Parameters -Micro/Nano-Robotic System Examples Around The World.

MICRO/NANO-SENSORS
Imaging Sensors (Far-Field and Near-Field) - Position Sensors - Capacitive Sensors - Linear Variable Differential Transformer - Interferometric Sensors - STM Tips Based, Etc - Force and Pressure Sensors - Strain Gauges - Deflection Based - AFM, Etc. - Visual Force Sensing - Bending Imaging Etc. - Capacitive Force/Tactile Sensors – Accelerometers – Gyroscopes - Chemical Sensors - Flow Sensors, Etc.

MICRO/NANO-ACTUATORS
Piezoelectric Actuators - Bending Type - Unimorph and Bimorphs - Stack Type – Piezotubes - Thin-Film Type – ZnO, Etc. Films - Surface Acoustic Waves - PZT Actuators as also integrated Sensors - Electrostatic, Thermal, Ultrasonic, Electro, Magnetostrictive, and Shape Memory - Alloy Based Actuators - Polymer Actuators - Dielectric Elastomers - Carbon Nanotube (CNT) Actuators - Biomolecular Motors.

MICRO/NANO MANIPULATORS
SPM Probes and Micro/Nanogrippers - Case Study: Atomic Manipulation using STM - Optical Tweezers and AC Electrokinetics (Dielectrophoresis, Etc.) - Case Study: Bio-Manipulation using Optical Tweezers and Dielectrophoresis - Case Study: Carbon Nanotube Manipulation using Nanoprobes - Case Study: High Density Data Storage Using Nanoprobes.

MANUFACTURING TECHNIQUES, NANO-ROBOT DESIGN & CONTROL
Micro/Nanofabrication - Micro/Nano Assembly - Self-Assembly - Hybrid integration, Etc.-Case Study: Precision Micro/Nanoparticle Assembly (Under SEM) - Case Study: Guided Self-Assembly.
Biomimetics and Design Strategy - Case Study: Roboflies: Biomimetic Micromechanical Flying Robots - Kinematics and Dynamics (Teleoperation Based, Task Based and Automatic) Control Approaches – Issues.

TEXT BOOKS :

1. M. Elwenspoek and R. Wiegerink, Mechanical Microsensors, Springer-Verlag Berlin, 2001.
2. J. Israelachvili, Intermolecular & Surface Forces, Academic Press Ltd., 2nd Edition, 1992.

REFERENCE BOOKS:

1. M. Scherge and S. Gorb, Biological Micro- and Nano-tribology: Nature's Solutions, Springer Verlag, Berlin Heidelberg, 2001.
2. V J Morris, a R Kirby, a P Gunning, Atomic Force Microscopy for Biologists, London, Imperial College Press, 1999.
3. Dror Sarid, Scanning Probe Microscopy, Oxford University Press, Revised Edition, 1994.
4. S. Fatikow and U. Rembold, Microsystem Technology and Microrobotics, Springer Verlag, 1997.
5. (Ed. by) H.-J. Güntherodt, D. Anselmetti, and E. Meyer, Forces in Scanning Probe Methods, NASA Science Series, 1995.
6. B. Bhushan, Handbook of Micro/Nanotribology, CRC Press, 2nd Ed., 1999.
7. D. Maugis, Contact, Adhesion and Rupture of Elastic Solids, Springer Verlag, Berlin, 2000.
8. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.
9. G. T. Kovacs, Micromachined Transducers Sourcebook, Mc-Graw-Hill Companies inc., 1998.
10. Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, McGraw-Hill inc., 2002.

		L	T	P	C
NT0004	**ADVANCED DRUG DELIVERY SYSTEMS**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE
The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology and to explore their applications for drug delivery systems

DENDRIMERS
Dendrimers- Synthesis -Nanoscale containers- Gene transfection- Nanoscafold systems- Biocompatibility of Dendromers

MICROFABRICATED DRUG DELIVERY SYSTEMS
Microfabricated drug delivery systems – Microneedles- Micropumps-Microvalves-Implantable microchips – sustained chronic disease

PROPERTIES OF DRUG TARGETING DELIVERY SYSTEMS
Properties of drug targeting delivery systems-ADME hypothesis- site specific drugs- Synthetic carrier for drugs-Liposomes- Antidodies

TARGETED NANO PARTICLES
Targeted Nano particles for drug delivery-Polymers nanotubes- Issues for specific disease will be addressed.

VIRUS BASED NANOPARTICLES
Virus Based Nanoparticles - Modification by bioconjugation – Tumour targetting invivo – use in biomedical Imaging

TEXT BOOK
1. Drug Delivery: Engineering Principles for Drug Therapy, M. Salzman,

REFERENCE BOOKS
1. Drug Delivery and Targeting, A.M. Hillery, CRC Press, 2002.
2. Drug Delivery: Principles and Applications, B. Wang, Wiley Intersceince, 2005

		L	T	P	C
NT0005	**LITHOGRAPHY TECHNIQUES AND FABRICATION**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE
The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology and to explore their limitations.

CHEMISTRY OF RESIST MATERIALS
Introduction - DNQ–Novolac Positive Photoresists - Improvement in Photoresist Performance - Chemical-Amplification Resist Systems - Acid-Catalyzed Reactions - Route for Actual Use of Chemically Amplified Resists - Improvement in Process Stability - Surface Imaging - Resists for ArF Lithography - Modern Resist Technology.

MULTILAYER RESISTS & DRY ETCHING OF RESISTS
Introduction - Resist Sensitivity - Depth of Focus - Limitations of Resist Aspect Ratio - Reflection and Scattering Effects - Reflective Standing Wave Effects - Plasma-Etch Resistance - Wet-Development/Dry-Pattern Transfer Approaches to Multilayers - Resist Behavior in Plasmas - Silicon Dioxide, Metal and Polymer Etching of Resists – Ultraviolet and E-Beam Curing – Resist Stripping.

ELECTRON BEAM LITHOGRAPHY

Introduction - Electron Guns - The Beam Blanker - Deflection Systems - Electron–Electron Interactions - Shaped-Beam Instruments - Electron Projection Lithography - Image Blur by Electron–Electron Interactions - Electron Beam Alignment Techniques - Interaction of the Electron Beam with the Substrate - Electron Beam Resists - Proximity Effect of Electron Beam.

ELECTRON BEAM NANOLITHOGRAPHY

Introduction - Electron Scattering and Proximity Correction - Small-Angle Beam Broadening: Resolution and Process Latitude - Advanced Resist - Resist Processing Resist Exposure Methods - Shot Noise - Resist and Substrate Charging - Deflection of the Electron Beam Due to Charging - Outlook for e-Beam Nanolithography.

COMPLEMENTARY LITHOGRAPHY TECHNIQUES

X-Ray Lithography - Characteristics of X-ray Lithography - Selection of X-ray Wavelength - Resolution of X-ray Lithography - X-ray Sources - X-ray Masks - X-ray Resist Materials – EUV Lithography - EUV Optics - Resolution of EUV Lithography - EUV Sources - EUV Masks - EUV Resist Materials – EUV Exposure tools - Soft Lithography - Nanoimprint Lithography - Step-and-Flash Imprint Lithography - Imprint Lithography Issues.

TEXT BOOK

1. Kazauaki Suzuji, Bruce W.Smith. Microlithography: Science and Technology, CRC Press, ISBN: 978-0824790240.

REFERENCE BOOKS :

1. Syed Rizvi. Handbook of Photomask: Manufacturing Technology, Taylor Francis Press, ISBN: 978-0824753740.
2. N. P. Mahalik. Micromanufacturing and Nanotechnology, Springer Publications, ISBN: 978-3540253778.
3. David G. Bucknall. Nanolithography and patterning techniques in microelectronics, CRC Press, ISBN: 978-1855739314.

		L	T	P	C
NT0006	**NANOMAGNETISM**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE

The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES

To understand the basic concepts involve in this technology and to explore their limitations.

MAGNETIC FIELDS

Introduction – Magnetism - History of Magnetism - Magnetism, Neutrons, Polarized Electrons, and X-rays - Spin Polarized Electrons and Magnetism - Polarized X-rays and Magnetism - Electric Fields, Currents, and Magnetic Fields - High Current Densities - Magnetic and Electric Fields inside Materials - Stray and Demagnetizing Fields of Thin Films - Applications of Stray and Demagnetizing Fields - Magnetic Force Microscopy.

CONCEPTS OF MAGNETIC INTERACTIONS

Exchange, Spin–Orbit, and Zeeman Interactions - Independent Electrons in a Central Field - Interactions between two Particles – Exchange Interaction - Electron Exchange in Atoms and Molecules - Magnetism and the Chemical - The Spin–Orbit Interactions - Semiclassical Model for the Spin–Orbit Interaction - Theory of the Zeeman Effect - Electronic and Magnetic Interactions in Solids

MAGNETIC MATERIALS & TYPES OF MAGNETISM

The Importance of Electron Correlation and Excited States - Why are Oxides often Insulators? - Correlation Effects in Rare Earths and Transition Metal Oxides - Magnetism in Transition Metal Oxides - Superexchange - Double Exchange - Colossal Magnetoresistance - Magnetism of Magnetite – Diamagnetism - Paramagnetism - Ferromagnetism - Antiferromagnetism - Ferrimagnetism - Metamagnetism – Superparamagnetism.

MAGNETIC HYSTERESIS
Hysteresis loops – Hysteresis loops and magnetic domains – Hysteresis loop properties – Hysteresis loop interpretation – General characterization of hysteresis – Magnetization curves – Eddy currents & Magnetic losses – Hysteresis Lag, Dissipation, Memory and branching and Metastability – Rate Independent Hysteresis – Rate Dependent Hysteresis – Magnetostatics – Magnetic Moments.

MAGNETIC ANISOTROPY & MAGNETIC DOMAINS
Anisotropy – Symmetry breaking – Uniaxial Anisotropy – Cubic Anisotropy – Higher order anisotropy constants – Magnetocrystalline Anisotropy – Magnetostriction – Stress Anisotropy – Shape Anisotropy – Existence of domains – Domain theory – Domain walls – Bloch walls – Domain Structures – Ideally soft materials.

TEXT BOOK

1. J. Stohr, H.C. Siegmann. Magnetism from Fundamentals to Nanoscale Dynamics. ISBN: 139-783540302827.

REFERENCE BOOKS :

1. Giorgio Bertotti. Hysteresis in Magnetism: for Physicists, Materials Scientists, and Engineers. ISBN: 978-0120932702
2. D.J. Craik. Magnetic Oxides, Part 1 & 2. ISBN-13: 978-0471183549.
3. Ivan Nedkov, M. Ausloos. Nano-Crystalline and Thin Film Magnetic Oxides. ISBN: 978-0792358732.

		L	T	P	C
NT0007	**NANOTECHNOLOGY IN HEALTH CARE**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE
The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology and to explore their limitations.

BASICS
Behavior of Molecules in Solution - DNA Machines - Molecular Motors - Patterning Single Molecules - Nano-Structured Surfaces – Applications in Cell Engineering - Optical and Electronic Measurements of Charge Transport in Biomolecules - Membrane Proteins - Nanopore Engineering; Bilayer Techniques.

DNA STRUCTURES
Introduction, DNA Arrays - DNA Nanomechanical Devices - DNA for Coding & information Storage - DNA Based Computation - Atomic Force Microscopy of DNA - Scanning Tunnelling Microscopy of DNA- Confocal Microscopy.

MICROFLUIDICS AND LAB-ON-A-CHIP
Introduction - Concepts and Advantages of Microfluidic Devices - Fluidic Transport - Stacking and Scaling - Materials for The Manufacture (Silicon, Glass, Polymers) - Fluidic Structures - Fabrication Methods - Surface Modifications - Spotting - Detection Mechanisms.

POLYMER NANOCONTAINERS
introduction, Liposomes in Biotechnology, Polymer Nanocontainers in Therapy, Dendrimers, Layer-By-Layer Deposition, Block Copolymers Self Assembly and Nanocontainers - Polymer Nanocontainers With Controlled Permeability - Block Copolymer Protein Hybrid System, Stimuli Responsive Nanocapsules, Biomaterials and Gene Therapy - In vivo imaging of Quantum Dots Encapsulated in Phospholipids Micelles.

DRUG DELIVERY
Nano Materials Synthesis and Characterization - Different Methodology Used in The Targeted Drug Delivery - Bio Marker Using Nano Materials - Targeted Delivery for Disease Diagnosis and Therapeutics - Different Detection Methods for Targeted Delivery.

TEXT BOOK

1. Christof M. Niemeyer & Chad A. Mirkin, Nanobiotechnology: Concepts, Application and Perspectives, Wiley-VCH (April 9, 2004) ISBN-10: 3527306587.

		L	T	P	C
NT0008	**PRODUCT DESIGN, MANAGEMENT TECHNIQUES AND ENTREPRENEURSHIP**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE
The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology and to explore their limitations.

PRODUCT DESIGN
Concept Generation-Product Architecture-Industrial Design Process-Management of Industrial Process and assessing the qualityof insutrial design-Establishing the product specification

PRODUCT DEVELOPMENT
Criteria of selection of product-Product development-Process design of manufacture-Estimate the manufacturing cost-Reduce the support cost-Prototyping-Economics of project development projects-Elements of economic analysis financial models selective analysis and influence of the quantitative factors

MANAGEMENT TECHNIQUES
Technology management-Scientific management-Development of management thought-principals of management functions of management-Planning Organization-Directing staffing and controlling management by objective-SWOT analysis-Enterprise resource planning and supply chain management

ENTREPRENEURIAL COMPETENCE AND ENVIRONMENT
Concept of entrepreneurship - Entrepreneurship as a career personality – Characteristics of a successful entrepreneur - Knowledge and skill required for an entrepreneur - Business environment entrepreneurship development training - Centre and state Govt policies and regulations-International business

MANAGEMENT OF SMALL BUSINESS
Prefeasibility study - Ownership - Budgeting-Project Profile preparation - Feasilbility report preparation evaluation criteria market and channel selection product launching monitoring and evaluation of business effective management of small business

TEXT BOOK
1 Karal, T Ulrich Steven, D Eppinger, " Product Design and Development", McGraw –Hill International , editions ,2003

REFERENCES BOOKS

1. S. Rosenthal " Effective Product Design and Development", Irwin,1992
2. H.Koontz and H Weihrich," Essentials of management" , McGraw Hill Publishing company, Singapore International Edition,1980
3. J.J Massie," essentials of Management" Prentice Hall of India Pvt Ltd,1985
4. Hisrich," Entrepreneurship" Tata McGraw Hill, New Delhi,2001

		L	T	P	C
NT0009	**INTELLECTUAL PROPERTY RIGHTS, INNOVATION AND TECHNOLOGY**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE
The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology and to explore their limitations.

IP LAW BASICS
Introduction-Background and Concepts-Brief History of Institutions-Investing in Knowledge-Market Failures in Knowledge-IP, Public Sponsorship & Prize-IP Law Basics-Means of IP Protection-Patents-Copyrights - IP and Antitrust.

DESIGN OF IP
Optimal Design of IP-Scarce Ideas vs. Non-scarce ideas-Policy Levers in IP Design-Breadth- Length-Required Inventive Steps-Optimal Size of Reward and Structure-Entry Cost Regime- Horizontal Competition Regime-Economic Effects of Exemptions.

PROTECTING CUMULATIVE INNOVATIONS
Protecting Cumulative Innovations-Three Types of Cumulativeness-Basic v. Applied Research- Research Tool-Quality Ladders-Policy Levers and Prospecting-Battle Over Stem Cell Patents and WARF-Open Source (OS)-Incentive for OS

LICENSING AND JOINT VENTURE
Licensing, Joint Ventures and Competition Policy-Licensing-Licensing vs. Product Sale-Licensing for Productive Efficiency-New Product Innovation vs. Cost Reduction Innovation-Mergers-Ex Ante: R&D Joint Ventures-Ex Post: Patent Pool-Collective Rights Management Organization

LITIGATION AND ENFORCEMENT
Litigation and Enforcement-Remedies for Infringement-How they matter- Enforcement of IP by Technical Means-Limited Sharing of Copyrighted Works-Technology Transfer, Diffusion, and Adoption-Networks and Network Effects-Concepts and Issues-Direct vs. Indirect Network –Effects-Physical Networks-Business Strategies-System Competition vs. Standard Competition

TEXTBOOK
1. Innovation and Incentives, Suzanne Scotchmer, MIT Press 2004.

REFERENCE BOOK
1. Industrial Organization: Contemporary Theory & Practice, 3e, L.
2. Pepall, D.J. Richards, and G. Norman, South-Western 2005.

		L	T	P	C
NT0010	**SOCIETIAL IMPLICATIONS OF NANOTECHNOLOGY**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE
The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES
To understand the basic concepts involve in this technology and to explore their limitations.

ECONOMIC IMPACTS OF NANOTECHNOLOGY

Socio-Economic Impact of Nanoscale Science - Managing the Nanotechnology Revolution: Consider the Malcolm - Transcending Moore's Law with Molecular Electronics and Nanotechnology - Semiconductor Scaling as a Model for Nanotechnology Commercialization - Nanotechnology and Zettabits - Sustaining the Impact of Nanotechnology - Non-Nano Effects of Nanotechnology on the Economy.

SOCIAL SCENARIOS
Navigating Nanotechnology through Society - Nanotechnology, Surveillance, and Society - Innovations for Social Research – Nanotechnology : Societal Implications - Nanotechnology and Social Trends.

CONVERGING TECHNOLOGIES & GOVERNANCE
Implications on Quality of Life - Management of Innovation for Convergent Technologies - The "Integration/Penetration Model" - Social Impacts of Nanobiotechnology Issues - Analogies for Interdisciplinary Research - Innovation, Legal Risks, and Society.

ETHICS AND LAW
Ethical Issues in Nanoscience and Nanotechnology - Ethics & Law in a New Frontier - An Exploration of Patent Matters Associated with Nanotechnology - The Ethics of Ethics - Negotiations over Quality of Life in the Nanotechnology Initiative

PUBLIC PERCEPTIONS & EDUCATION

Public Interaction Research - Communicating Nanotechnological Risks - Understanding of Nanotechnology's Social Impacts - Nanotechnology in the Media.

Educating Undergraduate Nanoengineers - Interactive, Entertaining, Virtual Learning Environments - Nanotechnology in K-12 Education - Education Opportunities - Human Resources for Nanotechnology.

TEXT BOOK

1. Mihail C. Roco and William Sims Bainbridge, "Nanotechnology: Societal Implications II – Individual Perspectives", Springer Publishers, Sponsored by National Science Foundation, ISBN-10 1-4020-4658-8.

NT0011	MEMS/NEMS	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To introduce to the students, the various opportunities in the emerging field of bioscience and nano-bioscience thro' Nanotechnology.

INSTRUCTIONAL OBJECTIVES

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global context

INTRODUCTION TO FABRICATION TECHNIQUES

Introduction-Basic fabrication techniques (lithography, thin film deposition and doping) MEMS fabrication techniques-Nano fabrication techniques (E-Beam nano-imprint fabrication, Epitaxy and strain engineering. Scanned probe techniques)-Strings and membranes – Beam theory – Variational calculus: Lagrange equations and an alternative way to look at strings, membranes and plates-Plate theory

MACHINING AND TRANSPORT PROPERTY

Introduction to Micromachining and MEMS – Essential technical background for lithography-based micromachining - Photolithography, vacuum systems, etching methods, deposition methods, and process integration Microscopic Energy Transport- Basics of statistical thermodynamics/quantum mechanics - Microscopic transport theory - Applications to semiconductor electronic/optoelectronic devices - Applications to MEMS/NEMS devices - Applications to nanostructures - Applications to biological systems

MEMS DEVICE PHYSICS AND DESIGN

Critical understanding of various transduction principles -Design, production, and characterization of MEMS devices - Sensing (piezoelectric, capacitive, magnetic, etc.) - Actuation (electrostatic, electromagnetic, thermal, piezoelectric, SMA, etc.) Layout and design rules Experimental Mechanics for Microelectromechanical Systems (MEMS) - Methods, techniques, and philosophies to characterize micro/nano electro-magneto-mechanical systems (NEMS) - Material and mechanical property characterization - Crystallographic and anisotropic properties - Emerging approaches for micro/nano scale characterization - Biomechanical testing techniques

INTERFACIAL PHENOMENA

Surface tension, surfactants, and interfacial forces - Interfacial thermodynamics - Interfacial hydrodynamics - Dynamics of the triple line - Applications to wetting, change of phase, foams and emulsions, MEMS, and biological systems

APPLICATIONS

Sensors, Actuators, and Signal Processing - Principles and performance of micro transducers - Design of experiments - Sensor and actuator spatial/temporal resolution, error analysis, uncertainty - propagation, and data acquisition - Applications of micro transducers for distributed real-time control of systems

REFERENCE BOOKS

1. J. A. Pelesko and D. H. Bernstein, Modeling MEMS and NEMS. 2002, Boca Raton, Florida: Chapman & Hall/CRC.
2. N. Cleland, Foundations of Nanomechanics: From Solid-State Theory to Device Applications. Advanced Texts in Physics. 2003, Berlin: Springer.
3. V. Kaajakari, Practical MEMS. 2009, Las Vegas, Nevada: Small Gear.
4. Liu, Foundations of MEMS. Illinois ECE Series. 2006, Upper Saddle River, New Jersey: Pearson/Prentice Hall.

		L	T	P	C
NT0012	**NANOTECHNOLOGY FOR ENERGY SYSTEMS**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE

The ultimate aim of this course is to have deeper understanding of the Nanotechnology.

INSTRUCTIONAL OBJECTIVES

To understand the basic concepts involve in this technology and to explore their applications for energy systems

INTRODUCTION

Nanotechnology for sustainable energy-Materials for light emitting diodes-batteries-advanced turbines-catalytic reactors-capacitors-fuel cells.

RENEWABLE ENERGY TECHNOLOGY

Energy challenges, development and implementation of renewable energy technologies - nanotechnology enabled renewable energy technologies - Energy transport, conversion and storage, Nano, micro and meso scale phenomena and devices.

MICRO FUEL CELL TECHNOLOGY

Micro-fuel cell technologies, integration and performance for micro-fuel cell systems - thin film and microfabrication methods - design methodologies - micro-fuel cell power sources,

MICROFLUIDIC SYSTEMS

Nano-electromechanical systems and novel microfluidic devices - nano engines - driving mechanisms - power generation - microchannel battery - micro heat engine (MHE) fabrication - thermocapillary forces - Thermocapillary pumping (TCP) - piezoelectric membrane.

HYDROGEN STORAGE METHODS:

hydrogen storage methods - metal hydrides - size effects - hydrogen storage capacity - hydrogen reaction kinetics - carbon-free cycle- gravimetric and volumetric storage capacities - hydriding/dehydriding kinetics - high enthalpy of formation - and thermal management during the hydriding reaction - distinctive chemical and physical properties - multiple catalytic effects - degradation of the sorption properties - hydride storage materials for automotive applications.

TEXT BOOK

1. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986

REFERENCE BOOKS

1. Fuel cell technology handbook. Hoogers. CRC Press, 2003.
2. Handbook of fuel cells: Fluel cell technology and applications by Vielstich. Wiley, CRC Press, 2003.

		L	T	P	C
NT0013	**OPERATION RESEARCH**	**3**	**0**	**0**	**3**
	Prerequisite				
	NIL				

PURPOSE

To introduce managerial skill for budding engineers

INSTRUCTIONAL OBJECTIVES

1. To equip the students with scheduling and network analysis
2. To make the students aware of replacement policy and game theory
3. To introduce the topic of inventory control
4. To make students aware of the problems of linear programming

RESOURCE SCHEDULING AND NETWORK ANALYSIS

Problem of sequencing – Sequencing n jobs through 2 machines and 3 machines, 2 jobs through m machines. PERT and CPM –Critical path calculation – Probability and cost consideration.

REPLACEMENT AND GAME THEORY

Replacement Models – Replacement of items that deteriorate with time – Equipment that fails suddenly. Two person zero sum games – Pure strategies and saddle point – Mixed strategies – 2 x n and m x 2 games – Method of dominance – Numerical and graphical solutions.

INVENTORY CONTROL

Inventory models – Deterministic models – Economic ordering quantity, Reorder level, optimum cost – Instantaneous and Non-instantaneous receipt of goods with or without shortages.

LINEAR PROGRAMMING

Introduction to Linear Programming – Formulation of the problem – Graphical method – Simplex method – Artificial variable techniques - Primal-dual problems – Dual Simplex method.

ADVANCED LINEAR PROGRAMMING PROBLEMS

Integer programming problem - Cutting plane algorithm – Transportation models - Vogel's Approximation method – MODI method – Unbalanced transportation problem – Degeneracy in transportation models – Assignment models – Traveling salesman problem-Dynamic Programming problem.

TEXT BOOK

1. Kanti Swarup, Gupta P.K., and Man Mohan, "O*perations Research*" Sultan Chand & Sons, 1994.

REFERENCE BOOKS

1. Gupta P.K., and Hira D.S., "*Operations Research*", S.Chand & Sons, 2000.
2. Sundaresan.V, Ganapathy Subramanian.K.S. and Ganesan.K, *"Resource Management Techniques*", A.R. Publications,2002
3. Taha H.A., "*Operations Research – An introduction*", 7th edition, PHI, 2002.
4. Sharma S.D., "*Operations Research*", Kedarnath Ramnath & Co., Meerut,1994.
5. Billy B. Gillet, *"Introduction to Operations Research "*– TMH Publishing Co.
6. Gupta P.K., and Manmohan, "*Operations Research and Quantitative Analysis"* – S.Chand & Co., New Delhi.
7. Hamblin S., and Stevens Jr., *"Operations Research*", Mc Graw Hill Co.
8. Taha H.A., "*Operations Research – An introduction*", 8th edition, Taha H.A., "*Operations Research – An introduction*", 7th edition, PHI, 2002.

NT0014	MICROELECTRONICS and VLSI	L	T	P	C
		3	0	0	3
	Prerequisite				
	Nil				

PURPOSE

To introduce the students to the basics of the emerging field of microelectronics and VLSI design.

INSTRUCTIONAL OBJECTIVES

The objective of this course is to make the students familiar with the properties behavior and applications and implementation microelectronic technology into integrated circuits.

INTRODUCTION TO BASIC ELECTRONICS

Semiconductor Physics: Basic concepts, Intrinsic and extrinsic semiconductors, diffusion and drift currents, p-n junction under open-circuit, reverse bias and forward-bias conditions, p-n junction in the breakdown region, Ideal diode, terminal characteristics of junction diode.

Amplifiers: Introduction of different types of amplifiers and their characteristics, Principle of amplification, Frequency response of RC coupled amplifiers, amplifier bandwidth and Concept of Cascaded Amplifiers,

DIGITAL ELECTRONICS

Binary, Octal and Hexadecimal number systems and conversions, Boolean Algebra, Truth tables of logic gates (AND, OR, NOT), NAND, NOR as universal gates, Difference between combinational circuits and sequential circuits, Introduction to flip-flops (S-R & J-K).

Electronics Instruments: Role, importance and applications of general-purpose test instruments viz Multimeter Digital & Analog, Cathode Ray Oscilloscope (CRO), Function/Signal Generator.

INTRODUCTION TO IC TECHNOLOGIES AND BASIC VLSI DESIGN STYLES

IC Layout, Masks, Fabrication, Layout Rules

MOS Transistor, Logical and Delay Models, Logic Gates, Basic VLSI Design Styles-NMOS, CMOS, Introduction to CMOS, Combinatorial CMOS Logic, Process flow ; Noise Margin; Inverter Threshold Voltage; NMOS Inverter design and characteristics; CMOS Inverter Design and Properties; Inverter as an Amplifier and Differential Amplifier, Delay, Power Dissipation and scaling in CMOS circuits.

VLSI DESIGN TECHNIQUES

Introduction, Trends & Projections in VLSI Circuits, Flow diagram of VLSI Circuit Design and VLSI Design issues, MOSFET fundamentals, Enhancement Mode MOSFETs, Depletion Mode MOSFETs, Weak & strong Inversion Conditions, Threshold Voltage Concept in MOSFETs, IV Characteristics of a MOSFET, Limitations in IV Model and MOSFET Parasitics.

INTRODUCTION TO LOW-POWER DIGITAL DESIGN

Power and Energy, Power Reduction from High to Low Level, Architecture Level: activity reduction, low activity code, gated clocks, asynchronous, Architecture Level: Vdd reduction, pipelining, parallelization, adiabatic, Architecture Level: capacitance reduction, simplicity, Low level: latch design, activity reduction, gated clocks, and glitches, Low level: Vdd and VT reduction, Low level: capacitance reduction, low-power library.

TEXT BOOKS

1. Millman and Grabel, “Microelectronics”, 2nd Ed. Tata McGraw-Hill (1999).

REFERENCE BOOKS

1. Sedra A S and Smith K C, “Microelectronic Circuits” 4th Ed., New York, Oxford University Press, New York (1997).
2. Tocci R J and Widmer N S, “Digital Systems – Principles and Applications”, 8th Ed., Pearson Education India, New Delhi (2001).
3. Cooper and Helfrick, “Modern Electronic Instrumentation and Measuring Techniques”, 4th print Prentice Hall of India, New Delhi (1996).
4. Boylestad and Nashelsky, “Electronic Devices and Circuit Theory”, 8th Ed, Pearson Education India, New Delhi (2002).
5. S.M. Kang & Y. Leblibici, “CMOS Digital Integrated Circuits-Analysis & Design”, TMH, Ed. 2003.