BASICS OF MATERIAL SCIENCE [As per Choice Based Credit System (CBCS) scheme] (Effective from the academic year 2015 -2016) Course: B.E. / Nano Technology Semester: III			
Subject Code	15NT32	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			

Course objectives:
In this course, students will get basics of engineering materials and their properties. Also this course will create awareness among the students about the importance of material science in the field of nano science and technology.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module 1 **Introduction to Material Science** Fundamentals of materials science; Structure: Introduction to microstructure, and nanostructure; Introduction, importance and examples for nanomaterials, biomaterials, electronic, optical, and magnetic materials, ceramic and glass materials, composite materials, polymeric materials, metals and alloys; Introduction and applications of modern engineering materials: shape memory materials, chromic materials (thermo, photo, and electro chromic), rheological fluids, metallic glasses, advanced ceramics; Introduction and applications of Ferroelectricity and ferroelectric materials, Piezoelectricity and piezoelectric materials, pyro-electric materials.	**10**	**L1, L2**
Module 2 **Electrical Properties of Materials** Introduction; Measurement of electrical resistivity; Electrical conductivity: conductors, semiconductors, and insulators; Electronic conduction: energy band structures in solids, band and atomic bonding models (for metals, semiconductors, and insulators), drift velocity and electron mobility, factors influencing electrical resistivity of metals, intrinsic semiconduction, extrinsic semiconduction (n-type and p-type), carrier mobility, Hall effect; Semiconductor devices: rectifier and p-n rectifying junction (forward, and reverse bias), transistor, junction transistor and MOSFET; Conduction in ionic materials; Dielectric behaviour: Introduction to electric dipole,	**10**	**L1, L2, L3**

capacitance, polarization (electronic, ionic, and orientation); Supper conductors and their applications.		
Module 3 **Optical Properties of Materials** Absorbance and Transmittance: Introduction and measurement of absorbance by absorbance spectroscopy; Index of refraction and Abbe's refractometer; Birefringence and birefrigent materials; Photosensitivity, Photoconductivity, and Photoresistivity; Reflectance and reflectivity, Scattering (Rayleigh, Mie, and geometric) and their applications; Luminescence: types and applications; Fluorescence and its applications; Photonic Materials: principle, and device construction; Liquid crystals and liquid crystal display: molecular orientations, sensitivity to electric field, LCD construction, operation; Photoconducting materials: photoconductive device, construction, materials used, and applications; Photodetectors: characteristics, charged coupled device; Photonic crystals: classification and applications.	**10**	**L1, L2, L3**
Module 4 **Thermal and Magnetic Properties** **Thermal Properties:** Introduction; Heat capacity: specific, molar, and volume heat capacity, factors affecting specific heat capacity; Thermal expansion: factors affecting thermal expansion, coefficient of thermal expansion, importance, and applications of thermal expansion property (bimetal, and mercury-in-glass thermometer); Thermal conductivity: Fourier's law, thermal conductance, resistance, transmittance, and admittance, factors affecting thermal conductance. **Magnetic Properties:** Magnetic materials, angular momentum; definitions of magnetic dipole, dipole moment, flux, flux density, field strength, magnetization, susceptibility, permeability, relative permeability, Bohr Magneon; Classification of magnetic materials: diamagnetic, paramagnetic, ferromagnetic, antiferromagnetic, and ferrimagnetic materials; Hard and soft magnetic materials: comparison, properties and applications; Introduction and applications of Garnets, Magnetoplumbites, Magnetic bubbles, and Magnetic thin films; Spintronics and devices: OMR, GMR, TMR, CMR, advantages, and applications.	**10**	**L1, L2, L3**
Module 5 **Defects and Imperfections & Mechanical Properties of Materials** **Defects and Imperfections:** Point defects: vacancies, interstitialcy, Schottky defect, Frankel defect, and impurity defects; Line defects: edge dislocation, screw dislocation, Burger's vector, cross slip of a screw dislocation, climb of an edge dislocation; Surface imperfections: grain boundary, tilt	**10**	**L1, L2, L3, L4**

boundary, twin boundary. **Mechanical Property of Materials:** Mechanism of elastic action; UTM: Components; Tensile strength, and compression strength: Introduction, concept, testing procedure; Engineering stress and strain, true stress and strain, linear and non-linear elastic properties; Relationship between engineering strain and true strain, engineering stress and true stress; Hardness: Brinell, and Rockwell hardness tests; Fracture: ductile and brittle fracture; Fatigue: mechanism of fatigue; Creep: various stages of creep; Impact strength: Izod and Charpy impact strength tests.		

Course outcome:

On completion of this course, students will be able to:

- Demonstrate fundamentals of material science;
- Illustrate electrical and optical properties of materials;
- Explain thermal and magnetic properties of materials;
- Analyze mechanical properties of materials;
- Apply materials for nano-sclae applications

Graduate Attributes (as per NBA):

- o Engineering Knowledge.
- o Problem Analysis.
- o Design / development of solutions (partly).
- o Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. D. John Thiruvadigal, S. Ponnusamy, C. Preferencial Kala, M. Krishna Mohan, “Material Science” Vibrant Publications, 2014

2. Callister’s “Materials Science and Engineering” Adapted by R, Balasubramaniam, Wiley India Pvt. Ltd, New Delhi, 2011

3. Dr. M. K. Muralidhara, “Material Science and Metallurgy”, Subhas Stores, 2011

Reference Books:

1. Donald Askeland, PradeepFulay, Wendelin Wright, The Science & Engineering of Materials, 6th Ed., Cengage Learning, 2011

2. Raghavan V. “Materials Science & Engineering – A First Course”, 5th edition, Prentice Hall of India, New Delhi, 2005

3. Thiruvadigal, J. D., Ponnusamy, S. and Vasuhi.P. S., “Materials Science”, 5th edition, Vibrant Publications, Chennai, 2007

<table>
<tr><td colspan="4">FOUNDATIONS OF NANOSCALE SCIENCE AND TECHNOLOGY
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2015 -2016)
Course: B.E. / Nano Technology
Semester: III</td></tr>
<tr><td>Subject Code</td><td>15NT33</td><td>IA Marks</td><td>20</td></tr>
<tr><td>Number of Lecture Hours/Week</td><td>04</td><td>Exam Marks</td><td>80</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exam Hours</td><td>03</td></tr>
<tr><td colspan="4">CREDITS – 04</td></tr>
<tr><td colspan="4">Course objectives:
In this course students will learn about the basics of nanoscale science, types of structures and nanomaterial, their engineering applications and hazards.</td></tr>
</table>

<table>
<tr><th>Modules</th><th>Teaching Hours</th><th>Revised Bloom's Taxonomy (RBT) Level</th></tr>
<tr><td>Module 1
Introduction to Nanoscience and Nanotechnology
History, background and interdisciplinary nature of nanoscience and nanotechnology, challenges of Rechard Feynman, scientific revolutions, nanosized effects surface to volume ratio, examples of surface to volume ratio, atomic structure, Bohr atomic model, molecules and phases, introduction to classical physics and quantum mechanics, importance of nanoscale materials and their devices.</td><td>10</td><td>L1, L2</td></tr>
<tr><td>Module 2
Classification of Nanostructures
Zero dimensional, one-dimensional and two dimensional nanostructure materials - classification of solids: conductor, semiconductors, insulator, types of semiconductor, doping, diodes, current flow in semiconductors, ceramics and nanocomposites, quantum size effect(QSE) in 1D, 2D, 3D nanomaterials, quantum dots, nanowires, nanotubes, nanosheets, top down and bottom up approach.</td><td>10</td><td>L1, L2</td></tr>
<tr><td>Module 3
Biomimetics and Biomaterials
Biomimetics: Biomimetics: lessons from nature – Introduction, Industrial significance, Lessons from nature and applications, overview of various objects from nature and their selected functions, Lotus effect, Velcro effect, biologically inspired mechanisms, Biologically inspired structures and tools, biological materials.
Biomaterials:Introduction, Classification of Biomaterials,</td><td>10</td><td>L1, L2, L3</td></tr>
</table>

Biomaterials as implant inhuman body, characterization of biomaterials.		
Module 4 **Introduction to nanomaterials and devices:** Types of nanomaterials: Metal nanoparticles eg Au, Ag, Cu, Pt and their application as FETs. Metal oxide nanoparticles TiO_2, ZnO, SnO_2 and their application in solar cells, MEMS based gas sensors, Semiconducting Cadmium and Selenide quantum dots bio imaging, Carbon based nanomaterials and their applications in FETs , MOSFETS, sensors and actuators , Silicon based nanostructures and their application in single electron electronics used as tips for AFM and Field emission microscopy, magnetic and ceramics nanomaterials and their application.	**10**	**L1, L2, L3, L4**
Module 5 **Introduction to nanotoxicology:** Nanomaterialspollution – Nanomaterials in Environment - Toxicology of Airborne – Effect of Nanomaterials in the environment.Safety and pollution Control techniques-handling, storage, packaging, transportation and disposal.	**10**	**L1, L2, L3, L4**

Course outcome:

On completion of this course, students will be able to:

- Describe fundamentals of nano science and nano technology;
- Classify nano-structures;
- Differentiate nanomaterials;
- Analyze biomaterials;
- Explain nano toxicology.

Graduate Attributes (as per NBA):

- o Engineering Knowledge.
- o Problem Analysis.
- o Design / development of solutions (partly).
- o Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Edward L. Wolf, "Nanophysics and Nanotechnology - An Introduction to Modern Concepts in Nanoscience" Second Edition, John Wiley & Sons, 2006.

2. Nanotechnology – Basic Science & Emerging Technologies: 2002 by Michael Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons, and BurkhardRaguse.

3. Nanoparticles technology: Masuo Hosokawa, Kiyoshi Nogi, Makio Naito,

ToyokazuYokoyama, First edition 2007, ISBN: 978-0-444-53122-3.
Reference Books: 1. Vladimir P. Torchilin (2006) Nanoparticulates as Drug Carriers, Imperial College Press. 2. M. Reza Mozafari (2007) Nanomaterials and Nanosystems for Biomedical Applications. 3. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, 2002. 4. Biomimetics: lessons from nature – an overview by Bharathbhushan 5. Biomimetics—using nature to inspire human innovation Yoseph Bar-Cohen.

MOSFETs AND DIGITAL CIRCUITS [As per Choice Based Credit System (CBCS) scheme] (Effective from the academic year 2015 -2016) Course: B.E. / Nano Technology Semester: III			
Subject Code	15NT34	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			

Course objectives:
This course will enable students to:
- Describe, Illustrate and Analyze MOS transistor theory, MOS VI characteristics, NMOS and PMOS transistor and CMOS technology
- Define and describe realization of digital circuits using CMOS technology
- Describe, Demonstrate, Analyze and Design of Mealy and Moore Models, Synchronous Sequential Circuits, State diagrams and Registers and Counters.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module 1 **MOSFETs** **Field – Effect Transistors:** Introduction, Construction and Characteristics of JFETs, Transfer Characteristics- Derivation, Applying Schokley's Equation, Depletion Type **MOSFET**: Basic Construction, Types of MOS, NMOS, PMOS, Basic Operation and Characteristics, VI Characteristics, Fabrication process of MOS transistors, N-well process, twin well process, SOI process **MOSFET models**: Small signal model, introduction to second order effects: body effect, channel length modulation, sub threshold conduction	**10**	**L1, L2**
Module 2 **CMOS Technology:** CMOS inverters, voltage transfer characteristics, propagation delay, power dissipation equation,	**10**	**L1, L2**

MOSFET scaling and its impact on current and power equation MOS capacitance, MOS modeling, Spice Models **Realization of digital circuits using CMOS technology:** NAND Gate, NOR Gate, CMOS transmission gates, Multiplexer, 2:1, 4:1, XOR gate, XNOR gate, Complex logic circuits, AOI gate, OAI gate,		
Module 3 **CMOS sequential circuits** 1-bit Latch, SR latch, gated SR latch, D-latch, positive triggered latch, negative triggered latch, master-slave register, flip flop, edge triggered register, JK flip flop, Latch vs Registers **Timing Diagram**: Timing definitions, setup time, hold time, clock to q delay, maximum clock frequency, mux based latch, CMOS Schmitt trigger, ring oscillator	**10**	**L1,L2, L3**
Module 4 **Registers and Counters** **Registers:** Introduction, Registers: Four Bit Latch, Shift Register, Serial In Serial Out Shift Register: Left-Shift Serial-In Serial-Out Register with D Flip-Flop, Serial-In Parallel-Out Shift Register, Parallel-In Serial-Out Shift Register: PISO Left-Shift Register, Ring Counter, Johnson Counter. **Counters:** Introduction, Synchronous Counter, Modulus-4 Synchronus Up Counter, Modulus-4 Synchronus Down Counter, Modulus-4 Synchronus Up/Down Counter, Modulus-8 Synchronus Up Counter, Modulus-8 Synchronus Down Counter, Modulus-8 Synchronus Up/ Down Counter.	**10**	**L1, L2, L3, L4**
Module 5 **Finite State Machines**: Introduction, mealy machine, Moore machines, sequence detector, examples of sequence detector of 4 bit sequence, representing counters using FSM diagrams	**10**	**L1, L2, L3, L4**

Course outcome:

After studying this course, students will be able to:

- Discuss MOSFETs and its properties, CMOS technology and importance of MOS models
- Use CMOS technology and realize combinational and sequential digital circuits
- Design complex digital circuits and state machines

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

• The students will have to answer 5 full questions, selecting one full question from each module.
Text Books: 1. Neil H.E. Weste, Kamran Eshraghian**, *Principle of CMOS and VLSI Design A Systems Perspective 2nd Edition*,** Addison Wesley(Module 1 to Module 3) 2. D. P. Kothari and J. S Dhillon, “Digital Circuits and Design”, Pearson, 2016, ISBN:9789332543539 (Module 4 and Module 5)
Reference Books: 1. Donald D. Givone, “Digital Principles and Design”, McGraw Hill. 2. Sung-Mo (Steve) Kang, Yusuf Leblebici, **CMOS DIGITAL INTEGRATED CIRCUITS ANALYSIS & DESIGN3rd Edition**, Mc Graw-Hill 3. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press.

PHYSICAL AND CHEMICAL PRINCIPLES OF NANOTECHNOLOGY [As per Choice Based Credit System (CBCS) scheme] (Effective from the academic year 2015 -2016) Course: B.E. / Nano Technology Semester: III			
Subject Code	15NT35	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			
Course objectives: To learn the physical and chemical principles involved in the materials and systems.			

Modules	**Teaching Hours**	**Revised Bloom’s Taxonomy (RBT) Level**
Module 1 **Quantum Mechanics:** Introduction, Planks Hypothesis- Origin of quantum mechanics, Classical v/s Quantum mechanics, experimental and theoretical methods: Dual nature of matter by Debroglie, Uncertainty principle, Localization experiment, Complementarity. Valence bond theory and its applications; Introduction to molecular orbital theory, and computational chemistry.	**10**	**L1, L2**
Module 2 **Basics of Thermodynamics** **Thermodynamics:** Introduction, importance and limitations of thermodynamics; thermodynamic terms definition and examples for: system and surroundings, properties of a system, state variables, processes, thermodynamic	**10**	**L1, L2**

equilibrium, internal energy, enthalpy, and heat capacity of a system; Zeroth law of thermodynamics.; First law of thermodynamics: definition, mathematical expressions, heat capacity (at constant volume, and constant pressure); Spontaneous process: criteria for spontaneity; Second law of thermodynamics: equivalent forms, entropy and its illustrations, Third law of thermodynamics: definition and illustration.		
Module 3 **Lattice Vibrations and Band Theory of Solids** Concept of lattice vibrations and thermal heat capacity, classical, Einstein and Debye theories of molar heat capacity and their limitations. Band Theory of Solids: Origin of bands, band theory of solids, motion of electron in periodic field of crystal, Kronig-Penny model, Brillion zones, concept of holes, distinction between metal, insulator and semi- conductor.	**10**	**L1,L2, L3**
Module 4 **Semiconductors and Tunneling** **Semiconductor:** Intrinsic semiconductors, doping and extrinsic semiconductors, simple models for semiconductors, Donor and acceptor levels, p-n junction and rectification, tunneling and resonant tunneling. **Tunneling:** Concept of tunneling, tunneling through potential barrier, classical vs quantum tunneling, tunneling junction, tunneling diode.	**10**	**L1, L2, L3**
Module 5 **Colloidal Systems** Introduction, Crystalloids and colloids, Classifications of colloids with examples: based on state of aggregation, affinity, and natural dispersed phase. Characteristics of colloidal solutions: Dynamic properties (Brownian motion, diffusion, sedimentation, colligative properties, adsorption, and filterability), Optical properties (visibility, colour, and Tyndall effect), Electrical properties (electrophoresis, and electro-osmosis). Emulsion: introduction, classification, types of emulsions formed on mixing of two partly or completely insoluble liquids, inter-conversion of dispersed phase and medium, characteristics of emulsions, identification of type of emulsion.	**10**	**L1, L2, L3**
Course outcome: This subject enables the student to come across the important physical and chemical principles which have applications in all aspects.		
Graduate Attributes (as per NBA): o Engineering Knowledge. o Problem Analysis. o Design / development of solutions (partly).		

o Interpretation of data.
Question paper pattern: • The question paper will have ten questions. • Each full Question consisting of 16 marks • There will be 2 full questions (with a maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer 5 full questions, selecting one full question from each module.
Text Books: 1. Solid State Physics: S.O. Pillai 2. A text book of engineering chemistry, ShashiChawla, DhanpatRai& Co, Educational and Technical Publishers, Delhi, 2011
Reference Books: 1. Thermodynamics and Statistical Mechanics by John M. Seddon, J. D. Gale 2. Introduction to Solid State Physics C. Kittle 3.Solid State Physics: A.J. Decker

FUNDAMENTALS OF BIOSCIENCE [As per Choice Based Credit System (CBCS) scheme] (Effective from the academic year 2015 -2016) Course: B.E. / Nano Technology Semester: III			
Subject Code	15NT36	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03
CREDITS – 04			
Course objectives: • To understand the basic concepts of biochemistry and pathways involved in metabolism. • To study characteristics of microbes and microbial synthesis of nano materials.			

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module 1 **Cell Biology** The Cell: the Basic Unit of Life - Molecular Components of Cells; Cell Metabolism; Cell Growth and Differentiation; Cell division -Mitosis and meiosis. Cell to cell integration; Cell-cell interaction : Malignant growth; Eukaryotic and prokaryotic	**10**	**L1, L2**

cells, Plant and animal cells. Cytosketal elements, Microtubules: structure & functions, shaping of the cells and mechanical support. Microfilaments: structure & functions. Structure of intermediate filaments. Cytoplasmic microtrabecular system (lattice). Covalent modifications of cytosketal proteins. Cytoskeletal architecture. Structure of cytoplasm, Nucleus, Mitochondria, Ribosome, Golgi bodies, Lysosomes. Endoplasmic Reticulum, Peroxisomes, Chloroplast and Vacuoles. Cell locomotion (Amoeboid, Flagella, Cillar). RBC, WBC.		
Module 2 **Biological membranes:** Biological membranes: Structure and conformational properties of cell membranes, Singer and Nicholson model, Membrane permeability, fluidity, micelle formation, reverse micelles, properties, passive transport and active transport, facilitated transport, energy requirement, mechanism of Na^+/ K^+, glucose and amino acid transport. Integral proteins in membranes, conformational variations during ion transport, Organization of transport activity in cell. Action Potentials. Role of transport in signal transduction processes, molecular reception. Blood Brain Barrier.	**10**	**L1, L2, L3**
Module 3 **Molecular Biology** Gene; Genetic Code; Replication; Transcription; translation; Expression of Genetic Information; Genetic Engineering - Recombinant DNA Technology. Catalytic strategies: Protease, Carbonic Anhydrases-. Restriction Enzymes, DNA-Cleavage Reactions- Nucleoside Monophosphate Kinases: Catalyzing Phosphoryl Group Exchange between Nucleotides without Promoting Hydrolysis.	**10**	**L1,L2, L3**
Module 4 **Immunology** Immune system: The Cellular Basis of Immunity; Innate immunity and adaptive immunity; The Fine Structure of Antibodies and types; The Functions of Antibodies; Multi gene organization of Ig gene; 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, CD4 cells.	**10**	**L1, L2, L3**
Module 5 **Biomachines** Biomotors: Conversion of Chemical Energy into Mechanical Work by Protein Motors- Brief Description of ATP Synthase Structure- The F1 Motor: A Power Stroke-A Pure Power Stroke-Coupling and Coordination of Motors - The Bacterial Flagellar Motor; kinesin and dynein linear motors.	**10**	**L1, L2, L3, L4**

Biomachines: Heart as a pump, Kidney as a filtration Unit, Brain as a data storage device, Stomach as a digester. Biological Sensors in the human body.		

Course outcome:

Students will have basic idea of different branches of life science like microbiology, immunology, biochemistry, molecular biology and cell biology.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly).
- Interpretation of data.

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Microbiology by Michael J PelczarJr Chan ECS, Noel R Krieg, Tata McGraw Hill Publishing co Ltd.
2.'Biochemistry'J.M.Berg, J.L.Tymosczko and L.Sryer. W.H. Freeman Publications.
3.'Molecular Biology of the cell' Alberts, 2003Garland Science.
4. Principles of Biochemistry by Albert Lehninger, CBS publishers
5. 'Molecular Motors', Frank H. Deis, Nancy Counts Gerber, Roger E. Koeppe, II.

Reference Books:

1. Principles of protein structure. G. Schuiz and R.H. Shrimer, SpringerVerlag, 1984.
2. Principles of Nucleic acid structure.W. Saenger,Springer 1984.
3. Physical Chemistry of Membranes:An introduction to the structure and dynamics of biological membranes. B.L. Siler,Allen and Unwin and the Solomon Press, 1985.

SIMULATION AND MODELLING LAB

[As per Choice Based Credit System (CBCS) scheme]

(Effective from the academic year 2015 -2016)

Course: B.E. / Nano Technology

SEMESTER – III

Laboratory Code	15NTL37	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	50
		Exam Hours	03

CREDITS – 02

Course objectives:	
• To know fundamental skills and knowledge required to use MATLAB for the simulation of engineering systems • To introduce concepts of numerical methods and introduce Matlab in an Engineering framework	
Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. Evaluate using MATLAB: a. (a) $\frac{1}{2\times3}$ (b) $2^{2\times4}$ (c) $5 \times 10^{-4} + 2.5 \times 10^{-2}$	**L1, L2, L3**
2. Solve using MATLAB the following array operations: (a) 1+ [2 3 −1]. (b) 3 x [1 4 8] . (c) [1 2 3] x [0 −1 1]. (d) Square each element of the vector [2 3 1].	**L1, L2, L3**
3. Consider the given function $f(x) = \frac{x}{1+x^2}, \quad -2 \le x \le 2$ Write a Matlab code to plot with the elements of its vector representation	**L5, L6**
4. Consider the following linear system: 2x1 + 2 x2=18 -x1 + 2 x2=2 solve the system using the graphical method with MATLAB	**L5, L6**
5. Let $A = \begin{bmatrix} 1.2969 & .8648 \\ .2161 & .1441 \end{bmatrix}$ (a) Find the determinant and inverse of A (using Matlab). (b) Let B be the matrix obtained from A by rounding off to three decimal places (1.2969 7→ 1.297). Find the determinant and inverse of B. How do A−1 and B−1 differ? Explain how this happened. (c) Set b1 = [1.2969; 0.2161] and do x = A \ b1 . Repeat the process but with a vector b2 obtained from b1 by rounding off to three decimal places. Explain exactly what happened. Why was the first answer so simple? Why do the two answers differ by so much?	**L5, L6**
6. Write a well-commented function program for the function $x^2 e^{-x2}$, using entry-wise operations (such as .* and .^). To get e^x use exp(x). Include adequate comments in the program. Plot the function on [−5, 5]. Turn in printouts of the program and the graph.	**L5, L6**
7. Write a well-commented script program that graphs the functions sin x, sin 2x, sin 3x, sin 4x, sin 5x and sin 6x on the interval [0, 2π] on one plot. (π is pi in Matlab.) Include comments in the program. Turn in the program and the graph.	**L5, L6**
8. Suppose a ball is dropped from a height of 2 meters onto a hard surface and the coefficient of restitution of the collision is .9 (see Wikipedia for an explanation). Write a well-commented script program to calculate the total	**L5, L6**

	distance the ball has traveled when it hits the surface for the n-th time. Enter: format long. By trial and error approximate how large n must be so that total distance stops changing. Turn in the program and a brief summary of the results.	
9.	(a) Write a well-commented Matlab function program *myinvcheck* that a. makes a n × n random matrix (normally distributed, A = randn(n,n)), • b. calculates its inverse (B = inv(A)), • c. multiplies the two back together, • d. calculates the residual (difference from the desired n × n identity matrix eye(n)), and • e. returns the norm of the residual. (b) Write a well-commented Matlab script program that calls *myinvcheck*for n = 10, 20, 40, . . . , 2 i10 for some moderate i, records the results of each trial, and plots the error versus n using a log plot. (See help loglog.) What happens to error as n gets big? Turn in a printout of the programs, the plot, and a very brief report on the results of your experiments.	**L1, L2, L3**
10.	You are given the following data: > t = [0 .1 .499 .5 .6 1.0 1.4 1.5 1.899 1.9 2.0] > y = [0 .06 .17 .19 .21 .26 .29 .29 .30 .31 .31] (a) Plot the data, using ”*” at the data points, then try a polynomial fit of the correct degree to interpolate this number of data points: What do you observe. Give an explanation of this error, in particular why is the term badly conditioned used? (b) Plot the data along with a spline interpolant. How does this compare with the plot above? What is a way to make the plot better?	**L5, L6**

Course Outcome:

- Students can able to understand the use of software tools for modelling and analysis of mathematical concepts for engineering applications
- Students will be able to model and analyze simple engineering concepts and its importance in engineering applications

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4.Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Book

1. Introduction to Numerical Methods and Matlab Programming for Engineers, Todd Young and Martin J. Mohlenkamp, May 5, 2015
2. MATLAB for Engineering Applications, ABDULLAH ALSHEHRI

DIGITAL ELECTRONICS LAB [As per Choice Based Credit System (CBCS) scheme] (Effective from the academic year 2015 -2016) Course: B.E. / Nano Technology SEMESTER - III			
Laboratory Code	15NTL38	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	80
		Exam Hours	03
CREDITS – 02			

Course objectives:

This laboratory course enables students to:

- get practical experience in design, realisation and verification of Demorgan's Theorem, Full/Parallel Adders and Subtractors, Multiplexer using logic gates, Demux and Decoder, Flip-Flops, Shift registers and Counters
- model, simulate and verify functionality of CMOS digital circuits

Laboratory Experiments: **NOTE:** Use discrete components to test and verify the logic gates. Multisim may be used for designing the gates along with the above.	**Revised Bloom's Taxonomy (RBT) Level**
1. To verify (a) Demorgan's Theorem for 2 variables (b) The sum-of product and product-of-sum expressions using universal gates.	**L1, L2, L3**
2. To design and implement (a) Full Adder using basic logic gates. (b) Full subtractor using basic logic gates.	**L5, L6**
3. To design and implement 4-bit Parallel Adder/ subtractor using IC 7483.	**L5, L6**
4. To realize (a) 4:1 Multiplexer using gates (b) 3-variable function using IC 74151(8:1 MUX) (c) 1:8 Demux and 3:8 Decoder using IC74138	**L2, L3**
5. To realise the following flip-flops using NAND Gates. (a) Clocked SR Flip-Flop (b) JK Flip-Flop	**L2, L3**
6. To realize the following shift registers using IC7474 (a) SISO (b) SIPO (c)PISO (d) PIPO	**L2, L3**
7. To realize the Ring Counter and Johnson Counter using IC7476	**L2, L3**
8. To realize the Mod-N Counter using IC7490	**L2, L3**
9. To capture CMOS inverter schematic and check for its functionality (selecting suitable technology 130nm and below, connecting 0.01pF of load capacitance and setting lengths & widths of transistor geometries)	**L4, L5, L6**
10. To capture schematic of NAND, NOR, AND using NAND and Inverter, OR using NOR & Inverter. Verify functionality of gates using CMOS logic, measure propagation delay of gates by setting widths of transistors	**L4, L5, L6**
11. To capture schematic of 2:1 multiplexer using CMOS transmission gates and verify its functionality, extend the design for 4:1 multiplexer	**L4, L5, L6**
12. To capture schematic of XOR gate, XNOR gate, multiplexer based latch, master slave register and verify its functionality	**L4, L5, L6**

Course outcomes: On the completion of this laboratory course, the students will be able to:

- Design, Test and Evaluate various combinational circuits such as adders, subtractors, multipliers, comparators, parity generators, multiplexers and de-Multiplexers.
- Construct flips-flops, counters and shift registers and verify its functionality
- Model and verify CMOS digital circuits using MOS transistors

Graduate Attributes (as per NBA)

Engineering Knowledge.

Problem Analysis.

Design/Development of solutions.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Book (For 1 to 6 experiments):

1. K. A. Navas, "Electronics Lab Manual", Volume I, PHI, 5th Edition, 2015, ISBN:9788120351424

Reference Book (For 9 to 12 experiments):

2. Cyril Prasanna Raj P., "CMOS digital circuit design manual", Volume 1, MSEC E-publication, Edition 2016