MATERIALS SCIENCE AND ENGINEERING

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

(Effective from the academic year 2015 -2016)

Course: B.E. / Nano Technology

Semester: IV

Subject Code	15NT42	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 understand various concepts related to the material science and engineering, crystal structure, various types of materials, and their uses in developing new technology.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module 1 **Introduction to Materials Science and Engineering** Functional Classification of Materials; Classification of Materials Based on Structure; Environmental and Other Effects; Materials Design and Selection; The Structure of Materials: Technological Relevance; The Structure of the Atom; The Electronic Structure of the Atom; The Periodic Table and Engineering materials; Atomic Bonding; Binding Energy and Inter-atomic Spacing; Amorphous Materials: Principles and Technological Applications; Lattice, unit cells, Basis, and crystal structure; Points, directions, and planes in the unit cell.	**10**	**L1, L2**
Module 2 **Crystal structure** Introduction, Differences between Crystalline solids and amorphous solids; Unit cell: Introduction, Miller Indices, high density planes and influence on the behavior of the crystal, Close packing (hexagonal, and cubic), Bravias lattices (in two and three dimensional space), Lattice systems: possible variations, edge lengths, axial angle, and examples; Crystallographic point groups and symmetry operations; Wigner-Seitz cell: Introduction, and construction; Atomic packing: packing fraction, Co-ordination number; Examples of simple crystal structures: NaCl, ZnS and diamond; Symmetry operations, point groups and space groups, Single Crystals, Polycrystalline Materials, Anisotropy.	**10**	**L1, L2**
Module 3 **Diffusion** Introduction, diffusion Vs bulk flow, diffusion vs osmosis,	**10**	**L1,L2, L3**

diffusion Vs drift; Diffusion in the context of different disciplines, Introduction to: atomic diffusion, Eddy diffusion & Eddy motion, Effusion & Graham's law, Photon diffusion, and Passive transport (simple, facilitated, filtration, and osmosis); Mechanism of diffusion in solids (vacancy, and interstitial); Steady state diffusion (Fick's first law); Unsteady state diffusion (Fick's second law); Types of diffusion (self, inter, volume, grain boundary, and surface diffusions); Factors affecting diffusion (diffusion species, temperature, concentration, crystal structure, grain boundary, grain size); Introduction to diffusion in: ionic materials, polymeric materials; Diffusion and material processing (melting and casting, sintering, grain growth, and diffusion bonding); Applications of diffusion.		
Module 4 **Polymeric materials and Liquid crystals** Introduction, Thermotropic liquid crystals; Lyotropic liquid crystals: lamellar, hexagonal, cubic, and nematic phases; Chemical constitution and liquid crystalline behaviour; liquid crystalline behaviour in homologous series (para-azoxyanisole, para-alkyloxy benzene homologous series); molecular ordering in nematic, cholesteric, smetic, and columnar liquid crystals; Identification of liquid crystals; liquid crystalline polymers; Applications of liquid crystal in displays: introduction, twisted nematic cell transmissive, and reflective displays; types of liquid crystal displays and their applications, applications of chiral liquid crystals in thermography	**10**	**L1, L2, L3**
Module 5 **Ceramic, and Smart materials** **Ceramic Materials:I**ntroduction, Definition of Ceramics Ceramic Microstructures, Types of ceramics,Traditional Versus Advanced Ceramics, General Characteristics of Ceramics, Bonding in Ceramics, Structure of Ceramics, Properties of Ceramics, Applications. **Smart materials:**Historical background, definition, classification of smart materials, thermoresponsive materials, piezoelectric materials, ferrofluids: synthesis and application, electro- rheological fluids (ER) and magneto-rheological fluids (MR) fluids modes of operation and application, smart gel, shape memory alloys.	**10**	**L1, L2, L3, L4**
Course outcome: On completion of this course students will be able to: • Describe the physics of materials; • Explain the crystal structure of materials; • Apply diffusion process for preparing materials; • Demonstrate preparation of polymeric materials and liquid crystals; • Analyze ceramic and smart materials for engineering and technology applications.		

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. Donald R. Askeland, Pradeep P. Fulay, D. K. Bhattacharya, Materials Science and Engineering, Second Indian Reprint, Cengage Learning, 2010
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. D. John Thiruvadigal, S. Ponnusamy, C. Preferencial Kala, M. Krishna Mohan, "Material Science" Vibrant Publications, 2014
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
4. A text book of engineering chemistry, ShashiChawla, DhanpatRai and Co, 2011,
5. Michel Barsoum, M.W Barsoum Fundamentals of Ceramics, 2002, CRC Press.

SYNTHESIS AND PROCESSING TECHNIQUES

[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2015 -2016)
Course: B.E. / Nano Technology
Semester: IV

Subject Code	15NT43	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 provide students with the knowledge of techniques used for synthesis and surface modification of nanomaterials.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module 1 **Physical Methods:** Ball milling synthesis, Arc discharge, RF-plasma, Plasma arch technique, Inert gas condensation, electric explosion of wires, Ion sputtering method, Laser pyrolysis, Molecular beam epitaxy and electrodeposition. Electro spinning, Physical vapor Deposition (PVD) – Chemcialvapour Deposition (CVD) - Atomic layer Deposition (ALD) – Self Assembly- LB (Langmuir-Blodgett) technique.	**10**	**L1, L2**
Module 2 **Chemical methods 1:** Chemical precipitation methods- co-precipitation, arrested precipitation, sol-gel method, chemical reduction, photochemical synthesis, electrochemical synthesis, Microemulsions or reverse micelles, Sonochemical synthesis, Hydrothermal, solvothermal, supercritical fluid process, solution combustion process.	**10**	**L1, L2, L3**
Module 3 **Chemical methods 2:** Spray pyrolysis method, flame spray pyrolysis, gas phase synthesis, gas condensation process, chemical vapor condensation. Fundamental aspects of VLS (Vapor-Liquid-Solid) and SLS (Solution-Liquid-Solid) processes – VLS growth of Nanowires – Control of the size of the nanowires – Precursors and catalysts – SLS growth – Stress induced recrystallization.	**10**	**L1,L2, L3**
Module 4 **Lithography:**Nanomanipulation and Nano lithography – Soft Lithography – Electron beam lithography, SEM based nanolithography, AFM based nanolithography, Ion beam lithography- Oxidation and metallization - Mask and its application - Deep UV lithography, X-ray based Lithography, Dip pen lithography. Self-assembly of Nanoparticles and Nanowires.	**10**	**L1, L2, L3, L4**
Module 5 **Surface Modification of Nanoparticles:**Introduction,Surface modification of inorganic nanoparticles by organic functional groups - Instantaneous nanofoaming method for fabrication of closed-porosity silica particle- Development of photocatalyst inserted into surface of porous aluminosilicate - Fabrication technique of organic nanocrystals and their optical properties and materialization - Development of new cosmetics based on nanoparticles - Development of functional skincare cosmetics	**10**	**L1, L2, L3, L4**

using biodegradable PLGA nanospheres.		

Course outcome:

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

- Experiment physical techniques used for synthesis and processing of nanomaterials;
- Analyze chemical methods used for synthesis and processing of nanomaterials;
- Select Lithography technique top down fabrication nanostructures;
- Test surface modifications of nanoparticels.

Graduate Attributes (as per NBA):

- Engineering Knowledge.
- Design / development of solutions (partly).

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. Hari Singh Nalwa - Encyclopedia of Nanotechnology.
2. Processing & properties of structural Naonmaterials by Leon L. Shaw (editor)
3. Chemistry of Nanomaterials : Synthesis, properties and applications by CNR Rao et.al.
4. Nanochemistry: A chemical approach to NanomaterialsRoayal Society of Chemistry, Ozin and Arsenault, Cambridge UK 2005,
5. Nanoparticles: From Theory to Applications, G.Schmidt, WileyWeinheim 2004.

Reference Books:

1. Nanomaterials – A. K. Bandyopadhyay, New Age International Publishers, 2nd Edition, 2010
2. T. Pradeep , “NANO The Essential , understanding Nanoscience and Nanotechnology”. Tata McGrawHill Publishing Company Limited, 2007.
3. C.A. Mirkin and C.M. Niemeyer, Nanobiotechnology- II, More Concepts and Applications, WILEY-VCH, VerlagGmbH&Co, 2007.
4. David G. Bucknall. Nanolithography and patterning techniques in microelectronics, CRC Press

ELECTRONIC INSTRUMENTS AND MEASUREMENTS

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

(Effective from the academic year 2015 -2016)

Course: B.E. / Nano Technology

Semester: IV

Subject Code	15NT44	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 learn about:

- The accuracy and precision, types of errors, statistical, and probability analysis.
- The basic functional concepts of various analog and digital measuring instruments.
- The basic concepts of microprocessor based instruments.
- The functioning and types of oscilloscopes and signal generators, AC and DC bridges.
- The significance and function of different types of transducers.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module 1 **Measurement and Errors, Ammeters, Voltmeters&Multimeters, and Measuring Probes** **Measurement and Error:** Definitions, Accuracy and Precision, Significant Figures, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors. **Ammeters:** DC Ammeter, Multirange Ammeter, The Ayrton Shunt or Universal Shunt, Requirements of Shunt, Extending of Ammeter Ranges, RF Ammeter (Thermocouple), Limitations of Thermocouple. **Voltmeters &Multimeters:** Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter, Extending Voltmeter Ranges, Loading, Transistor Voltmeter, Differential Voltmeter, Average Responding Voltmeter, Peak responding Voltmeter, True RMS Voltmeter. **Measuring Probes:**Introduction, types, introduction to nanoprobes	**10**	**L1, L2**
Module 2 **Digital Instruments and Data Acquisition** **Digital Voltmeters:** Introduction,RAMP technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly used principles of ADC, Successive Approximations, Continuous Balance DVM, $3\,^1/_2$ -Digit, Resolution and Sensitivity of Digital Meters,	**10**	**L1, L2**

Data Acquisition: ADC, DAC, Signal conditioners **Digital Instruments:** Introduction,Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Decade Counter, Electronic Counter, Digital Tachometer, Digital pH Meter, Digital Phase Meter, Digital Capacitance Meter.		
Module 3 **Oscilloscopes, and Signal Generators** **Oscilloscopes:** Introduction, Basic principles, CRT features, Block diagram of Oscilloscope, Simple CRO, Vertical Amplifier, Horizontal Deflecting System, Sweep or Time Base Generator, Storage Oscilloscope, Digital Readout Oscilloscope, Probes for CRO. **Signal Generators:** Introduction, Fixed and Variable AF Oscillator, Standard Signal Generator, AF sine and Square Wave Generator, Function Generator, Square and Pulse Generator, Sweep Generator.	**10**	**L1,L2, L3**
Module 4 **Measuring instruments, and Bridges** **Measuring Instruments:** Output Power Meters, Field Strength Meter, Stroboscope, Phase Meter, Vector Impedance Meter, Q Meter, Megger, Analog pH Meter, Telemetry. **Bridges:** Introduction,Wheatstone's bridge, Kelvin's Bridge; AC bridges, Capacitance Comparison Bridge, Inductance Comparison Bridge, Maxwell's bridge.	**10**	**L1, L2, L3, L4**
Module 5 **Transducers, and Actuators** Introduction, transducers and actuators of: electrical, inductive, capacitive, optical, piezoelectric, and photovoltaic. Thermistor, LVDT, Semiconductor photo diode and transistor.	**10**	**L1, L2, L3**
Course outcomes: After studying this course, students will be able to: • Differentiate accuracy and precision • Explain various types of analog and digital measuring instruments. • Analyze the performance of the AC and DC bridges. • Analyze the performance characteristics of analog and digital measuring instruments. • Recognize the importance of lifelong learning in the field of electronic instrumentation.		
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 consists 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. A. D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1st Edition, 2015, ISBN:9789332556065.
2. H. S. Kalsi, "Electronic Instrumentation", McGraw Hill, 3rd Edition, 2012, ISBN:9780070702066.

Reference Books:

1. A. K. Sawhney, "Electronics and Electrical Measurements", DhanpatRai& Sons.
2. David A. Bell, "Electronic Instrumentation and Measurements", Oxford University Press.

APPLICATIONS OF NANOTECHNOLOGY

[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2015 -2016)
Course: B.E. / Nano Technology
Semester: IV

Subject Code	15NT45	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 subject student will be introduced to applications of nano technology in fields of energy, defence, health, communication, transportation, and agriculture.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module 1 **NT in photovoltaics, batteries, and fuel cells applications** **Photovoltaics:** Introduction, limitations of conventional solar cells, applications of nanotechnology in photovoltaics; Three generation solar cells; Second generation solar cells (CIGS and CdTe): construction, advantages and limitations, Ultrathin nanotechnology solar cells (plastic solar cells): construction, working principle, advantages and limitations. Applications of CNTs in: photovoltaic diode, photo-active layer, transparent electrode, and dye-sensitized solar cells. **Batteries, and Fuel cells:** Nanobatteries: Introduction, advantages, nanotechnology applications under development; Applications of nanotechnology in Hydrogen fuel cells:	**10**	**L1, L2, L3**

production of hydrogen (Tandem cells), storage and transport of hydrogen; improving the efficiency of catalyst, and electrolyte. Applications of nanotechnology in improving the efficiency of DMFC, and SOFC.		
Module - 2 **NT in energy transmissions, water purification, and defense applications** **Energy transmissions:** Applications of nanotechnology to energy production, Nanoscale materials; General energy applications: lighting, heating, transportation, capacitors, power chips; Nanoparticles for energy transmission development: wires and cables; electrical transmission infrastructure: transformers, substations, and sensors. **Water purification:** Nanooligodynamic metallic particles: oligodynamic effect, mechanism and applications; Photocatalysis: types and applications of nanotechnology in photocatalysis; Desalination: nanofiltration, advantages and limitations, future directions of nanotechnology in membrane process. **NT in Defense:** Nanotechnology for soldiers: Smart helmets: significance, sensors, optical/IR, RF, and acaustic arrays, antiballistic protection. Smart suits: as armour, for ventilation, for camouflage. Smart equipments: B/C detection, health monitoring and wound healing.	**10**	**L1, L2, L3**
Module – 3 **NT in agriculture, and food processing applications** **NT in agriculture applications:** Overview of nanotechnology applications in agriculture: Nanoscale carriers, Microfabricated xylem vessels, Nanolignocellulosic materials, Clay nanotubes, Photocatalysis, Nanobarcode technology, Quantum dots for staining bacteria, Biosensors. Nanotechnologies in animal production and health care: Improving feeding efficiency and nutrition, Zoonotic diseases, Animal reproduction and fertility, Nanotechnology and animal waste management. **NT in food processing applications:**Nanofood, introduction, nanoencapsulation, nanocomposites in food packaging, smart food packaging, analytical food packaging.	**10**	**L1,L2, L3**
Module 4 **NT in civil engineering, automobile, and aerospace applications** **NT in civil engineering applications:** Nanotechnology for green building: Introduction, Coatings: self-cleaning coatings, anti-stain coatings, De-polluting surfaces, Scratch-resistant coatings, Anti-fogging and anti-icing coatings, Antimicrobial coatings, UV protection, Anti-corrosion coatings, and Moisture resistance. **NT in automobile applications:** Functionalities of	**10**	**L1, L2, L3**

nanotechnologies (mechanical, geometric effect, electronic/magnetic, optical, and chemical); Applications of NT towards: car body shell, car body, car interior, chasis and tyres, electrics and electronics, engine and drive train. **NT in aerospace applications:** Potential space benefits: resources in space, technical difficulties, Radiation shielding, Space elevator, Leapfrogging effect, Space elevator (electromagnetic), solar power satellites		
Module 5 **Nanotechnology in Electronics, Computer Engineering & Photonics** Introduction to: MOSFET, CMOS, and microchips (DRAM, SRAM, FIFO, EPROM, and PROM). Single electron transistors: introduction, Coulomb blockade, miniature flash memory, and Yano type memory. Quantum mechanical tunneling: RTDs and Esaki diodes. Introduction to spintronics, molecular nanoelectronics, fault tolerant designs, quantum cellular automata, and quantum computing. MEMS and MOEMS: introduction and applications. Introduction to: nanotechnology in photonics, photonic crystals, plasmonics, and spray-on nanocomputers.	**10**	**L1, L2, L3**

Course outcome:

After completion of this subject, students will be able to:

- Describe applications ofnano technology in the photovoltaics, batteries, and fuel cells;
- Illustrate nano technology in the energy transmissions, water purification, and defense;
- Explain nano technology in the agriculture and food processing;
- Describe nano technology in the civil engineering, automobile, and aerospace sector;
- Research nano technological advances in the electronics, computer engineering, and photonics.

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. Nanotechnology, Importance & Applications, M.H. Fulekar, I.K. International Publishing

House, New Delhi, 2011
2. Nanotechnology Applications to Telecommunications and Networking, Daniel Minoli, Wiley Interscience, John Wiley & Sons, 2006, ISBN: 13-978-0-471-71-63-9-6.
3. Nanotechnology, Fundamentals and Applications, ManasiKarkare, I.K. International Publishing, New Delhi, 2008, ISBN : 978-81-89866-99-0

References:

1. "How helpful is nanotechnology in agriculture?-Review", Allah Ditta, Advances in natural sciences: Nanoscience and nanotechnology, 3 (2012) 033002 (10pp), IOP Publishing, doi:10.1088/2043-6262/3/3/033002
2. Nanotechnology – Innovation opportunities for tomorrow's defense, Frank Simonis and Steven S, Freely downloadable from web.
3. Nanotechnologies in Automobiles-Innovation potentials in Hesse for the Automotive industry and its subcontractors, Volume 3 of the Aktionslinie, Hesse Nanotech series of publications. 2008
4. Nanotechnology for green building, George Elvin, Green Technology Forum, 2007

BIOCHEMISTRY AND MICROBIOLOGY

[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2015 -2016)
Course: B.E. / Nano Technology
Semester: IV

Subject Code	15NT46	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 nanomaterials .

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module 1 **Biomolecules and biological membranes:** Types of chemical reactions, pH, buffers and their properties, concentration of solutions. Brief description of the biomolecules: Carbohydrates; Proteins; Lipids; Nucleic acids (DNA & RNA). Classes of Enzymes with examples. Biological membranes: structure, permeability, properties, passive transport and active transport, facilitated transport,	**10**	**L1, L2**

mechanism of Na^+ / K^+, glucose and amino acid transport.		
Module 2 **Bioenergetics and metabolism:** Principle of bioenergetics – Bioenergetics and thermodynamics, phosphoryl group transfer and ATP, Biological oxidation and reduction reaction. Glycolysis, fate of pyruvate under anaerobic conditions, gluconeogenesis, Pentose phosphate pathway of glucose oxidation, Citric acid cycle. Oxidative phosphorylation and photophosphorylation.	**10**	**L1, L2, L3, L4**
Module 3 **Study of Microorganisms:** Scope of microbiology, History of microbiology, origin of life, Prokaryotes and Eukaryotes. Microbial diversity and Taxonomy. Structure, Classification and Reproduction of bacteria, fungi, viruses, Protozoa and Algae. General features of Actinomycetes.	**10**	**L1,L2, L3**
Module 4 **Microbial growth and Control of microorganism:** Growth curve patterns, physical conditions required for growth. Control of microorganism by physical agents (high temperature, low temperature, dessication, osmotic pressure, radiation); Control of microorganism by chemical agents; Antiobiotics and other chemotherapeutic agents.	**10**	**L1, L2, L3**
Module 5 **Microbial synthesis of Nano materials:** Biosynthesis of nano particles by bacteria and fungi (intracellular and extracellular synthesis). Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation of nanostructured materials by virus - TMV virus; Synthesis process and application, Role of plants in nanoparticle synthesis – marigold, tulsi and aloe vera.	**10**	**L3, L4, L5**
Course outcome: • Students will gain knowledge on basic concepts of biomolecules, bioenergetics and metabolism. • The subject will provide background knowledge of different microbes and the ways in which these microbes can be used in synthesis of nanomaterials.		
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. Microbiology by Michael J PelczarJr Chan ECS, Noel R Krieg, Tata McGraw Hill Publishing co Ltd.
2. Microbiology by Prescott, Harley, Klein, McGraw Hill.
3. Lehninger- Principles of Biochemistry by David L. Nelson and Michael M. Cox, 5th Edition,WH Freeman and Company.
4. Principles of Biochemistry by LubertStryer, Freeman Int. Edition

Reference Books:

1. T. Pradeep, "NANO The Essential, understanding Nanoscience and Nanotechnology". Tata McGraw - Hill Publishing Company Limited, 2007.
2. C. A. Mirkin and C. M. Niemeyer, Nanobiotechnology- II, More Concepts and Applications, WILEY-VCH, VerlagGmbH&Co, 2007

ELECTRONIC INSTRUMENTATION LAB

[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2015 -2016)
Course: B.E. / Nano Technology
SEMESTER - IV

Laboratory Code	15NTL47	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 realize and demonstrate that how different for finding out values of resistance, capacitance and inductance
- To interface sensors and demonstrate the method used in sensing temperature and pressure
- To study the working principle of data acquisition modules in electronic instrumentation

Laboratory Experiments:	**Revised Bloom's Taxonomy (RBT) Level**
1. To find the value of unknown resistor using Wheatstone bridge.	**L1, L2, L3**
2. To find the value of unknown capacitance and inductance using Maxwell's bridge	**L4, L5, L6**
3. To find the value of unknown capacitance using Wein's series and parallel bridge.	**L5, L6**
4. Measurement of frequency using Lissajous method	**L4, L5, L6**

5. To study and verify characteristic of variable resistor transducer (strain gauge)	**L5, L6**
6. To study and verify characteristic of LVDT	**L5, L6**
7. TO STUDY CHARACTERISTICS OF TEMPREATURE TRANSDUCER LIKE THERMOCOUPLE,THERMISTOR AND RTD WITH IMPLEMENTATION OF A SMALL PROJECT USING SIGNAL CONDITIONING CIRCUITS LIKE INSTRUMENTATION AMPLIFIER	**L5, L6**
8. Measurement of pressure using piezoelectric pick up.	**L5, L6**
9. To interface temperature sensor to Data Acquisition Kit and display the temperature measured.	**L1, L2, L3**
10. STUDY OF DISTANCE MEASUREMENT USING ULTRASONIC TRANSDUCER.	**L5, L6**
11. MEASUREMENT OF POWER and ENERGY USING ARDUINO	**L5, L6**

Course Outcome:

- Students can learn the how to work with electronic instruments and bridge networks for sensing physical parameters
- Students will be able to demonstrate the working of sensors and interfacing circuits in measuring of physical parameters

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. Lab Manual

BIOCHEMISTRY AND MICROBIOLOGY LAB

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

(Effective from the academic year 2015 -2016)

Course: B.E. / Nano Technology

SEMESTER – IV

Laboratory Code	15NTL48	IA Marks	20
Number of Lecture Hours/Week	01Hr Tutorial (Instructions) + 02 Hours Laboratory	Exam Marks	50
		Exam Hours	03

CREDITS – 02

Course objectives:

Biochemistry is the study of chemical processes in living organisms. It deals with the structures and functions of cellular components such as proteins, carbohydrates, lipids, nucleic acids and other biomolecules. The experiments included in biochemistry lab are fundamentals in nature, dealing with the identification and classification of various carbohydrates, acid-base titration of amino acids, isolation of proteins from their natural sources, etc.

Lab experiments	**Revised Bloom's Taxonomy (RBT) Level**
1. Qualitative analysis of glucose	**L1, L2, L3**
2. Iso-electric precipitation of proteins; casein from milk	**L4, L5**
3. Qualitative analysis of fructose	**L1, L2, L3**
4. Separation of amino acids by thin layer chromatography	**L5, L6**
5. Estimation of saponification value of fats/oils	**L5, L6**
6. Detection of adulteration in milk	**L5, L6**
7. Qualitative analysis of amino acids	**L5, L6**
8. Estimation of iodine value of fat/oil	**L5, L6**
9. Titration curves of amino acids	**L1, L2, L3**
10. Estimation of blood glucose by glucose-oxidase method	**L5, L6**
11. Estimation of acid value from castor oil/coconut oil	**L5, L6**
12. Quantitative estimation of amino acids by ninhydrin method	**L4, L5**

Course Outcome:

By the end of the lab students will be able to identify and classify the various carbohydrates, acid-base titration of amino acid, and isolation of protein from their natural sources.

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. Lab Manual