NOOURL ISLAM CENTRE FOR HIGHER EDUCATION

NOORUL ISLAM UNIVERSITY, KUMARACOIL

B.TECH. NANO TECHNOLOGY

CURRICULUM & SYLLABUS

SEMESTER I

(Common for All B.E/B.Tech. Programmes Except Marine Engineering)

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG1101	Technical English – I	3	1	0	4
2.	MA1101	Engineering Mathematics – I	3	1	0	4
3.	PH1101	Engineering Physics – I	3	0	0	3
4.	CH1101	Engineering Chemistry - I	3	0	0	3
5.	ME1101	Engineering Graphics	3	0	0	3
6.	CS1101	Fundamentals of Computing and Programming	3	0	0	3
PRACTICAL						
7.	CS1171	Computer Practice Lab - I	0	1	2	2
8.	ME1171	Computer Aided Drafting and Modeling Lab	0	1	2	2
9.	PH1171	Physics Lab – I	0	0	2	1
10.	CH1171	Chemistry Lab - I	0	0	2	1
TOTAL			18	4	8	26

*** Those who have admitted from the Academic Year 2013-2014 onwards**

EG1101 TECHNICAL ENGLISH – I 3 1 0 4

UNIT-I 9

Verb-Tenses -12 Tenses-8 Passive Forms- Word formation with prefixes and suffixes

UNIT-II 9

Expansion of Compound Nouns – Punctuation - Definitions of Technical Terms - Changing words from one form to another - Imperatives and Instructions - Conditional clauses.

UNIT-III 9

Interrogatives and Question Tags - Asking Questions - Comprehension – Discourse Markers

UNIT –IV 9

Concord - Identifying Common Errors - Cause and Effect Expressions – Paragraph Writing – Copy Writing: Slogans and Captions - Writing Instructions - Letter Writing (Formal Letters)

UNIT –V 9

Creative Writing – Transcoding: Bar Chart, Flow Chart - Pie Chart - Tree Diagram - Tabular Column

L: 45 + T: 15, TOTAL: 60 PERIODS

TEXT BOOK:

Department of Humanities and Social Sciences, Anna University, English for Engineers and Technologists, Combined Edition (Volumes 1 @ 2), Chennai: Orient Black Swan Pvt.Ltd.,2006 Themes 1-4 (Resources, Energy, Computer, Transport)

EXTENSIVE READING:

A.P.J.Abdul Kalam with Arun Tiwari, Wings of Fire: An Autobiography, University Press (India) Pvt.Ltd, 1999, 30 Impression 2007

***NOTE*:**

The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

MA1101 ENGINEERING MATHEMATICS - I 3 1 0 4

AIM:

To impart the fundamental knowledge of Engineering Mathematics to the students in order to achieve a well founded knowledge about the principles of Mathematics.

OBJECTIVE:

The course objective is to develop the required skill of the students in the area of

Engineering Mathematics with special emphasis on the characteristic equation of matrices, differential calculus, Beta and Gamma functions and to develop basic knowledge to the students in double and triple integration.

UNIT I MATRICES 9

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of eigen values and eigen vectors(without proof)– Cayley Hamilton theorem (statement only), verification and its applications – Orthogonal and Symmetric matrices and their properties(excluding proof)- Orthogonal transformation of a symmetric matrix to diagonal form.

UNIT II DIFFERENTIAL CALCULUS 9

Curvature – Cartesian co-ordinates and parametric form -Centre and radius of curvature, Circle of curvature – Evolutes.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9

Partial derivatives – Total derivatives – Jacobians – Properties – Maxima and minima for functions of two variables–Lagrange Multiplier method- Taylor's expansion.

UNIT IV BETA AND GAMMA INTEGRALS 9

Evaluation of improper integrals- Beta and Gamma functions – Properties – Relation between Beta and Gamma functions - Evaluation of integrals using Beta and Gamma functions.

UNIT V MULTIPLE INTEGRALS 9

Evaluation of double and triple integrals – Area as double integral in cartesian and polar co-ordinates– Change of order of integration- Transformation of Cartesian coordinates into polar coordinates.

L: 45 + T: 15, TOTAL: 60 PERIODS

TEXT BOOK:

Grewal B.S., "Higher Engineering Mathematics"- 40th Edition , Khanna Publishers, Delhi 2007.

REFERENCES:

1 Veerarajan T, " Engineering Mathematics (for first year)", Tata McGraw- Hill Publishing Company Ltd.,New Delhi , 2007
2 Erwin Kreyszig, " Advanced Engineering Mathematics", 7th Edition, Wiley India, 2007.
3 P.Kandasamy , K.Thilagavathy , K.Gunavathy" Engineering Mathematics" Vol,1 S.Chand & Company Ltd.2002
4. B.V. Ramana,"Higher Engineering Mathematics" Tata McGraw- Hill, Publishing Company Ltd.,New Delhi, 2006

PH1101 ENGINEERING PHYSICS – I 3 0 0 3

AIM:

To provide a sound knowledge on the principles of Physics and its practical applications in various areas of Engineering and Technology.

OBJECTIVE:

At the end of the course students would be exposed to

- The mechanical properties of matter and its engineering applications
- Application of ultrasonics in Industry and Medical field
- The important properties of light and their application
- Application of laser and fiber optics in communication and technology
- The fundamentals of heat- energy conversion and its application.

UNIT I Properties of matter 9

Elasticity – Poisson's ratio – Stress-strain diagram – factors affecting elasticity – bending of beams – cantilever – bending moment – theory and experiment of Young's modulus determination – Uniform and non-uniform bending – I shaped girders – twisting couple – hollow cylinder – shaft – torsion pendulum – determination of rigidity modulus

UNIT - II Ultrasonics 9

Introduction-production of ultrasonic waves- magnetostriction effect- magnetostriction generator-piezoelectric effect-piezoelectric generator-detection of ultrasonic waves-properties - velocity measurement - acoustic grating-industrial applications-drilling, welding, soldering and cleaning- SONAR- non destructive testing pulse echo system-medical applications-sonograms.

UNIT –II Optics 9

Interference: air wedge- theory and experiment-testing of flat surfaces- Michelson's Interferometer-types of fringes- applications (determination of wavelength and thickness of thin transparent medium).

Polarization: Introduction- double refraction, quarter and half wave plates- production of plane, circularly and elliptically polarized light-detection of plane, circularly & elliptically polarized light.

Photoelasticity- Stress-optic law- photoelastic bench

UNIT- IV Lasers & Fiber Optics 9

Introduction- principle of spontaneous emission and stimulated emission, Einsteins A and B coefficients-derivation- population inversion, pumping, types of lasers- Nd-YAG, CO_2-applications.

Principle and propagation of light in optical fibre- numerical aperture and acceptance angle- types of optical fibres (material, refractive index, mode)- double crucible technique of fibre drawing, fibre optic communication system (Block diagram)-fibreoptic sensors.

UNIT – V Heat and Thermodynamics **9**

Thermal conductivity- Forbe's and Lee's disc methods-radial flow of heat- thermal conductivity of rubber and glass-thermal insulation in buildings - Laws of thermodynamics- Carnot's cycle as heat engine – efficiency, Otto engine & Diesel engine (qualitative).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.K. Gaur and S.L.Gupta, 'Engineering Physics' Dhanpat Rai publications, New Delhi.
2. Marikani A, 'Engineering Physics' PHI learning pvt ltd, III Edition, New Delhi.
3. Palanisamy.P.K., 'Engineering Physics' Scitech publications, Chennai.
4. M.N. Avadhanulu and PG Kshirsagar. ' A Text book of Engineering Physics', S.Chand and company, Ltd., New Delhi.

REFERENCES:

1. Serway and Jewett, 'Physics for Scientists and Engineers with Modern Physics', 6th Edition, Thomson Brooks/Cole, Indian reprint.
2. Brijlal and Subrahmanyam 'Heat and Thermodynamics' S. Chand , Limited.
3. Ajoy Ghatak, ' Optics' Tata McGraw Hill Publications, New Delhi.
4. Brijlal and Subrahmanyam 'Properties of Matter' S. Chand , Limited.

CH1101 ENGINEERING CHEMISTRY-I 3 0 0 3

AIM

To have a thorough knowledge of the basics of chemistry particularly engineering oriented topics to engineering students.

OBJECTIVES

To make the students conversant with the principles of the following topics: (i) Water Technology, (ii) Engineering Materials and Polymers,(iii) Surface Chemistry and Nanomaterials,(iv) Analytical Techniques and (v) Chemical Kinetics

UNIT I WATER TECHNOLOGY 9

Water as a universal solvent – hard and soft water – reasons for hardness – disadvantages of hard water in washing and industrial purposes - estimation of hardness by EDTA method, problems; boiler feed water – characteristics- softening methods - external conditioning – demineralization (ion exchange) process, desalination by reverse osmosis method- internal conditioning (phosphate, calgon and carbonate conditioning methods); stages in domestic water treatment – disinfection by chlorination, ozone and UV treatments.

UNIT-II ENGINEERING MATERIALS AND POLYMERS 9

Abrasives – Natural & synthetic – Moh's scale, diamond, carborundum – Refractories – classification and properties – Cement – Manufacture. Lubricants- Types – properties of lubricants – oiliness, fire & flash points, pour & cloud point (definition only) – solid lubricants – Graphite and MoS_2.

Polymer and polymerization (definition only)- examples for natural & synthetic polymers, Preparation, properties and uses of Kevlar, Nomex, Rubber – natural and synthetic – neoprene, butyl rubber- vulcanization of rubber,Introduction to Conducting polymers and Liquid crystal polymers.

UNIT III SURFACE CHEMISTRY AND NANOMATERIALS 9

Adsorption – classification- adsorption of gases on solids- adsorption isotherms- Freundlich and Langmuir adsorption isotherms- adsorption of solutes from solution- application of adsorption-catalysis and pollution control-Nanomaterials – introduction – carbon nanotubes (CNT) and their applications.

UNIT IV ANALYTICAL TECHNIQUES 9

Importance of spectroscopic techniques- Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy. Thermal Analysis- TGA and DTA- principles- thermogram of calcium oxalate monohydrate.

UNIT-V CHEMICAL KINETICS 9

Introduction – rate, rate constant, order & molecularity of reactions –First order reaction – Derivation of rate constant – Second order reactions – rate constant (no derivation, equation and problem only) - activation energy – concept-Arrhenius equation-derivation- steady state approximation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. P.C. Jain and Monica Jain, Engineering Chemistry DhanpatRai Pub, Co., New Delhi (2002)
2. S.S. Dara, A text book of engineering chemistry S. Chand & C. Ltd., New Delhi (2006)
3. B. Sivasankar Engineering Chemistry Tate McGraw- Hill Pub. Co. Ltd, New Delhi (2008)

REFERENCES:

1. B. K. Sharma Engineering Chemistry Krishna Prakasan Media (P) Ltd., Meerut (2001)
2. R. Gopalan, D. Venkappayya, Sulochana Nagarajan, Engineering Chemistry Vikas Pub, Co., New Delhi (2006)
3. Principles of physical chemistry by Samuel Glasstone,Van Nostrand pub.comp, Newyork.
4. Principles of physical chemistry by Puri & Sharma,Vikas pub.comp,2008

ME1101 ENGINEERING GRAPHICS 3 0 0 3

OBJECTIVE

- To know the fundamental principles of geometrical drawing
- To visualize the various machine components

Unit I - Introduction 9

Introduction to Engineering Drawing, Drawing Standard, ISI code of practice, Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Unit II - Orthographic Projection (Points, Lines & Planes) 9

Principles of orthographic projection-projection of points, straight lines, traces and projection of planes inclined to both planes Orthographic projection of simple engineering components-missing view exercises.

Unit III - Orthographic Projection (Solids) 9

Projection of solids – Inclined to one plane - Sections and Sectional Views of Right Angular Solids covering - Prism, Cylinder, Pyramid, Cone – Auxiliary Views

Unit IV - Pictorial Projections 9

Principles of pictorial views, isometric view of simple solids. Free hand sketching of orthographic views from pictorial views. Free hand sketching of isometric views from given two or three views.

Unit V - Development Of Surfaces & Perspective Projection 9

Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Perspective Projection of Planes and Solids

L: 45 + T: 15, TOTAL: 60 PERIODS

TEXT BOOKS:

1. Venugopal K and Prabhu Raja V, “Engineering Graphics”, New Age International Publishers, 2007.
2. . Luzadder W J, “Fundamentals of Engineering Drawing”, Prentice Hall Book Co., New York, 1998
3. Bhat, N.D.& M. Panchal , *Engineering Drawing*, Charotar Publishing House,2008

REFERENCES:

1. Kumar M S, “Engineering Graphics”, Ninth Edition, DD Publications, Chennai, 2007.
2. Bureau of Indian Standards, “Engineering Drawing Practices for Schools and Colleges SP 46-2003”, BIS, New Delhi, 2003.
3. Shah, M.B. & B.C. Rana , *Engineering Drawing and Computer Graphics*, Pearson *Education,2008*

CS1101 FUNDAMENTALS OF COMPUTING AND PROGRAMMING 3 0 0 3

AIM:

To provide an awareness to Computing and Programming

OBJECTIVES:

- To enable the student to learn the major components of a computer system
- To know the correct and efficient ways of solving problems
- To learn to use office automation tools
- To learn to program in C

UNIT - I Introduction to Computers 9

Introduction – Characteristics of Computers – Evolution of Computers - Computer Generations – Classification of Computers – Basic Computer organization – Number Systems

UNIT -II Computer Software 9

Computer Software –Types of Software – Software Development Steps – Internet Evolution - Basic Internet Terminology – Getting connected to Internet Applications.

UNIT – III Problem Solving and Office Application Software 9

Planning the Computer Program – Purpose – Algorithm – Flow Charts – Pseudocode - Application Software Packages- Introduction to Office Packages (not detailed commands for examination).

UNIT – IV Introduction to C 9

Overview of C – Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operators – Decision Making - Branching and Looping.

UNIT – V Functions and Pointers 9

Handling of Character Strings – User-defined Functions – Definitions – Declarations - Call by reference – Call by value – Structures and Unions – Pointers – Arrays – The Preprocessor – Developing a C Program : Some Guidelines

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ashok.N.Kamthane,“ Computer Programming”, Pearson Education (India) (2008).
2. Behrouz A.Forouzan and Richard.F.Gilberg, “A Structured Programming Approach Using C”, II Edition, Brooks-Cole Thomson Learning Publications, (2007).

REFERENCES:

1. Pradip Dey, Manas Ghoush, “Programming in C”, Oxford University Press. (2007).
2. Byron Gottfried, “Programming with C”, 2nd Edition, (Indian Adapted Edition), TMH publications, (2006).
3. Stephen G.Kochan, “Programming in C”, Third Edition, Pearson Education

India, (2005).
4. Brian W.Kernighan and Dennis M.Ritchie, “The C Programming Language”, Pearson Education Inc., (2005).
5. E.Balagurusamy, “Computing fundamentals and C Programming”, Tata McGraw-Hill Publishing Company Limited, (2008).
6. S.Thamarai Selvi and R.Murugan, “C for All”, Anuradha Publishers, (2008).

CS1171 COMPUTER PRACTICE LAB - I 0 1 2 2

LIST OF EXERCISES

a) Word Processing **15**

1. Document creation, Text manipulation with Scientific notations.
2. Table creation, Table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing - flow Chart

b) Spread Sheet **15**

5. Chart - Line, XY, Bar and Pie.
6. Formula - formula editor.
7. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
8. Sorting and Import / Export features.

c) Simple C Programming * **15**

9. Data types, Expression Evaluation, Condition Statements.
10. Arrays
11. Structures and Unions
12. Functions

*** For programming exercises flow chart and pseudo code are mandatory.**

TOTAL: 45 PERIODS

Hardware / Software required for a batch of 30 Students

Hardware

LAN System with 33 nodes (OR) Standalone PCs– 33 Nos.
Printers– 3 Nos.

Software

OS– Windows / UNIX Clone
Application Package– Office suite
Compiler– C

ME1171 COMPUTER AIDED DRAFTING AND MODELING LAB

L-T-D: 0-0-2 Credits: 2

(i) Introduction to computer aided drafting and solid modeling: software and hardware.

(ii) Understand basic 2D geometric construction techniques.
a. Cartesian and polar coordinate systems: locating points, coordinate entry methods, units and limits.
b. Object generation: lines, arcs, polylines, and multilines; rectangles, circles, polygons, and ellipses.
c. Transformations: move, copy, rotate, scale, mirror, offset and array; trim, extend, fillet, chamfer
d. Layers: creation, naming, properties manager.
e. Blocks: create, edit, import and explode.
f. Text: creating and editing, formatting, text styles.
g. Dimensions: creating and editing, dimension styles.

(iii) Exercise on basic drafting principles to create technical drawings.
a. Create orthographic views of machine parts from pictorial views.
b. Create isometric views of machine parts from orthographic views
c. Create hatched sectional views of machine parts.

(iv) Understanding basic solid modeling techniques
a. Creation of solid primitives
b. Boolean operations
c. Extrude, Revolve operations
d. 3D Views

(v) Exercise on basic modeling to create machine parts Create solid models from pictorial views

TOTAL: 45 PERIODS

University Examination:

Question paper may contain two parts. Part A shall contain 2D drafting which carries 40% marks, Part B shall contain 3D drafting which carries 40% marks and 20% marks is for viva voce conducted during the exam.

PH1171 **PHYSICS LAB- I** **0 0 2 1**

LIST OF EXPERIMENTS

(Any five experiments)

1. (a) Particle size determination using Diode Laser
   (b) Determination of Laser parameters- Wavelength and Numerical aperture
2. Determination of velocity of sound and compressibility of liquid- Ultrasonic Interferometer.
3. Determination of thermal conductivity of a bad conductor- Lee's Disc method
4. Determination of thickness of a thin wire- Airwedge
5. Torsional Pendulum- Determination of rigidity modulus
6. Compound pendulum- Determination of acceleration due to gravity
7. Determination of Young's Modulus- Non-Uniform bending

Reference: Physics lab manual- Department of Physics

CH1171 **CHEMISTRY LAB - I** **0 0 2 1**

List of Experiments

1. Determination of total hardness of water by EDTA method.
2. Determination of alkalinity (titrimetry method)
3. Determination of percentage purity of washing soda
4. Conductometric titration of a strong acid with a strong base
5. Determination of strength of hydrochloric acid (p^Hmetry)
6. Determination of the amount of Na^+ in water sample (Flame photometry)
7. Determination of molecular weight and degree of polymerization of a polymer
8. Determination of the amount of Ca^{2+} in water sample .
9. Determination of iron in rust by Permanganometry.

Minimum five experiments shall be offered.

References:

1. J. Bassette, R. B. Deanen& G. H. Jeffery & J. Mendham, Text book of Vogel Quantitative Inorganic Analysis, ELBS, England.

TOTAL: 45 PERIODS

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B.TECH. NANO TECHNOLOGY

CURRICULUM & SYLLABUS

SEMESTER II

(Common for All B.E/B.Tech Programmes Except Marine Engineering)

Sl. No	Course Code	Course Title	L	T	P	C
Theory						
1.	EG1102	Technical English – II	3	0	0	3
2.	MA1102	Engineering Mathematics – II	3	1	0	4
3.	PH1102	Engineering Physics – II	3	0	0	3
4.	CH1102	Engineering Chemistry – II	3	0	0	3
5.	ME1102	Engineering Mechanics	3	0	0	3
6.	BE1101	Basic Engineering - I (Basic Electrical and Electronics Engineering)	3	1	0	4
7.	BE1102	Basic Engineering – II (Basic Mechanical and Civil Engineering)	3	1	0	4
Practical						
8.	CS1172	Computer Practice Lab - II	0	1	2	2
9.	PH1172	Physics Lab – II	0	0	2	1
10	CH1172	Chemistry Lab - II	0	0	2	1
11.	BE1171	Basic Engineering Lab – I (Basic Electrical and Electronics Engineering Lab)	0	0	4	2
12.	BE1172	Basic Engineering Lab – II (Basic Mechanical and Civil Engineering Lab)	0	0	4	2
TOTAL			21	4	14	32

***Those who have admitted from the Academic Year 2013-2014 onwards.**

EG1102 TECHNICAL ENGLISH - II 3 0 0 3

UNIT-I **9**

Technical Vocabulary - Active and Passive Vocabulary – Articles - Prepositions – Expansion of Abbreviations and Acronyms

UNIT-II **9**

Phrases- Adverbs –Different grammatical forms of the same word –Active Voice-Passive Voice

UNIT-III **9**

Phonemes - Vowels, Consonants and Diphthongs – Word Stress and Intonation

UNIT-IV **9**

Writing Recommendations – Checklists - Essay Writing - Business Letters: - Letter Calling for quotation, Letter Placing Order, Letter of Complaint, Letter Seeking Clarification - Business Proposal Writing

UNIT-V **9**

Numerical Adjectives – CV/Resume Writing – One Word Substitutes – Virtual Communication: E-Mail Writing

TOTAL: 45 PERIODS

TEXT BOOK:

Department of Humanities and Social Sciences, Anna University, English for Engineers and Technologists, Combined Edition (Volumes 1 @ 2), Chennai: Orient Black Swan Pvt.Ltd. 2006 Themes 5-8 (Technology, Communication, Environment, Industry)

EXTENSIVE READING:

Shiv Khera, You Can Win, Milan, Delhi, 2004

OR

CanField Jack, Chicken Soup for the Soul, Westland, Chennai, 1999.

***NOTE*:**

The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

MA1102 ENGINEERING MATHEMATICS II 3 1 0 4

AIM:

To impart the fundamental knowledge of Engineering Mathematics to the studentsin order to achieve a well founded knowledge about the principles of Mathematics.

OBJECTIVE:

To develop basic knowledge to the students in differential equations and vector calculus. This subject is further broadened to the functions of complex variables and complex integration. A thorough knowledge about Laplace transforms is also covered to aid the students solve the differential equations.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9

Linear differential equations of second order with constant and variable coefficients- Cauchy's and Legendre's linear equations – Method of variation of parameters

UNIT II COMPLEX VARIABLES 9

Functions of a complex variable – Analytic function – Necessary conditions- Cauchy-Riemann equations in cartesian and polar co-ordinates - Sufficient conditions(excluding proof) –Properties of analytic function – Harmonic and its conjugate – Construction of analytic function by Milne Thomson method – Conformal mappings
$w = z + c$, cz , $1/z$ and Bilinear transformation.

UNIT III COMPLEX INTEGRATION 9

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Laurent's expansion – Singular points – Residues – Cauchy's Residue theorem – Evaluation of real definite integral using contour integration(excluding poles on the real axis) - $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{\infty} \frac{f(x)}{g(x)}dx$

UNIT IV VECTOR CALCULUS 9

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT V LAPLACE TRANSFORMS 9

Laplace transform –Existence condition– Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Transform of Periodic functions. Inverse Laplace transform – Convolution, Initial and Final value theorems (statement only) – Solutions of linear ordinary differential equation of second order with constant coefficients using Laplace transform techniques.

L: 45 + T: 15, TOTAL: 60 PERIODS

TEXT BOOK:

Grewal B.S., "Higher Engineering Mathematics"- 40th Edition , Khanna Publishers, Delhi 2007.

REFERENCES:

1. Erwin Kreyszig, " Advanced engineering Mathematics", 7th Edition, Wiley India, 2007
2. Veerarajan T, " Engineering Mathematics (for first year)", Tata McGraw- Hill Publishing Company Ltd.,New Delhi,2007.
3. P.Kandasamy , K.Thilagavathy , K.Gunavathy" Engineering Mathematics" S.Chand & Company Ltd.2002.
4. B.V. Ramana,"Higher Engineering Mathematics" Tata McGraw- Hill Publishing Company Ltd.,New Delhi,2006.

PH1102 ENGINEERING PHYSICS – II 3 0 0 3

AIM:

To enable the students' understand the Physics behind various engineering materials and correlate it to technological applications.

OBJECTIVE:

At the end of the course students would be exposed to

- Fundamentals of quantum mechanics and its application to electron microscopy
- Various crystal structures and their defects
- The synthesis, properties and applications of various engineering materials

UNIT –1 Quantum Mechanics 9

Matter waves- de-Broglie wavelength - Schrodinger's wave equation-time independent and time dependent equations- physical significance of wave function- particle in a one dimensional box- electron microscope- scanning electron microscope- transmission electron microscope.

UNIT II Elementary crystal physics 9

Lattice – Unit cell, Bravais lattice ,lattice planes-Miller indices ,d-spacing in cubic lattice. Calculation of number of atoms per unit cell,atomic radius, coordination number and packing
factor for SC,BCC,FCC and HCP structures- diamond cubic, NaCl and ZnS structures. Crystal defects.

UNIT- III Conducting & Semiconducting Materials 9

Conducting materials – Drawbacks of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states Semiconducting materials: intrinsic semiconductor-carrier concentration derivation

- fermi level - electrical conductivity- band gap determination, extrinsic semiconductors, compound semiconductors (qualitative), Hall effect -determination of hall coefficient - applications.

UNIT- IV Magnetic, Superconducting and Dielectric Materials 9

Magnetic Materials: Origin of magnetic moment-Bohr magneton - ferromagnetism – magnetic domains- hysteresis-soft and hard magnetic materials- applications.

Superconductivity: Properties-types of super conductors - BCS theory of superconductivity (qualitative) - applications of superconductors.

Dielectric materials - active and passive dielectrics - types of polarization- dielectric loss- dielectric breakdown – uses of dielectric materials.

UNIT- V New Engineering Materials 9

Metallic glasses: preparation, properties and applications. Shape Memory Alloys (SMA): characteristics, properties and applications.

Nanomaterials -synthesis-top-down approach (Ball milling), bottom-up approach (CVD)- properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rajendran, V, and Marikani A, 'Materials science' TMH publications, New Delhi
2. Palanisamy P.K "Materials Science", Scitech publications Pvt Ltd, Chennai
3. Arumugam M, "Materials Science", Anuradha publications, Kumbakonam
4. R.K. Gaur and S.L.Gupta, 'Engineering Physics' Dhanpat Rai publications, New Delhi

REFERENCES:

1. Charles Kittel ," Introduction to solid state physics ", John Wiley & sons, 8ed.
2. Charles P.Poole and Frank J. Owner, " Introduction to Nanotechnology, Wiley India.
3. Pillai, S.O. 'Solid state physics' NewAge international pubishers, Chennai.

CH1102 ENGINEERING CHEMISTRY-II 3 0 0 3

AIM

To have a thorough knowledge of the basics of chemistry particularly engineering oriented topics to engineering students

OBJECTIVES

To make the students conversant with the principles of the following topics: (i) Fuels And Combustion,(ii) Electrochemistry And Corrosion, (iii) Energy Sources And Batteries, (iv) Phase Rule And Alloys And (v) Thermodynamics.

UNIT I FUELS AND COMBUSTION 9

Classification of fuels with examples– characteristics of a good fuel- fossil fuels- Coal – proximate and ultimate analysis- metallurgical coke – manufacture by Otto-Hoffmann method – Petroleum processing and refining – cracking (definition only) - knocking – octane number and cetane number – synthetic petrol – Bergius process- Calorific value –GCV, LCV (problems)- Gaseous fuels- water gas and producer gas, Flue gas analysis – Orsat apparatus – theoretical air for combustion (problems).

UNIT-II ELECTROCHEMISTRY AND CORROSION 9

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – single electrode potential – Nernst equation– reference electrodes – Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance- Electrochemical corrosion – protective coatings – paints – constituents and functions.

UNIT –III ENERGY SOURCES AND BATTERIES 9

Renewable & non-renewable energy sources- wind energy, solar energy and solar cell- Nuclear reactions – Fission and fusion – nuclear reactors – light water and breeder nuclear reactors (elementary ideas only) – Nuclear power plants in India.

Batteries- primary and secondary cells- alkaline battery- lead acid battery- nickel cadmium battery- lithium battery (Li-TiS_2)- H_2-O_2 fuel cell.

UNITV PHASE RULE AND ALLOYS 9

Statement and explanation of terms involved – one component system – water system – condensed phase rule – simple eutectic system (lead-silver system only) – alloys – importance, ferrous alloys – nichrome, invar and stainless steel – heat treatment of steel, non-ferrous alloys – brass, bronze and solder.

UNIT-V THERMODYNAMICS 9

Introduction- I law of thermodynamics (statement only)- Relation between ΔE & ΔH -II law of thermodynamics (statement only)- concept of entropy – Clausius-Clapeyron equation (no derivation)- Importance, terms involved (problem) -Free energy changes- ΔG – Gibbs Helmoltz equation (derivation) - III law of thermodynamics- concept of absolute entropy- zeroth law of thermodynamics (statement only).

TOTAL: 45 PERIODS

TEXT BOOKS:

1 P.C. Jain and Monica Jain, Engineering Chemistry DhanpatRai Pub, Co., New Delhi (2002)

2 S.S. Dara, A text book of engineering chemistry S. Chand & C. Ltd., New Delhi (2006)

3. B. Sivasankar Engineering Chemistry Tate McGraw- Hill Pub. Co. Ltd, New Delhi (2008).

REFERENCES:

1 B. K. Sharma Engineering Chemistry Krishna Prakasan Media (P) Ltd., Meerut (2001)
2 Principles of physical chemistry by Samuel Glasstone,Van Nostrand pub.comp, Newyork.
3 Principles of physical chemistry by Puri & Sharma,Vikas pub.comp,2008.

ME1102 ENGINEERING MECHANICS 3 0 0 3

OBJECTIVE

This is a basic engineering course common to all branches to inculcate in the students, problem
solving abilities and to enhance their analytical abilities.

Unit I - Statics of Particles 10

Statics –Basics Concepts, Fundamental principles & concepts: Vector algebra, Newton‟s laws, gravitation, force (external and internal, transmissibility), couple, moment (about point and about axis), Varignon‟s theorem, resultant of concurrent and non-concurrent coplanar forces, static equilibrium, free body diagram, reactions. Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, constraints and static determinacy; 3-D statics.

Unit II - Application of Statics & Friction 9

Analysis of Structures- Trusses: Assumptions, rigid and non-rigid trusses; Simple truss (plane and space), analysis by method of joints. Analysis of simple truss by method of sections;

FRICTION: Friction- Coulomb dry friction laws, simple surface contact problems, friction angles, types of problems, wedges. Sliding friction and rolling resistance

Unit III - Centroid, Centre of Gravity and Moment of Inertia 8

Moment of Inertia- First moment of mass and center of mass, centroids of lines, areas, volumes, composite bodies. Area moments- and products- of inertia, radius of gyration, transfer of axes, composite areas. Rotation of axes, principal area-moments-of-inertia,. Second moment of mass, Mass moments- and products- of inertia, radius of gyration, transfer of axes, flat plates (relation between area- and mass- moments- and products- of inertia), composite bodies. Rotation of axes, principal mass-moments-of-inertia.

Unit IV - Particle Dynamics 8

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton’ s 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Unit V Kinematics & Kinetics of Rigid Bodies: 10

Plane kinematics of rigid bodies- Rotation; Parametric motion. Relative velocity,

instantaneous center of rotation. Relative acceleration, rotating reference frames. Rotating reference frames, 3-part velocity and 5-part acceleration relations, Coriolis acceleration. Plane kinetics of rigid bodies- Kinetics of system of particles and derivation of moment equation. Translation. Fixed axis rotation; General planar motion.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics and Dynamics", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2006.
2. Tayal A K, "*Engineering Mechanics- Statics and Dynamics*" , Umesh Publications, Delhi,2004
3. Irving H. Shames, Engineering Mechanics, Prentice Hall, New Delhi 1997.

REFERENCES:

1. Bansal R K, "Engineering Mechanics", Laxmi Publications Pvt. Ltd., New Delhi, 2006.
2. Bhavikatti S S, "Engineering Mechanics", New Age International Pvt. Ltd., New Delhi, 2003.
3. Young D H and Timashenko S, "Engineering Mechanics", Tata Mcgraw-Hill, Fourth Edition, 2006.
4. Jivan Khachane, Ruchi Shrivastava, "Engineering Mechanics: Statics and Dynamics", ANE Books, 2006.
5. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2006.
6. NPTEL courses: *http://nptel.iitm.ac.in/courses.php*, web and video resources on *Engineering Mechanics*.

BE1101 BASIC ENGINEERING - I 3 1 0 4

(Basic Electrical and Electronics Engineering)

Objectives:

- To understand the basic solutions of AC and DC circuits.
- To study the basic principle and operation of AC and DC machines.
- To study the fundamental operations of measuring instruments.
- To study the layout of power system.

Unit: 1 – Electrical circuits 9

Ohms Law, Kirchhoff's laws, Mesh and Nodal Analysis for DC Circuits.
Introduction to AC Circuits, Faraday's Law of Electromagnetic Induction, Lenz law, Inductor, Capacitor, Power factor, Waveforms and RMS value, Average Value, Peak factor and Form factor, Single phase circuits- Series and Parallel, Three phase balanced circuits. Fundamentals of wiring and earthing.

Unit: II – Electrical Measurements, Machines and Power system 9

Operating principles of Moving coil and Moving iron instruments (Ammeter and voltmeter), Dynamometer type watt meter and Energy meter, Errors in Measurements. Construction, Principle of operation and Applications of DC Generators, DC Motors, Single phase transformers. Structure of power system

UNIT- III Semiconductor devices and applications 9

Characteristics of PN Junction diode-Zener Effect-Zener diode and its characteristics-Half wave and Full wave Rectifiers-Voltage regulation,Bipolar Junction transmitter-CB,CE,CC Configuration and characteristics.

UNIT-IV Digital Electronics 9

Binary number system-logic gates-Boolean algebra-Combinational Circuit-half and Full adder,Sequential Circuit-Flip flops-Shift Registers(SIPO,SISO,PIPO,PISO) – Counters: Synchronous and Asynchronous –A/D conversion-Successive approximation,D/A conversion-Weighted Resistor

UNIT – V Fundamentals of Communication Engineering 9

Types of Signals: Analog and Digital Signals – Modulation and Demodulation – Principles of Amplitude and Frequency modulation – Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fiber (Block Diagram)

L: 45 + T: 15, TOTAL: 60 PERIODS

TEXT BOOKS:

1. V.N. Mittle “Basic Electrical Engineering”, Tata McGraw Hill Edition, New Delhi, 1990.
2. V.K.Mehta “Principles of Power System”, S.Chand & Company Ltd, New Delhi, 2001.
3. R.S.Sedha,”Applied electronics”S.Chand&Co.,2006.

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition, (2006).
2. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press (2005).
3. Chakrabarti A, Soni M.L, Gupta P.V, Bhatnagar U.S , “ A Text book on Power System Engineering,” Dhanpat Rai & Co, New Delhi,2010.
4. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basc Electrical Electronics and Computer engineering”,Tata McGraw Hill, Second edition(2006).
5. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford Press(2005).
6. Mehta V K, “Principles of Electronics”,S.Chand&Company Ltd(1994).
7. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series McGraw Hill,(2002).
8. Premkumar N, “Basic Electrical Engineering”, Anuradha Publishers,(2003)

BE1102 **BASIC ENGINEERING – II** **3 1 0 4**

(Basic Mechanical and Civil Engineering)

Aim:

To introduce students to the profession of Mechanical and Civil Engineering and involve them in small-scale projects which would allow them to develop teamwork skills.

Objective:

- To understand the basic knowledge about the Mechanical components used in various application
- To be aware of the different fields of Civil Engineering, such as Surveying, Structural and Transportation Engineering.

Unit I – IC Engine and Boilers **9**

IC Engines: Working and comparison of two stroke and four stroke petrol and diesel engines - general description of various systems using block diagrams – air system, fuel system and ignition system. A brief description of CRDI, MPFI, GDI and Hybrid Vehicles.

Steam boilers: Classification – Cochran boiler, Babcock and Wilcox boiler, High pressure Boilers - Lamont, Benson boiler

Unit II – Compressor, Blower, Pumps, Power plants, Refrigeration and Air Conditioning **9**

Principles and fields of application of compressors - reciprocating and centrifugal, blower principle, pumps- reciprocating, and centrifugal pumps steam

Elementary ideas of hydroelectric, thermal and nuclear power plants

Refrigeration & Air Conditioning: Refrigerants, Vapor compression system, Vapor absorbtion system window air conditioning unit -types (general description only).

Unit III – Manufacturing Processes **9**

Basic Principles of Manufacturing processes – casting, metal forming - forging, rolling, Metal joining - soldering, Welding Machining processes- Lathe construction, operation - turning, taper turning, thread cutting

UNIT - IV Civil Engineering and Materials **9**

Introduction: Civil Engineering, branches of Civil Engineering, contribution to society, Scope,

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections, glass, wood, FRP

Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

Sub Structure: Types, Bearing capacity – Requirement of good foundations.

Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering– Types of Bridges and Dams

UNIT- V Civil Engineering structures

Building planning **9**

Residential, Institutional and industrial – functional requirements. – Basics of Interior Design and Landscaping.

Roads- benefits- classifications- traffic signs

Bridges-components od bridges-Dam-Purpose of reservoir.

Environmental Engineering: Protected water supply, water treatment methods-sewage treatment- Pollution-Types-causes-remedial measures

L: 45 + T: 15, TOTAL: 60 PERIODS

TEXT BOOKS

1) Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kr. Jain, "Basic Civil Engineering", Laxmi Pulications,
2) Roy and Choudhary, "*Elements of Mechanical Engineering*"
3) J Benjamin, "*Basic Mechanical Engineering*"

References

1. K.Venugopal and v prabu raja "*Basic Mechanical Engineering*" Anuradha Agencies
2. Shanmugam G and Palanichamy M.S "*Basic Mechanical Engineering*" Tata MC Graw Hill.
3. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering",Tata McGraw Hill Publishing Co., New Delhi, (1996).
4. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd. (1999).
5. Seetharaman S. "Basic Civil Engineering", Anuradha Agencies, (2005).

CS1172 COMPUTER PRACTICE LAB – II 0 1 2 2

Prerequisite: None

List of Experiments

1. Unix Commands **15**

Study of Unix OS - Basic Shell Commands - Unix Editor

2. Shell Programming **15**

Simple Shell program - Conditional Statements - Testing and Loops

3. C Programming on Unix **15**

Dynamic Storage Allocation-Pointers-Functions-File Handling

TOTAL: 45 PERIODS

Hardware / software requirements for a batch of 30 students

Hardware

1 UNIX Clone Server
33 Nodes (thin client or PCs)
Printer– 3 Nos.

Software

OS– UNIX Clone (33 user license or License free Linux)
Compiler- C

PH1172 PHYSICS LAB - II 0 0 2 1

LIST OF EXPERIMENTS

(Any five experiments)

1. Determination of focal length of convex lens- Newtons Rings
2. Determination of wavelength of mercury spectrum- Spectrometer grating
3. Determination of Viscosity of a liquid- Poiseuille's method.
4. Determination of hysteresis loss in a ferromagnetic material.
5. Determination of dielectric constant of a material at room temperature.
6. Determination of band gap of a semiconducting material.
7. Determination of Young's modulus- Uniform bending.

REFERENCE: Physics lab manual- Department of Physics

CH1172 CHEMISTRY LAB- II 0 0 2 1

LIST OF EXPERIMENTS

1. Determination of concentration of ferrous ion by potentiometry.
2. Conductometric titration of mixture of acids.
3. Estimation of copper in brass by EDTA method.
4. Determination of chloride content in water sample by argentometry.
5. Determination of acidity by titrimetry.
6. Determination of iron content in a solution by spectrophotometric method.
7. Determination of amount of water of crystallization in hydrated barium chloride.
8. Percentage purity of limestone (permanganometry)

Minimum five experiments shall be offered.

TOTAL: 45 PERIODS

REFERENCES:

1. J. Bassette, R. B. Deanen & G. H. Jeffery & J. Mendham, Text book of Vogel Quantitative Inorganic Analysis, ELBS, England.

BE1171 **BASIC ENGINEERING LAB – I** **0 0 4 2**

(Basic Electrical and Electronics Engineering Lab)

I. Electrical Engineering Lab

1. Study of Symbols, Cables and Earthing.
2. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
3. Fluorescent lamp wiring.
4. Stair case wiring / Lamp control from three different places/ Doctor Room control/ Go down control
5. Measurement of electrical quantities – voltage, current, power & computation of power factor in RLC circuit.
6. Measurement of energy using single phase energy meter.
7. Fan Wiring.

II. Electronics Engineering Lab

1. Study of Electronic components and equipments – Resistor, colour coding, Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT, NAND and NOR.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.
6. Characteristics of PN Junction diode
7. Characteristics of Zener diode
8. Voltage Regulator using Zener diode

TOTAL: 45 PERIODS

BE1172 **BASIC ENGINEERING LAB – II** **0 0 4 2**

(Basic Mechanical and Civil Engineering Lab)

OBJECTIVE:

Introduction to different materials in engineering practices with respect to their workability, formability & machinability with hand tools & power tools and to develop skills through hands on experience.

I. Mechanical Engineering Lab

1. Welding - Metal arc welding tools and equipment, exercises.
2. Fitting - Tools, operations, exercises, types of joints. (*Term work to include one job involving fitting to size, male-female fitting with drilling and tapping*.)

3. Foundry- Tools, preparation of moulding sand, patterns, cores, foundry exercises.
4. Carpentry- Tools, carpentry process, carpentry exercises, types of joints.
5. Assembly and Inspection.(*Assembly and Disassembly of some products, tools used. Videos of advancement in manufacturing technology. Inspection of various components using different measuring instruments.*)
6. Machine Tools I - Demonstration of drilling machine.
7. Machine Tools II - Demonstration of Lathe.
8. Study of Automobile and Power Transmission.
9. Wood working - Demonstration of wood working machinery and furniture manufacturing.(*Term work includes one job involving joint and woodturning*)

II. Civil Engineering Lab

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

(c) Demonstration of elementary surveying techniques

TOTAL: 45 PERIODS

List of equipment and components
(For a Batch of 30 Students)

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. **15 Sets.**
2. Carpentry vice (fitted to work bench) **15 Nos.**
3. Standard woodworking tools **15 Sets.**
4. Models of industrial trusses, door joints, furniture joints **5 each**
5. Power Tools:

(a) Rotary Hammer	**2 Nos**
(b) Demolition Hammer	**2 Nos**
(c) Circular Saw	**2 Nos**
(d) Planer	**2 Nos**
(e) Hand Drilling Machine	**2 Nos**
(f) Jigsaw	**2 Nos**

6. Surveying equipment for Demonstration

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

NOORUL ISLAM UNIVERSITY, KUMARACOIL

DEPARTMENT OF NANOTECHNOLOGY

B.TECH NANOTECHNOLOGY

SEMESTER III

CURRICULUM AND SYLLABUS

SI.No	Course Code	Course Title	L	T	P	C
THEORY						
1	MA1202	Numerical Methods and Transforms	3	1	0	4
2	NT1201	Basic Quantum Mechanics	3	1	0	4
3	NT1202	Introduction to Nanoscience & Technology	3	1	0	4
4	NT1203	Elements of Materials Science	3	1	0	4
5	NT1204	Synthesis of Nanomaterials	3	1	0	4
6	NT1205	Thermodynamics of Nanostructures	3	1	0	4
PRACTICAL						
7	NT1271	Nanomaterials Synthesis Laboratory	0	2	2	3
TOTAL			18	8	2	27

MA1202 NUMERICAL METHODS AND TRANSFORMS 3 1 0 4

AIM:

To impart the fundamental knowledge of Engineering Mathematics to the students in order to achieve some knowledge about the principles of Mathematics.

OBJECTIVE:

To develop the skill of the students in the areas of Transform techniques and numerical analysis. This will be necessary for their effective studies in a large number of Engineering applications namely communication systems, electro-optics and electromagnetic theory. This course will also serve as a prerequisite for post graduate and specialized studies in research.

UNIT I LINEAR AND NON LINEAR EQUATIONS 9

Solution of non-linear equations-Method of false position, Newton Raphson method , Fixed point iteration method – Solution of linear system of Equations-Direct methods: Gauss Elimination and Gauss-Jordan methods – Iterative methods: Gauss Jacobi and Gauss – Seidel methods- Inverse of a matrix by Gauss-Jordan method.

UNIT II FIRST AND SECOND ORDER ORDINARY DIFFERENTIAL EQUATIONS 9

Solution of first order differential equations -Single step Methods : Taylor's Series, Euler, Modified Euler methods and Fourth order Runge-Kutta method. Multi-step methods : Milne's and Adam's predictor and corrector methods

UNIT III FOURIER SERIES 9

Introduction-Fourier series– Dirichlet's conditions – Euler's formulae - General Fourier Series - Even and odd functions - Half range series - Parseval's identity –Harmonic Analysis

UNIT IV FOURIER TRANSFORMS 9

Fourier integrals - Fourier sine and cosine integral- Complex form of Fourier integral – Fourier transform pair – Fourier Sine and Cosine transforms pairs– Properties - Convolution theorem – Parseval's identity

UNIT V Z-TRANSFORMS 9

Z- transform – Properties -Standard results - Inverse Z-transform - convolution theorem– Evaluation of inverse Z - transform – Application –Second order difference equations

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics" – 40th Edition , Khanna Publishers, Delhi 2007.

2. Gerald, C.F, and Wheatley, P.O, “Applied Numerical Analysis”, Sixth Edition, Pearson Education Asia, New Delhi, 2002.

REFERENCES:

1. Ramana B.V., “Higher Engineering Mathematics” Tata McGraw-Hill Pub. Co. Ltd., New Delhi,2007
2. Veerarajan T., “Engineering Mathematics (for Semester III), Tata McGraw – Hill Publishing Company Limited, New Delhi .2007
3. Narayanan. S, Manicavachagam Pillay T.K.,Viswanathan. S, Ramaniah. G., “Advanced Mathematics for Engineering students”, Volumes II & III, Viswanathan. S(Printers and Publishers) Pvt Ltd. Chennai 2002
4. Balagurusamy, E., “Numerical Methods”, Tata McGraw-Hill Pub. Co. Ltd., New Delhi,1999
5. Kandasamy, P.Thilakavathy, K and Gunavathy, K. “Numerical Methods”. S.Chand and Co. New Delhi, 2008

NT1201 BASIC QUANTUM MECHANICS 3 1 0 4

PREREQUISITE: Differential Equations

AIM: This course covers the experimental basis of quantum physics, introduces wave mechanics, Schrödinger’s equation in a single dimension, and Schrödinger’s equation in three dimension

OBJECTIVE: To give a basic understanding of quantum mechanics

UNIT – I **9**

Overview, scale of quantum mechanics, boundary between classical and quantum phenomena, Planck’s constant, interference, Fermat’s principle of least time, deBroglie wavelength, Double slit experiment with electrons and photons, wave particle duality, Heinsberguncertainity, Wavefunctions and wavepackets, probability and probability amplitude, probability density, Thomson atom, Rutherford scattering, photoelectric effect

UNIT – II **9**

Bohr mode, hydrogen spectral lines – Bohr correspondence principle, shortcomings of Bohr model, Wilson – sommerfield quantization rules, Schrödinger equation in one dimension, infinite 1D well – Eigen functions as basis – interpretation of expansion coefficients, measurement operations and expectation values, time evolution of eigenstates, classical limit

UNIT – III **9**

Eigenfunctions of p and x, Dirac delta function, Fourier transform wavefunctions and operators in position and momentum space, commutators and uncertainty – motion of wavepackets, group velocity and stationary phase, boundary conditions, 1D problems:

Finite square well, delta function potential, more 1D problems, tunneling

UNIT – IV **9**

Harmonic oscillator: series method, Harmonic oscillator: operator method, Dirac notation, Schrödinger equation in 3D: Cartesian, spherical coordinates, Angular momentum, simultaneous eigenfunctions

UNIT – V **9**

Spherical harmonics, Hydrogen atom: Radial equation, Hydrogen atom: 3D eigenfunctions and spectrum, Entanglement

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Gasiorowicz, S. (1974). *Quantum physics*. New York: Wiley.
2. French, A. P., & Taylor, E. F. (1978). *An introduction to quantum physics*. New York: Norton.
3. Griffiths, D. J. (2005). *Introduction to quantum mechanics*. Upper Saddle River, NJ: Pearson Prentice Hall.

REFERENCE BOOKS

1. Liboff, R. L. (1980). *Introductory quantum mechanics*. San Francisco: Holden-Day.
2. Eisberg, R. M., &Resnick, R. (1985). *Quantum physics of atoms, molecules, solids, nuclei, and particles*. New York: Wiley.
3. Feynman, R. P., Sands, M. L., & Leighton, R. B. (1989). *The Feynman lectures on physics: Commemorative issue. Vol. 3*. Pasadena: California Institute of Technology.
4. Cohen-Tannoudji, C., Diu, B., &Laloë, F. (1977). *Quantum mechanics*. New York: Wiley.
5. Sakurai, J. J., & Napolitano, J. (2011). *Modern quantum mechanics*. Boston [u.a.: Addison-Wesley.

NT1202 INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY

3 1 0 4

PREREQUISITE: Nil

AIM: To learn the basic concepts of nanoscale phenomena at the atomic and molecular scale.

OBJECTIVE: The objective of this course is to know the revolutions behind nanotechnology and nanomachines. The student will be clear about the aspects of intermolecular forces, various properties and other phenomena seen in the nanomaterials.

UNIT – I **9**

Background to nanotechnology – Definition for Nanotechnology - Scientific Revolutions – Types of nanotechnology – Top-Down and Bottom-Up – Moore's Law – Basic problems and limitations – Opportunities at the Nanoscale

UNIT – II **9**

Intermolecular forces – hydrophobic – van der Waals – hydrogen bonding – electrical double layer, self-assembly, micelles

UNIT – III **9**

Introduction to 0D, 1D & 2D nanomaterials, introduction to quantum confinement, introduction to quantum mechanical tunneling.

UNIT – IV **9**

Influence of nanosize on electronic transport, ballistic conductivity, quantum hall effect, single domain magnetic nanoparticles, uniaxial anisotropy, superparamagnetism, magnetic thin films – shape anisotropy. Exchange anisotropy

UNIT – V **9**

Grain size effects on strength of metals- Optical properties of quantum dots and metal nanoparticles – Hall – petch relationship – super plasticity.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Ratner, M. A., & Ratner, D. (2003). *Nanotechnology: A gentle introduction to the next big idea*. Upper Saddle River, NJ: Prentice Hall.

REFERENCE BOOKS

1. Wilson, M. (2002). *Nanotechnology: Basic science and emerging technologies*. Boca Raton: Chapman & Hall/CRC.
2. Poole, C. P., & Owens, F. J. (2003). *Introduction to nanotechnology*. Hoboken, NJ: J. Wiley.

NT1203 ELEMENTS OF MATERIAL SCIENCE 3 1 0 4

PREREQUISITE: Nil

AIM: 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.

OBJECTIVE: To Understand electrical properties of materials, the properties and applications of semi conducting materials, general properties and applications of magnetic and dielectric materials, the behavior of materials on exposure to light, general properties and application of modern engineering and bio materials, and familiarized with

the concepts of Nano Science and Technology.

UNIT – I MECHANICAL PROPERTIES OF MATERIALS 9

Stress Strain diagram for different engineering materials – Ductile and brittle material – Tensile strength – Hardness – Impact strength – Fatigue – Creep – Fracture – Factors affecting mechanical properties.

UNIT – II ELECTRONIC AND PHOTONIC MATERIALS 9

Semiconductors- Intrinsic and Extrensic – Hall effect –Superconducting materials. Photonic materials: LED and LCD materials – Photo conducting materials – Nonlinear optical materials (elementary ideas) and their applications.

UNIT – III DIELECTRIC AND MODERN ENGINEERING MATERIALS 9

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

UNIT – IV MAGNETIC MATERIALS 9

Magnetic materials: Ferrites– perovskites, dia, para, ferro, ferri, antiferro - Giant Magneto Resistance (GMR).

UNIT – V BIO MATERIALS 9

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

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Kasap, S. O. (2006). *Principles of electronic materials and devices*. Boston: McGraw-Hill.
2. Van, V. L. H. (2008). *Elements of materials science and engineering*. Pearson.
3. Vijaya, M. S., &Rangarajan, G. (2004). *Materials science*. New Delhi: Tata McGraw-Hill.

REFERENCE BOOKS

1. Hummel, R. E. (1992). *Electronic properties of materials*. Berlin: Springer-Verlag.
2. Raghavan, V. (2004). *Materials science and engineering: A first course*. New Delhi: Prentice-Hall of India.
3. Wadhwa, A. S., &Dhaliwal, H. S. (2008). *A textbook of engineering material and metallurgy*. New Delhi: University Science Press.
4. Bhat, S. V. (2002). *Biomaterials*. Boston, Mass. [u.a.: Kluwer Academic [u.a..
5. Wilson, M. (2004). *Nanotechnology: Basic science and emerging technologies*. Boca Raton: Chapman & Hall/CRC.

NT1204 SYNTHESIS OF NANOMATERIALS 3 1 0 4

PREREQUISITE: Basic Nanoscience

AIM: To study the basics of nanostructured materials and the various methods to prepare 0D, 1D and 2D nanomaterials.

OBJECTIVE: The objective of this course is to understand the basic concepts of nanostructured materials, principle behind the various methods used to synthesize/prepare nanomaterials, understanding the various processes involved in the preparation of the nanomaterials.

UNIT – I INTRODUCTION 9

Introduction – various preparation techniques – basic concepts of nanostructure materials – nucleation: surface nucleation growth-Homogeneous Nucleation- Heterogeneous Nucleation – DLVO theory – Bottom up and top down.

UNIT – II GENERAL SYNTHESIS METHODS 9

thermal evaporation – Spray Pyrolysis - molecular beam epitaxy – pulsed laser deposition – sputter deposition – chemical vapour deposition – layer-by-layer growth and ultra-thin films – chemical solution deposition, electro deposition, pyrolytic synthesis, plasma arcing electro deposition

UNIT – III LITHOGRAPHY 9

Clean room – optical lithography – Ultraviolet lithography – ion beam lithography – electron beam lithography

UNIT – IV SOL GEL METHODS 9

Sol-gel processing - fundamentals of sol-gel process – sol-gel synthesis methods for oxides –other inorganics and nano composites – the Pecheni method - polymer nano composites

UNIT – V SELF ASSEMBLY 9

Self-assembly, self-assembled monolayers (SAMs). Langmuir-Blodgett (LB) films, - Templated synthesis - Biomimetic Approaches

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Cushing, B. L., Kolesnichenko, V. L., & O'Connor, C. J. (January 01, 2004). Recent Advances in the Liquid-Phase Syntheses of Inorganic Nanoparticles. *Chemical Reviews, 104,* 9, 3893.
2. Ajayan, P. M., Schadler, L. S., & Braun, P. V. (2003). *Nanocomposite science and technology*. Weinheim: Wiley-VCH.

REFERENCE BOOKS

1. Cao, G. (2004). *Nanostructures &nanomaterials: Synthesis, properties & applications*. London: Imperial College Press.
2. Zhang, J. Z. (2003). *Self-assembled nanostructures*. New York: Kluwer Academic/Plenum Publishers.
3. Cushing, B. L., Kolesnichenko, V. L., & O'Connor, C. J. (January 01, 2004). Recent Advances in the Liquid-Phase Syntheses of Inorganic Nanoparticles. *Chemical Reviews, 104,* 9, 3893.
4. Inoue, A., & Hashimoto, K. (2001). *Amorphous and nanocrystalline materials: Preparation, properties, and applications*. Berlin: Springer.

NT1205 THERMODYNAMICS OF NANOSTRUCTURES 3 1 0 4

PREREQUISITE: Nil

AIM: To enable to apply the understanding of thermodynamics and kinetics in nanotechnology

OBJECTIVE: To learn the concepts of classical and statistical thermodynamics, and kinetics, and the difference between the thermodynamics of bulk systems and small systems.

UNIT – I LAWS OF THERMODYNAMICS 9

Classification of thermodynamic systems, Variables, Equation of State-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 – Enthalpy

UNIT – II CHEMICAL EQUILIBRIA AND PHASE EQUILIBRIA 12

Second Law of Thermodynamics – Entropy and Clausius inequality – Third Law of Thermodynamics. Criteria for spontaneous change – Gibbs free energy – Chemical equilibrium – Fundamental equations of Thermodynamics – Maxwell relations

UNIT – III THERMODYNAMICS OF FLUIDS 6

Multicomponent systems – chemical potential – Equilibrium constant – Gibbs-Helmholtz equation – Van't Hoff equation – Phase equilibria – one component – Clausius- Clapeyron equation Problem – two components – Gibbs Phase rule – Ideal solutions – Non-ideal solutions – Colligative properties.

UNIT – IV CHEMICAL KINETICS 7

Introduction to reaction kinetics – Complex reactions and mechanisms – Steady-state and equilibrium approximations – Chain reactions – Temperature dependence, Ea, catalysis – Enzyme catalysis

UNIT – V THERMODYNAMICS OF SMALL SYSTEMS 11

Surfaces and curvature – surface excess properties – surface tension – capillarity effects on phase diagrams – Gibbs –Wulff construction - adsorption at surfaces – Gibbs adsorption equation – nanoscale grain nucleation – film growth.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Atkins, P. W. (1978). *Physical chemistry*. San Francisco: W.H. Freeman.

REFERENCE BOOKS

1. Castellan, G. W. (1964). *Physical chemistry*. Reading, Mass: Addison-Wesley Pub. Co.
2. Hill, T. L. (1963). *Thermodynamics of small systems*. New York: W.A. Benjamin.
3. Houston, P. L. (2001). *Chemical kinetics and reaction dynamics*. Dubuque, Iowa: McGraw-Hill.
4. Mansoori, G. A. (2005). *Principles of nanotechnology: Molecular-based study of condensed matter in small systems*. Hackensack, N.J: World Scientific.

NT271 NANOMATERIAL SYNTHESIS LABORATORY 0 2 2 3

1. Synthesis of Silver (Ag) nanoparticles
2. Synthesis of Nickel (Ni) nanoparticles
3. Synthesis of Nickel oxide (NiO) nano-structured materials
4. Synthesis of Zinc Selenide (ZnSe) quantum dots
5. Synthesis of ZrO2 nano-sized materials
6. Fabrication of Co/CoO nanocomposite materials
7. Synthesis of polymer hydrogel
8. Synthesis of multi component ceramic nanoparticles

TOTAL: 45

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DEPARTMENT OF NANOTECHNOLOGY

B.TECH NANOTECHNOLOGY

SEMESTER IV

CURRICULUM AND SYLLABUS

SI.No	Course Code	Course Title	L	T	P	C
THEORY						
1	MA1206	Random Processes	3	1	0	4
2	MS1201	Environmental Science	3	0	0	3
3	NT1206	Solid State and Surface Science	3	1	0	4
4	NT1207	Nanobiotechnology	3	0	0	3
5	NT1208	Nanobiomaterials	3	0	0	3
6	NT1209	Basic Characterization Techniques	3	1	0	4
PRACTICAL						
7	NT1272	Nanobiotechnology Laboratory	0	2	2	3
8	NT1273	Basic Characterization Laboratory	0	2	2	3
TOTAL			18	7	4	27

MA1206 RANDOM PROCESSES 3 1 0 4

AIM:

The probabilistic models are applicable in all areas of Science and Engineering. This course provides necessary mathematical support to solve real life problems.

OBJECTIVE:

To have the fundamental knowledge of basic probability concepts, the standard distributions ,the classification of processes and spectral density which can describe real life phenomena.

UNIT I PROBABILITY AND RANDOM VARIABLE 9

Axioms of probability - Conditional probability – Independent Events - Total probability – Baye's theorem- Random variable - Probability mass functions - Probability density functions -Distribution functions- Properties – Expectation – Moments - Moment generating function and its propertie.

UNIT II STANDARD DISTRIBUTIONS 9

Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties (Problems only)– Central Limit Theorem.(without proof)

.

UNIT III TWO DIMENSIONAL RANDOM VARIABLES 9

Joint distributions - Marginal and Conditional distributions – Covariance - Correlation and Regression.

UNIT IV CLASSIFICATION OF RANDOM PROCESSES 9

Definition and Examples - first order, second order, strictly stationary, wide – sense stationary and Ergodic processes - Markov process - Binomial, Poisson and Gaussian processes - Sine wave process.

UNIT V CORRELATION AND SPECTRAL DENSITIES 9

Auto Correlation - Cross Correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function - Linear time invariant system - System transfer function –Linear systems with random inputs – Auto correlation and cross correlation functions of input and output – Fundamental theorem of power spectral density.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS:

1. Ross, S., "A First Course in Probability", Fifth edition, Pearson Education, Delhi, 2002 (Chapters 2 to 8)
2. Peebles Jr. P.Z., "Probability Random Variables and Random Signal Principles", Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2002, (Chapters 6, 7 and 8).

REFERENCES:

1. Henry Stark and John W. Woods "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Third edition, Delhi, 2002.
2. Veerarajan. T., "Probabilitiy, Statistics and Random Processes", Tata McGraw-Hill Publications, Second Edition, New Delhi, 2002.
3. Ochi, M.K. , "Applied Probability and Stochastic Processes", John Wiley & Sons, New York, 1990.
4. Dougles C. Montgomery and George C.Runger, "Applied Statistics and Probability for Engineers", 3rd Edition , John Wiley & Sons (2004)

MS1201 ENVIRONMENTAL SCIENCE 3 0 0 3

OBJECTIVES

- To provide the students about general aspirants of environment and ecology, the environment pollution and the current social issues.

UNIT I: NATURE OF ENVIRONMENT STUDIES AND NATURAL RESOURCES 9

Environment studies- definition- multi disciplinary nature – scope and importance- need for public awareness- Natural resources- Forest resources- energy resources- food Resources- water resources – land resources - mineral resources

UNIT II: ECO SYSTEMS AND BIO-DIVERSITY 9

Concept and component of eco systems- producer, consumer, decomposer- structure and function of eco system- food chain and food web- energy flow model- aquatic eco system- forest eco system- desert eco system- pyramid of biomass- ocean eco system- grass land eco system- Bio diversity in India- value of bio diversity- biodiversity threatens- biodiversity protection- In-situ and Ex-situ conservation.

UNIT III: ENVIRONMENTAL POLLUTION 9

Meaning of environmental pollution- air pollution- acid rain – global warming- water pollution- water pollution control- soil pollution- urban waste and soil pollution- marine pollution- noise pollution- thermal pollution- solid and hazardous waste management- waste disposal methods- solid waste and India- natural disaster and disaster management. Low carbon perspectives, Energy savings, Safety and Security

UNIT IV: SOCIAL ISSUES AND THE ENVIRONMENT 9

Unsustainable to sustainable development- sustainable development in India- water conservation, watershed management and water harvesting- environmental ethics- role of

engineer in environmental protection- economic aspects of environment.

UNIT V: HUMAN POPULATION AND ENVIRONMENT 9

Population growth- distribution of population- factors affecting variation in population- theories of population- future of human population- family welfare programme- HIV and AIDS- environment and human health- human rights- value education- women and child welfare.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Cunnigham & saigo: 'Environmental science: A global concern' 4th Ed.W.c. Brown Publishers. USA. 1997
2. Chauhan A.S, 'Environmental studies' 2nd revised ed. Jain Brother publishers, New Delhi, 2004,.

REFERENCE BOOKS

1. Benny Joseph : 'Environmental Science and Engineering', Tata McGraw- Hill Publication, 2006.
2. Siddique K.A. : Elements of Ecology and Environmental Pollution, 1st Ed. Kushal Publication, Varanasi, 2002.

NT1206 SOLID STATE AND SURFACE SCIENCE 3 1 0 4

AIM: The aim of this course is to study the fundamental aspects of solid state materials and their applications in various technology fields

OBJECTIVE: The course is designed to study the fundamentals of solid state physics, material synthesis, property studies with special emphasize on semiconductor materials, and applications of solid state material in various technology fields.

UNIT – I STRUCTURE OF SURFACES 9

Ideal Surfaces – Surfaces in porous solids, oxides, and alloys – Biomaterial Surfaces – Clean Surface Reconstruction and Relaxation – Adsorbate structure and adsorbate induced reconstruction.

UNIT – II CRYSTAL PHYSICS 9

Crystal lattice, unit cell and crystal systems, crystal planes and Miller indices; Diffraction- Bragg's law-Reciprocal lattice-X-ray diffraction methods--Rotation, Laue and powder methods, Brillouin Zones.Examples of simple crystal structures –NaCl and ZnS, Different types of solids-ionic, covalent and metallic.

UNIT – III PROPERTIES OF SOLIDS 9

Absorption and emission of radiation in ionic crystals and semiconductors, Electron luminescent materials, Nonlinear optical materials. Dielectric, piezo electric and ferro electric properties of materials.Concept of phonon and Thermal conductivity, Conductivity and super conductivity.Fundamentals of magnetic materials, Dia, Para,

Ferro, Antiferro, Ferri, Superpara magnetic Materials.

UNIT – IV ELECTRONS IN CRYSTALS 9

Translational symmetry – Periodic functions – Properties of reciprocal lattice – Bloch's theorem – Reduction to a Brillouin zone – Boundary conditions – Free electrons – Diffraction of valence electrons – Nearly free electron model – Density of States, k-point sampling

UNIT – V INTERFACES 9

Crystallography of surfaces - Metal-metal interfaces – Metal-Semiconductor interfaces – Applications based on interfaces: Quantum Hall effect – Photovoltaic effect – Semiconductor laser – and Light emitting diodes.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Azároff, L. V. (1960). *Introduction to solids*. New York: McGraw-Hill.
2. West, A. R., & West, A. R. (1988). *Basic solid state chemistry*. Chichester [West Sussex: Wiley.
3. Kittel, C. (1966). *Introduction to solid state physics*. New York: Wiley.
4. Pillai, S. O. (2005). *Solid state physics*. New Delhi: New Age International.

REFERENCE BOOKS

1. Callister, W. D. (2006). *Materials science and engineering: An introduction*. Hoboken, NJ: John Wiley & Sons.
2. Ropp, R. C. (2003). *Solid state chemistry*. Amsterdam: Elsevier.
3. Ehrenreich, H., & Turnbull, D. (1991). *Semiconductor heterostructures and nanostructures*. Boston, Mass: Academic Press.
4. Ashcroft, N. W., &Mermin, N. D. (1976). *Solid state physics*. New York: Holt, Rinehart and Winston.
5. Bhattacharya, D. K., & Sharma, R. (2007). *Solid state electronic devices*. New Delhi: Oxford University Press.

NT1207 NANOBIOTECHNOLOGY 3 0 0 3

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

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

UNIT – I CELL BIOLOGY 9

Structure and organization of prokaryotic and eukaryotic cell – cellular organelles – tissues and organs – The cell cycle: Mitosis and Meiosis – transport processes across cell membrane – active transport – passive transport – facilitated transport – signal transduction

UNIT – II CHEMISTRY OF BIOMATERIALS 9

Amino acids – proteins – carbohydrates – DNA – RNA – lipids - bio membrane

UNIT – III MOLECULAR BIOLOGY 9

Introduction to Gene – DNA structure – protein structure – central dogma: DNA replication – transcription – translation – mutation

UNIT – IV BIOMIMETIC NANOMATERIALS 9

Biogenic Nanoparticles – Biomineralization – Magnetosomes – S–layer proteins – bionano molecular motors – Nanostructures in marine organisms – DNA based Nanostructures - Protein based Nanostructures – Quantum dots

UNIT – V APPLICATIONS 9

Nanoparticles for Delivery of Drugs, DNA, or RNA - Nanoparticles in Cancer Therapy - Assembly of Nanocrystals by Microorganisms - Ion Channel Nanosensors - Detection of Viruses by Nanowires - DNA Mechanical Nanodevices - Controlled Denaturation of DNA by Gold Nanoparticles - Controlled Change of Protein Shape by DNA

TOTAL: 45 PERIODS

TEXT BOOKS

1. Lodish, H. F. (2000). *Molecular cell biology*. New York: W.H. Freeman.
2. Karp, G., & Geer, P. (2005). *Cell and molecular biology: Concepts and experiments*. Hoboken, NJ: John Wiley.

REFERENCE BOOKS

1. Niemeyer, C. M., &Mirkin, C. A. (2004). *Nanobiotechnology: Concepts, applications, and perspectives*. Weinheim: Wiley-VCH.
2. Wilson, M. (2004). *Nanotechnology: Basic science and emerging technologies*. Boca Raton: Chapman & Hall/CRC.
3. Schmid, G. (2004). *Nanoparticles: From theory to application*. Weinheim: Wiley-VCH.
4. Mirkin, C. A., & Niemeyer, C. M. (2007). *Nanobiotechnology II: More concepts and applications*. Weinheim: Wiley-VCH.

NT1208 NANOBIOMATERIALS 3 0 0 3

PREREQUISITE: basic knowledge of biology and materials science

AIM: This course covers the properties of materials, immunological aspects, and biochemistry

OBJECTIVE: To gain an understanding of the application of materials in biological systems, especially prosthetic applications.

UNIT – I PROPERTIES 8

Introduction and Historical background – Mechanical Properties of materials: Yield Strength – Tensile Strength – Plastic deformation – Brittleness – Hardness – Toughness – Creep, Viscous Flow, Fatigue – Glass transition – Surface Properties: Surface Energy, Critical Surface Tension, Hydrophobic interaction.

UNIT – II MATERIALS USED IN MEDICINE 11

Metals and Alloys: Stainless steel – Ti based alloys, Shape memory alloys – Synthetic Polymers: PE, PVC, PTFE, Nylon-6, Poly Urethane, PMMA, PLA, PGA – Hydrogels: Biodegradable materials (Bioresorbable materials) – Ceramic Materials: Al2O3, Hydroxyapatite – Bioactive glass – Natural materials: Collagen, Gelatin

UNIT – III BODY RESPONSE TO BIOMATERIALS 12

Proteins – Cells – Tissues – Inflammation, wound healing and Foreign body response – Immunne system – Innate immunity – Specific Acquired immunity – Systemic toxicity and hyper sensitivity – Blood coagulation – Tumorigenesis – Infection

UNIT – IV DEGRADATION OF BIOMATERIALS 5

Degradation of polymers – Degradation of metals and ceramics – Mechanical breakdown – Pathogenic calcification.

UNIT – V APPLICATIONS OF BIOMATERIALS 9

Biomaterials for Drug Delivery – Nanoparticles in Cancer Treatment – Biosensing Materials – Artificial blood vessels – Artificial heart valves – Orthopedic applications – Dental implants – Testing of biomaterials.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ratner, B. D. (2004). *Biomaterials science: An introduction to materials in medicine*. Amsterdam: Elsevier Academic Press.
2. Park, J. B., &Bronzino, J. D. (2002). *Biomaterials: Principles and applications*. Boca Raton: CRC Press.

REFERENCE BOOKS

1. Ajayan, P. M., Schadler, L. S., & Braun, P. V. (2003). *Nanocomposite science and technology*. Weinheim: Wiley-VCH.
2. Lanza, R. P., Langer, R. S., &Vacanti, J. (2000). *Principles of tissue engineering*. San Diego, CA: Academic Press.

NT1209 BASIC CHARACTERIZATION TECHNIQUES 3 1 0 4

PREREQUISITE: Nil

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

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

UNIT – I SIZE CHARACTERIZATION 9

Particle size: Dynamic Light scattering & Disc centrifuge method – Surface area: Nitrogen Adsorption analysis – BET surface area. Introduction to SPM – AFM - STM – MFM

UNIT – II SPECTROSCOPY 9

Introduction to absorption and emission of radiation - Natural line broadening - Doppler broadening - Dispersing elements: Prism and gratings - Fourier transformation and interferometers - Molecular symmetry - Rotational spectroscopy – Rotational Raman spectroscopy - Vibrational spectroscopy - Vibration–Raman spectroscopy

UNIT – III STRUCTURAL AND THERMAL CHARACTERIZATION 9

Bragg Equation - Atomic scattering factor – structure factor – X-ray diffraction - Space lattice – Bravais lattice – Miller indices – Crystal systems - Debye ScherrerEquation - Thermal analysis Specific heat capacity – TG – DTA – DSC

UNIT – IV ELECTRICAL CHARACTERIZATION 9

Measurement of dielectric constant –dielectric loss - electronic polarizability – ionic polarizability - Hall effect – Hall coefficient measurement – electrical conductivity – four probe measurement – super conductivity

UNIT – V MAGNETIC CHARACTERIZATION 9

Magnetic susceptibility – magnetic hysteresis loop – vibrating sample magnetometer – Introduction to SQUID magnetometer – giant magneto resistance (GMR)

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Willard, H. H., Merritt, L. L., & Dean, J. A. (1965). *Instrumental methods of analysis*. Princeton, N.J: Van Nostrand.
2. Kalantar-zadeh, K., & Fry, B. N. (2008). *Nanotechnology-enabled sensors*. New York: Springer.

REFERENCE BOOKS

1. Elzey, S. R. (2010). *Characterization of nanomaterials: Environmental, health, and safety studies*. Saarbrucken, Deutschland: LAP Lambert Academic Pub.
2. Ezawa, Z. F. (2000). *Quantum Hall effects: Field theoretical approach and related topics*. Singapore: World Scientific.
3. Lakowicz, J. R. (1983). *Principles of fluorescence spectroscopy*. New York: Plenum Press.
4. Mattox, D. M. (2010). *Handbook of physical vapor deposition (PVD) processing*. Norwich, N.Y: William Andrew.
5. Cao, G. (2004). *Nanostructures &nanomaterials: Synthesis, properties & applications*. London: Imperial College Press.

NT1272 BIOTECHNOLOGY LABORATORY 0 2 2 3

1. Observation of Polytene chromosomes from Chironomous larva
2. Cell division in plant cells (Allium cepa)
3. Isolation of genomic DNA from plant cells
4. Methylene Blue DNA Staining
5. Restriction enzyme digestion
6. Gel Electrophoresis (Agarose& Polyacrylamide)
7. Estimation of DNA purity and Quantification
8. Separation of amino acids by Thin Layer Chromatography

TOTAL: 45 PERIODS

NT1273 BASIC CHARACTERIZATION LABORATORY 0 2 2 3

1. Crystallinity and average particle size determination by X-Ray powder diffraction technique
2. Particle size analysis by Centrifugal Sedimentation and Dynamic Light Scattering techniques
3. Identification and quantification of compounds by UV-Vis Spectroscopy technique
4. FTIR Spectroscopy technique- Identification of chemical bonds
5. Raman Spectroscopy-Structure elucidation of the compounds
6. Weight loss and thermal effects by Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC)
7. Calculation of Surface area of Nanostructures by BET method
8. Cyclic voltammetry

TOTAL: 45 PERIODS

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DEPARTMENT OF NANOTECHNOLOGY

B.TECH NANOTECHNOLOGY

CURRICULUM & SYLLABUS

SEMESTER V

SI.No	Course Code	Course Title	L	T	P	C
THEORY						
1	MS1202	Professional and Business Ethics	3	0	0	3
2	NT1210	Thin Film Technologies	3	0	0	3
3	NT1211	Carbon Nanostructures and Applications	3	1	0	4
4	NT1212	Nanomedicine	3	1	0	4
5	NT1213	Analytical Spectroscopy	3	1	0	4
6	NT1214	Physics and Chemistry of Polymers	3	1	0	4
PRACTICAL						
7	NT1274	Thin Film Laboratory	0	1	2	2
8	NT1275	Computational and Simulation Laboratory	0	1	2	2
TOTAL			18	6	4	26

MS1202 PROFESSIONAL AND BUSINESS ETHICS 3 0 0 3

OBJECTIVES

• To create an awareness on Engineering Ethics and Human Values.
• To instill Moral and Social Values and Loyalty
• To appreciate the rights of Others.

UNIT I: HUMAN VALUES 9

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

UNIT II: ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT III: ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

UNIT IV: SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - Professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V: GLOBAL ISSUES 9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - oral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India, etc.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York.1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).

2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi,2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

NT1210	THIN FILM TECHNOLOGIES	L	T	P	C
		3	0	0	3

Prerequisite: Nil

AIM: To provide a basic knowledge on the fundamental aspects of thin film technology

OBJECTIVE: For a basic understanding on thin film technology, the course is designed to study the mechanism of formation of thin film, various fabrication methods, physic-chemical characterization and property studies of thin films, and thin film-based applications.

UNIT – I THIN FILMS& PLASMAS BASICS **9**

Introduction – Substrate surfaces – Electronic Nature of Surfaces – Adsorption reactions on solid surfaces - Plasma Potential – Electronic nature of Surfaces - Floating Potential – Sheath – Space Charge limited current flow – Processing plasmas – DC plasma – RF plasma – plasma in the presence of Magnetic field – Magnetrons.

UNIT – II THIN FILM FABRICATION METHODS **9**

Physical methods: PVD, Thermal evaporation, laser beam evaporation. Sputtering Methods: DC sputtering, RF sputtering - Chemical Methods: CVD - Molecular beam epitaxy - Homoepitaxy and heteroepitaxy, Lattice matching epitaxy and domain matching epitaxy - SAM – LB film

UNIT III STRESS AND DELAMINATION **9**

Film microstructures: Epitaxial Films, Polycrystalline Films, Origins of Film stress - Classification of film stress - Stress in epitaxial films - Stress concentration near a film edge A membrane film - Example: An equation governing interfacial shear stress - More general descriptions of edge stress - Fracture mechanics concepts: Energy release rate and the Griffith criterion - Crack edge stress fields - Phase angle of the local stress state - Driving force for interface delamination -

UNIT – III CHARACTERISTION OF FILMS **9**

Film thickness – Optical Methods, Interferometry, Elipsometry, Profilometry - uniformity – poly crystalline thin film – grain boundaries – surface energies – substrate for thin films and adhesion – voids, pinholes, grain size – film deposition rate – surface roughness

UNIT – V APPLICATIONS OF THIN FILMS **9**

Sensors, Anti-abrasive Coatings, Solar Cells, GMR devices. Magnetic Thin Films –

MOSFET –Anti Reflection Coating

TOTAL: 45 PERIODS

TEXT BOOKS

1. Elshabini-Riad, A., & Barlow, F. D..*Thin film technology handbook*. New York: McGraw-Hill, (1997).
2. Ohring, M. *The materials science of thin films*. Boston: Academic Press, (1992).
3. Thin film materials: Stress, Defect formation and surface evolution, L. B. Freund, S. Suresh, Jan 2003.

REFERENCE BOOKS

1. Chopra, K. L. *Thin film phenomena*. New York: McGraw-Hill, (1969).
2. Vossen, J. L., & Kern, W.,*Thin film processes*. New York: Academic Press, (1978).
3. Bunshah, R. F.,*Handbook of deposition technologies for films and coatings*. Park Ridge, N.J: Noyes Publications, (1994).
4. Dobkin, D. M., &Zuraw, M. K.,*Principles of chemical vapor deposition*. Dordrecht ; Boston: Kluwer Academic Publishers, (2003).
5. Smith, D. L., & Includes, *Thin film deposition and applications*. New York: McGraw-Hill, (1995).

NT1211	CARBON NANOSTRUCTURES AND APPLICATIONS	L	T	P	C
		3	1	0	4

UNIT – I CARBON **9**

Carbon - an element – atomic structure – Different hybridization – Chemical structure and Nature of carbon allotropes: Diamond, Graphite, Graphene, carbon clusters, Carbon nanostructures: carbon nanotubes, Diamond like carbon, carbon, and aerogel - porous carbon, activated carbon, carbon black, CNT, Nanotube Peapods and Graphene.

UNIT – II FULLERENES **9**

The structure of fullerenes; Synthesis (CVD and Arc Discharge), and purification of fullerenes; different sized fullerenes - doped fullerenes; Electrical and magnetic properties – electronic structure of fullerene – fullerene functionalization.

UNIT – III CNT **9**

Single-walled carbon nanotubes and multiwalled carbon nanotubes, Structure – zigzag, armchair, chiral, single and multiwall CNT - Synthesis and purification of carbon nanotubes: CVD, Arc Discharge, High Pressure Carbon Monoxide, Laser Ablation - mechanism of growth – electron transport – mechanical property – electronic structure of CNT.

UNIT – IV GRAPHENE **9**

Graphene Oxide structure and properties – Hummers method - electronic structure – electron transport –Graphene Oxide Reduction – reduced Graphene Oxide - few layer graphene - Micromechanical Exfoliation – from SiC —Graphene growth on surfaces (CVD) – graphene&graphene oxide functionalization.

UNIT – V APPLICATIONS **9**

Electrode material for super capacitor – Energy storage (Graphite) – Hydrogen Storage (CNT, Aerogels) - thermal protection systems (C-C composites) – fuel cell – Structural Stability (carbon fiber composite) – diamond like film (Abrasive) – Sensors and Biosensors (Graphene&Graphene Oxides)- graphene intercalated compounds.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Langa, F., Nierengarten, J.-F., & Royal Society of Chemistry (Great Britain). *Fullerenes: Principles and applications*. Cambridge: Royal Society of Chemistry, (2007).
2. Gaponenko, S. V.,*Optical properties of semiconductor nanocrystals*. Cambridge, UK: Cambridge University Press, (1998).
3. Shonaike, G. O., &Advani, S. G.,*Advanced polymeric materials: Structure property relationships*. Boca Raton, FL: CRC Press, (2003).

REFERENCE BOOKS

1. Dresselhaus, M. S., Dresselhaus, G., &Eklund, P. C.,*Science of fullerenes and carbon nanotubes*. San Diego: Academic Press, (1996).
2. Goddard, W. A.,*Handbook of nanoscience, engineering, and technology*. Boca Raton: CRC Press, (2003).
3. In Nalwa, H. S., *Nanostructured Materials and Nanotechnology: Concise Edition*. (Referex Mechanical Engineering and Materials.) San Diego: Academic Press [Imprint.] (2001).

NT1212	NANOMEDICINE	L	T	P	C
		3	1	0	4

Unit I – Nanocarriers **9**

Nanocarriers: various nanoformulations to nanomedicine – viruses as nanocarriers – polymeric nanocarriers – lipid-based nanocarriers – dendrimers –CNT as nanocarrier– inorganic nanoparticles – PEBBLE – nanoplexes – new-generation nanocarriers. Multifunctionalities for diagnostics and therapy (optical, magnetic, thermal, radioactive, biological agents).

Unit II – Nanotechnology for Infectious Diseases **9**

Pathogen infections and nanoparticle-based approaches. HIV: diagnosis, vaccines and antimicrobial drugs, therapy. Influenza: diagnosis, vaccines, therapy. Tuberculosis: diagnosis, TB vaccine, therapy. Malaria: diagnosis, vaccines, therapy.

Unit III – Nanotechnology for Cancer and neurodegenerative diseases **9**

Benefits of cancer nanotechnology – circulating tumour cells – chemotherapy – cancer gene therapy – photodynamic therapy – magnetic therapy – photothermal therapy – neutron capture therapy – laser assisted therapy- therapy for brain tumours, Alzheimers and

Parkinsons Syndromes.

Unit IV –Nanoparticles for targeting and bioimaging 9

Biotargeting: Need for targeting – targeted biological sites – targeting strategies – targeting groups. Biomedical imaging techniques: Optical (Fluorescence, Quantitative FRET microscopy), Magnetic Resonance Imaging, X-Ray CT imaging, Ultrasound imaging-Contrast agents.

Unit V – Tissue Engineering and Gene therapy 9

Nanotechnology in tissue engineering – nanofibres for tissue engineering – nanoparticle delivery of biomolecules – magnetically assisted tissue engineering – tissue/organ printing. Gene therapy: Principles, steps and impact – methods of gene delivery. Gene augmentation and gene silencing therapy.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOK

1. Paras N. Prasad, Introduction to Nanomedicine and Nanobioengineering, John Wiley &sons, 2012.

REFERENCE BOOKS

1. Goodsell, D. S. *Bionanotechnology: Lessons from nature*. Hoboken: Wiley-Liss, 2004.
2. Rosenthal, S. J., & Wright, D. W. *Nanobiotechnology protocols*. Totowa, N.J: Humana Press., 2005.
3. The Handbook of Nanomedicine Kewal K. Jain, Humana Press, 2008.
4. Ed.JohnP.Fisher, Antonios G. Mikos and Joseph D. Bronzo, Tissue Engineering, 2007.

NT1213	ANALYTICAL SPECTROSCOPY	L	T	P	C
		3	1	0	4

Prerequisite: Nil

Aim: To be familiar with the various characterization techniques used to characterize the various properties of nanomaterials

Objective: The objective of this course is to know the principle and working procedure of the various nano-characterization techniques that serve as important tools to describing the properties of nanomaterials and nanofeatures.

UNIT – I ABSORPTION SPECTROSCOPY 9

Absorption spectroscopy - Spectrum of the hydrogen atom - Classification of electronic states - Electronic selection rules –Atomic absorption spectroscopy - interaction of radiation with matter - fundamental laws of spectroscopy – Beer Lambert's law – Ringbom's plot – SPR evaluation of Gold and Silver Nanoparticles- Mass Spectroscopy.

UNIT – II EMISSION SPECTROSCOPY 9

Principle and Instrumentation of emission spectroscopy - Atomic emission spectroscopy,

Inductively coupled plasma spectroscopy, Molecular Luminescence spectroscopy, specific to nanomaterial analysis – Emission of ZnO and CdS Nanomaterials – Band gap measurement- Circular Dichroic spectrum- Optical Rotatory Dispersion.

UNIT – III MAGNETIC RESONANCE SPECTROSCOPY 9

Principles of NMR – NMR Spectra – NMR instrumentation – Chemical Shift - spin-spin splitting- Applications of NMR – FT-NMR -2D NMR– Principle and Instrumentation of Proton and Carbon NMR - Instrumentation of ESR – Applications of ESR – Spin labelling of ESR – Characterization of metal complexes by ESR

UNIT – IV ELECTRON SPECTROSCOPY 9

Principles of electron spectroscopy – Auger emission spectroscopy – instrumentation – applications of auger electron spectroscopy – electron spectroscopy for chemical analysis – chemical shifts in ESCA – analytical applications of ESCA

UNIT – V X-RAY AND RAMAN SPECTROSCOPY 9

Nature and Production of x-rays – X-ray absorption spectroscopy – X-ray diffraction – Bragg Law – Methods of x-ray study – laue pattern – powder method – Lattice Indexing - Raman spectroscopy – stokes and antistoke lines – Resonance Raman scattering – Qualitative analysis - Applications

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Khopkar, S. M. (2012). *Basic concepts of analytical chemistry*. Tunbridge Wells: New Academic Science.
2. Hollas, J. M. (2004). *Modern spectroscopy*. Chichester: Wiley.
3. Mitra, S. (1989). *Fundamentals of optical, spectroscopic, and X-ray mineralogy*. New York: Wiley.

REFERENCES

1. Andrews, D. L., Davies, A. M. C., & International Conference Spectroscopy Across the Spectrum: Techniques and Applications of Analytical Spectroscopy. (1995). Frontiers in analytical spectroscopy. Cambridge, UK: Royal Society of Chemistry.
2. Bansal, K. (2000). Analytical spectroscopy. New Delhi: Campus Books.
3. Progress in analytical spectroscopy. (1986). Oxford: Pergamon Press.

NT1214 PHYSICS AND CHEMISTRY OF POLYMERS 3 1 0 4

Prerequisite: Nil

Aim: To provide a fundamental understanding on polymers and polymer nanocomposites

Objective: The course is designed to study certain selected topics from the broad area of polymer and polymer science, which include various polymer types, synthetic methods and

mechanism of formation, polymer characterization, solution properties of polymers, nanocomposites and their application.

UNIT – I INTRODUCTION TO POLYMERS 9

Introduction Definitions, Hard solids vs soft solids, Classification and characteristics of macromolecules. Properties of polymers: molecular weight (MW) and its distribution; crystallinity, thermal transitions; tacticity, viscoelasticity – creep and stress relaxation. Thermodynamics of polymerization.

UNIT – II SYNTHESIS OF POLYMERS 9

Different types of polymerizations: Step polymerization, Chain polymerization, radical chain polymerization, living radical polymerization, ionic chain polymerization, chain copolymerization and stereo regular polymerization. Other polymerization processes (ring opening, group transfer and metathesis polymerization.

UNIT – III POLYMER FUNCTIONALIZATION AND CHARACTERIZATION 9

Introduction to Polymer Functionalization: Motivations, Crystallinity, Solubility IssuesCommon Functionalization Approaches ,Functionalization Case Studies: Biomaterials Systems, Liquid Crystal (LC) Polymers. Determination of molecular weight - methods for measuring number average, weight average, viscosity average MW: GPC, SEC, viscosity, light scattering and Osmometry. Spectroscopic techniques to determine chemical composition and molecular microstructure.

UNIT – IV POLYMER SOLUTIONS AND DEGRADATION OF MACROMOLECULES 9

Thermodynamics of polymer solutions; Flory-Huggins theory, solubility parameters; fractionation of macromolecules. Gels: Flory-Rehner theory. Polymer degradation: thermal degradation, degradation by catalyst residues, degradation by end groups; mechanism of stabilization - antioxidants and heat stabilizers, catalyst quenchers, end-capping;

UNIT – V NANO COMPOSITES 9

Introduction to composites, Fabrication of Polymer-carbon nanotubes based composites, their mechanical properties, and industrial possibilities. Epoxy nanocomposites, Silicon rubber, Organically modified clay, Magnetic polymer nanocomposites, Polymer/graphite nanocomposites, Wear resisting polymer Nanocomposites.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. R.Sinha, Textbook of Polymer Technology-1, Biotech Pharma Publications, 2012.
2. NiranjanKarak, Fundamentals of Polymers, Raw Materials to Finished Products, Phi Learning Private Limited, 2009.
3. Bhaskin, Rekha, Introductory polymer science, DhanpatRai Publishing Co. Pvt. Ltd.
4. V. K. Ahluwalia, Anuradha Mishra, Ane Books Pvt. Ltd., 2008.

REFERENCE BOOKS

1. Billmeyer, F. W.,*Textbook of polymer science*. New York: Wiley, (1984).
2. Flory, P. J.,*Principles of polymer chemistry*. Ithaca: Cornell University Press, (1953).
3. Gowariker, V. R., Viswanathan, N. V., &Sreedhar, J.,*Polymer science*. New York: Wiley, (1986).

NT1274	THIN FILM LABORATORY	L	T	P	C
		0	1	2	2

1. Preparation of CdS thin film using chemical bath deposition.
2. Synthesis of PVA and coating a thin film by spin coating.
3. Preparation of graphene oxide thin film using Doctor blade slurry technique from graphite..
4. Preparation of ZnO thin film using dip coating.
5. Preparation of ZnS thin film using chemical bath deposition.
6. Preparation of NiO thin film using spin coating
7. Preparation of CuO thin film using Spray pyrolysis technique.
8. Preparation of hydrophobic Langmuir Blodgett film using self-assembly.

TOTAL: 45 PERIODS

NT1275	COMPUTATION & SIMULATION LABORATORY	L	T	P	C
		0	1	2	2

Aim: To familiarize with MATLAB software.

1. Computational modeling of nanoparticles.
2. Modeling of the electronic structure of molecules, crystals, and surfaces. Simulates electrical transport in nano-devices.
2. Density functional theories of nanoparticles
3. Hydrogen storage interactions of nanoparticles
4. Response Surface Methodology (RSM) optimization studies.
5. Finite element analysis of Nano-sized magnetic materials.
6. Basic Image processing operations.
7. Image Enhancement.
8. Image segmentation.

TOTAL: 45 PERIODS

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

NOORUL ISLAM UNIVERSITY, KUMARACOIL

DEPARTMENT OF NANOTECHNOLOGY

B.TECH NANOTECHNOLOGY

CURRICULUM & SYLLABUS

SEMESTER VI

SI.No	Course Code	Course Title	L	T	P	C
THEORY						
1	IT1212	Cyber Security	3	0	0	3
2	NT1215	Nanolithography and Nanofabrication	3	1	0	4
3	NT1216	Nanorobotics	3	1	0	4
4	NT1217	Nanoelectronics and Nanophotonics	3	1	0	4
5	NT1218	Vacuum Science and cryogenics	3	1	0	4
6	NT1219	Nanoceramics	3	1	0	4
PRACTICAL						
7	NT1276	Surface Characterization Laboratory	0	1	2	2
8	NT1277	Nanoelectronics and Simulation Laboratory	0	1	2	2
TOTAL			18	7	4	27

IT1212 CYBER SECURITY 3 0 0 3

AIM

The Course curriculum aims at imparting the fundamentals of cyber crime investigation, the tools used for the investigation, in addition to giving an exposure to the various kinds of cyber security threats and their impact on connected systems/resources.

OBJECTIVES

- The course also gives an exposure to the different types of mechanisms to sanitize the cyber space by adopting standardized operating procedures while transacting business/commerce online, and also to ensure security of information handled over the net.
- Introduction to the Cyber Laws and the IPC/Cr.PC equips the students with sufficient legal knowledge about deterrence in preventing cyber crimes.

UNIT I COMPUTER ORGANIZATION& ARCHITECTURE AND OPERATINGSYSTEMS 6

Computer Organization, Architecture, Operating Systems, Process Management, CPU Scheduling, I/O Memory Management, file systems and deadlocks. LAN, MAN, WAN, ISO/OSI seven layer architecture.

UNIT II INFORMATION SECURITY FUNDAMENTALS 6

Background, Importance, statistics, national and international scenarios. Identification and authentication, confidentiality, privacy, integrity, non-repudiation. Goals of security: prevention, detection and recovery. E-commerce security. Critical Infrastructure Protection.

UNIT III SECURITY THREATS AND VULNERABILITIES 9

Overview of security threats, various kinds of threats; Authentication-weak passwords. Insecure internet connection- internet cookies, viruses and other infections. Security of hard drives, security of laptops; sniffers, backdoors and Trojans. Buffer overflow and other programming bugs. Common attacks- DoS, man-in-the-middle, brute force attacks

UNIT IV OVERVIEW OF SECURITY PRINCIPLES 15

Security policies and procedures, International standards, Security consideration of OS- OS hardening - Internet protocols and security: SSL/TLS, IP Security, Application layer security - Access Control: Physical, Logical and Biometric - Tools and Techniques: Firewalls, Antivirus, IDS, Log analysis, Cryptography, steganography - Security Infrastructure: PKI, VPN, Digital signature - Network scanners, vulnerability scanners - Device Security - Cloud computing security, Database security.

UNIT V CYBER CRIMES. 9

Cyber crimes, Cyber crime Investigation, and Cyber forensic tools. Cyber Laws. Information Technology Act, Cyber laws and cyber crime investigation. Social networks and analysis.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Thomas Calabres and Tom Calabrese, “Information Security Intelligence: Cryptographic Principles & Application”, Thomson Delmar Learning, 2004.
2. Bernadette H Schell, Clemens Martin, “Cyber Crime”, ABC-CLIO Inc, California, 2004.
3. Swiderski, Frank and Syndex, “Threat Modeling”, Microsoft Press, 2004.
4. William Stallings and Lawrie Brown, “Computer Security: Principles and Practice”, Prentice Hall, 2008.

REFERENCES

1. Silberschatz A, Galvin P, Gagne G, "Operating Systems Concepts", John Wiley & Sons, Singapore, 2006.
2. Principles and Practices of Information Security by Michael.E. Whiteman and Herbert .J. Mattord.
3. Cyber Laws by Aparna Viswanathan.
4. Joseph M Kizza, “Computer Network Security”, Springer Verlag, 2005.

NT1215	LITHOGRAPHY AND NANOFABRICATION	L	T	P	C
		3	1	0	4

Prerequisite: Nanotechnology

Aim: To study the various lithographic techniques involved in the fabrication of nanomaterials.

Objective: To understand the uses of clean room for the nanofabrication and to study the different lithographic methods used to fabricate nanomaterials, the various phenomena involved in these processes.

UNIT – I LITHOGRAPHY BASICS 9

Clean Room fundamental – contamination (Types & sources) – Design hinds – airborne particulate cleanliness classes – Typical clean room with HEAP supply (design and principle). Additive and subtractive pattern transfer - Photomask: Binary mask- Phase shift mask -Attenuated phase shift masks - alternating phase shift masks – Molds -sub resolution assist feature enhancement - Off axis illumination - Optical proximity correction — Steps involved in IC packaging.

UNIT – II OPTICAL LITHOGRAPHY 9

Optical projection lithography-Optical immersion lithography- Optical interferometric lithography - Holographic lithography - MOPL (Mask less Optical Projection Lithography) - ZPAL (Zone Plate Array Lithography) - EUVL (Extreme Ultraviolet Lithography) - Etching: Isotropic & Anisotropic etching.

UNIT – III ELECTRON BEAM LITHOGRAPHY 9

SEBL Scanning electron-beam lithography- Mask less (ML2) EBL: parallel direct-write e-

beam systems-E-beam projection Lithography (EPL) - SCALPEL Scattering with Angular Limitation Projection E-beam lithography- PREVAIL Projection reduction exposure with variable axis immersion lenses.

UNIT – IV ION BEAM LITHOGRAPHY 9

Ion beam Lithography- Focused Ion beam Lithography (FIB) - Ion Projection Lithography (IPL) - Projection Focused Ion Multibeam (PROFIB) - Masked Ion Beam Lithography (MIBL) - atom lithography – NEMS by X-ray Lithography

UNIT – V SOFT LITHOGRAPHY 9

Nano imprint lithography (NIL) - hot embossing- UV-NIL- Soft Lithography- Molding/Replica molding: Printing with soft stamps- Edge lithography -Dip-Pen Lithography-set up and working principle. Etching techniques- Reactive Ion etching –laser ablation.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. NATO Advanced Research Workshop on Nanolithography: a Borderland Between STM, EB, IB, and X-Ray Lithographies, Gentili, M., Giovannella, C., Selci, S., & North Atlantic Treaty Organization.,*Nanolithography*. Dordrecht: Kluwer Academic, (1994).
2. Weddige, E., *Lithography*. Scranton, Pa: International Textbook Co.(1966).

REFERENCE BOOKS

1. Bucknall, D. G.,*Nanolithography and patterning techniques in microelectronics*. Cambridge: Woodhead Pub. (2005).
2. Howerton, H.,*Introduction to Nanolithography*. New Delhi: World Technologies.(2011).
3. Li, X. *Catalytic approaches to nanolithography*. Enschede: Twente University Press, (2003).
4. ASHRAE journal, Setember 2014,
5. Nanofabrication: Fundamentals and applications, Ampere A Tseng, World Scientific, 2008.
6. Clean Rooms: Facilities and Practice, M. Kozicki, S. Hoenig, P. Rabin son;Van Nostrand Reinhold (VNR) publications, New York, 1991.

NT1216	**NANOROBOTICS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Prerequisite: Nanotechnology

Objective: To study the various Principles and functions related with the natural nanomachines

UNIT I: INTRODUCTION 9

Types of nanorobotic systems, magnetic nanorobots, MRI guided nanorobots, Nano device structures, Prototyping of nanostructures, rotatory nanomotors, NEMS based linear bearings,

CNT based motors, nanobearings, nanosatellites

UNIT II: MODELLING OF NANOROBOTS 9

Characterization methodology- Molecular dynamics, Virtual reality techniques, mechano synthesis, Forces involved- Vanderwaals forces, Capillary forces, contact angle, contact energy, Surface tension, Elastic contact mechanics, Electrical double layer, hydrodynamic forces

UNIT III: DESIGN AND CONTROL 9

Assembly and manipulation, Nanomanipulation with Scanning Probe Microscopy (SPM), microassembly, microscopic analysis- SEM, AFM based methods, Nanoscale force tracking, nanomechanical Cantilever based manipulation, Surface roughness and Topography,

UNIT IV: NATURE'S NANOROBOTS 9

Inorganic Molecular Machines- Rotaxane, Cafenanes, Synthetic contractile Polymers.Bionano motors- bacterial guided nanorobotics, ATP Synthase, Kinesin, Myosin, Dyenin, Flagella motors, DNA Tweezers, actuators and passive joints, Viral Protein Linear Motors, protein based nanosprings, Alpha helix bundle proteins, Beta proteins, ion channels.

UNIT IV: NANOROBOTS IN MEDICINE 9

Robots in Surgery, Robots in Blood Stream, Vasculoids for molecular transport, Biocompatibility and mechanical interaction of Vasculoids, Cellulocks, nanorobots for drug delivery, chromallocytes

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOK

1. ParagDiwan and AshishBharadwaj, Nanorobotics, Pentagon Press Publishers, New Delhi, 2006

REFERENCE BOOKS

1. Michael Gauthier and StephaneRegnier, Robotic Microassembly, John Wiley and Sons, Inc. Publishers, IEEE, 2010
2. Nicolas Chaillet and StéphaneRégnier, Microrobotics for Micromanipulation, John Wiley and Sons USA. 2010.
3. Mustapha Hamdi _ Antoine FerreiraDesign, Modeling and Characterization of Bio-Nanorobotic Systems. Springer Publications. 2011.
4. ConstantinosMavroidis and Antoine Ferreira, Nanorobotics: The Vision and Applications, Springer Sciences, New York, 2013.

NT1217	NANOELECTRONICS AND NANOPHOTONICS	L	T	P	C
		3	1	0	4

Prerequisite: Nil

Aim: To have broader aspects in understanding the role of Nanoelectronics, and its application.

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

UNIT – I INTRODUCTION 9

Basics of Nanoelectronics – Band diagram of semiconductor structures (quantum well, quantum barrier, super lattice) – Types of transistor integration – photons interacting with electrons in solids- electron transport

UNIT – II SINGLE ELECTRON DEVICES 9

Single electron Box - Single electron transistor (SET) – Single electron trap - coulomb blockade – performance of single electron transistor – Single electron transistor technology – Single electron transistor circuit design –electrostatic data storage

UNIT – III TUNNELING DEVICES 9

Quantum Mechanical Tunnel Devices -Tunneling diode – tunnel resistance – resonant tunneling diode (RTD) – Resonant tunneling bipolar transistor – Tunneling element technology- RTD-Circuit design based resonant tunneling diode

UNIT – IV TRANSISTOR 9

Introduction- Electrons in mesoscopic structures – Short channel MOS Transistor – Split gate transistor – Electron wave transistor – electron spin transistor – quantum cellular automate-quantum Dot array- – molecular tweezer- molecular processor- Molecular switches-molecular shuttle

UNIT – V FLEXIBLE ELECTRONICS 9

Polymer electronics - Self assembling circuits – Optical molecular memories – Switches based on fullerenes and CNTs, Quantum well infrared photo detector

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Wolf, E. L. (2004). *Nanophysics and nanotechnology: An introduction to modern concepts in nanoscience*. Weinheim: Wiley-VCH.
2. Hanson, G. W. (2008). *Fundamentals of nanoelectronics*. Upper Saddle River, N.J: Pearson/Prentice Hall.
3. Lim, T.-C. (2011). *Nanosensors: Theory and applications in industry, healthcare, and defense*. Boca Raton: CRC Press.

REFERENCE BOOKS

1. Goser, K., Dienstuhl, J., &Glösekötter, P. (2004). *Nanoelectronics and nanosystems: From transistors to molecular and quantum devices*. Berlin [u.a.: Springer.
2. Balandin, A. A., & Wang, K. L. (2006). *Handbook of semiconductor nanostructures and nanodevices*. Stevenson Ranch, Calif: American Scientific Publishers.
3. Cao, G. (2004). *Nanostructures & nanomaterials: Synthesis, properties & applications*. London: Imperial College Press.

NT1218	VACUUM SCIENCE & CRYOGENICS	L	T	P	C
		3	1	0	4

Prerequisite: Nil

Objective: The objective of the course is to provide a technological background of the basic experimental condensed matter related knowledge of production of Vacuum and Low Temperatures.

UNIT – I: PROPERTY OF GASES **9**

Introduction to Property of gases - Kinetic theory of gases, mean free path, particle flux, monolayer formation, Gas's law; Elementary Gas Transport Phenomenon: Viscosity, diffusion, and thermal transpiration.Viscous, molecular and Transition flow regimes, gas throughput, conductance, mass flow, pumping speed; Gas release from Solids: Vaporization, thermal desorption, virtual leaks, permeation, vacuum baking

UNIT – II: MEASUREMENT OF PRESSURE **9**

McLeod gauge, thermal conductivity gauges, spin rotor gauge, diaphragm/capacitance gauges manometer, Ionization gauges, hot cathode, cold cathode gauges; Flow Meters and Residual Gas Analyzer, Leak Detection.

UNIT – III: PRODUCTION OF VACUUM **9**

Mechanical pumps (Rotary, Lobe and Turbomolecular pumps), Diffusion pump, Getter and Ion pumps, Cryopumps, Pump Fluids; Materials in Vacuum: Vaporization, out-gassing, glasses and Ceramics. Joints, Seals and Components, Gaskets and Motion feed through.

UNIT – IV: SIGNIFICANCE OF LOW TEMPERATURE **9**

Properties of engineering materials at low temperatures; Cryogenic Fluids: Hydrogen, Helium 3, Helium 4, Critical State - Superfluidity; Liquifaction of Gases; Helium Liquifaction system – Nitrogen Liquifaction – Hydrogen Liquifaction – Oxygen Liquifaction

UNIT – V: CRYOSTAT DESIGN AND EXPERIMENTAL METHODS AT LOW TEMPERATURE **9**

Heat leak considerations, Cryogenic insulation, Cryogenics Vessels, Cryogenic level sensors. Closed Cycle Refrigerators, Green Refrigerants - Single and Double Cycle He3 refrigerator, He4 refrigerator, He3-He4 dilution refrigerator, Pomeranchuk Cooling, Pulsed Refrigerator System, Magnetic Refrigerators, Thermoelectric coolers.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Hablanian, M. H. (1997). *High-Vacuum Technology: A Practical Guide, Second Edition*: Taylor & Francis.
2. O'Hanlon, J. F. (1980). *A user's guide to vacuum technology*. New York: Wiley.

3. Kent, A. (1993). *Experimental low temperature physics*. New York: American Institute of Physics.
4. Ventura, G., &Risegari, L. (2010). *The Art of Cryogenics: Low-Temperature Experimental Techniques*: Elsevier Science.

REFERENCES

1. Roth, A. (1990). *Vacuum technology*. Amsterdam: North-Holland.
2. Chambers, A., Fitch, R. K., &Halliday, B. S. (1998). *Basic vacuum technology*. Bristol: Institute of Physics Pub.
3. Hucknall, D. J. (1991). *Vacuum technology and applications*. Oxford: Butterworth-Heinemann.
4. McClintock, P. V. E., Meredith, D. J., &Wigmore, J. K. (1992). *Low-temperature physics: an introduction for scientists and engineers*. Blackie.
5. Richardson, R. C., & Smith, E. N. (1988). *Experimental techniques in condensed matter physics at low temperatures*. Redwood City, Calif: Addison-Wesley Pub. Co.
6. McClintock, P. V. E., Meredith, D. J., &Wigmore, J. K. (1984). *Matter at low temperatures*. New York: Wiley.

NT1219	NANOCERAMICS	L	T	P	C
		3	1	0	4

UNIT – I INTRODUCTION 9

Introduction of ceramics, Common ceramics crystal structures: silicates, clay, minerals, graphite and carbides. Classification and applications of ceramics materials. Raw materials preparation, Different structural ceramics: their properties and applications. Metal carbides and Nitrides, metal oxides- alumina, zirconia. Glass, Cermet

UNIT – II PROPERTIES 9

Mechanical behavior of different structural ceramics-brittleness of ceramics, Concept of fracture toughness and different toughness measurement techniques, Elastic modulus, Strength measurement, Weibull theory.Structural phase transformation.

UNIT – III PROCESSING AND CHARACTERIZATION METHODS 9

Processing and properties of ceramics composites, Powder preparation: Powder flow, Compressibility and porosity measurements, Powder forming, Consolidation and different powder processing routes, Behavior of powder during compaction: Die compaction. Piezoelectric crystals.Characterization of powders: composition and their structure, Particle size and shape determination.

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UNIT – IV COMPACTION AND SINTERING 9

Different modern powder compaction methods. Hot isostatic presses, Spark plasma sintering, and Microwave sintering. Sintering of powders and evaluation of sintered products. Sintering theories, Solid and liquid phase sintering,

UNIT – V APPLICATION 9

Applications of sintered products: Thermal barrier systems, thermal protection systems-insulators, friction, Corrosion resistance, Magnetic and dielectric applications-resonators. Fabrication of ceramic based computer chips, applications in medicine, bone, dental and tissue engineering. Applications in manufacturing of construction material and transport.

T: 15 + L: 45 = TOTAL: 60 PERIODS

TEXT BOOKS

1. Rahaman, M. N. (2007). *Ceramic processing*. Boca Raton, FL: CRC/Taylor & Francis.
2. German, R. M., & Bose, A. *Injection molding of metals and ceramics*. Princeton, N.J., U.S.A: Metal Powder Industries Federation, (1997).
3. Upadhyaya, G. S.,*Sintered metallic and ceramic materials: Preparation, proerties, and applications*. Chichester, N.Y: Wiley, (1999).

REFERENCE BOOKS

1. Kingery, W. D., Bowen, H. K., &Uhlmann, D. R. *Introduction to ceramics*. New York: Wiley, (1976).
2. German, R. M. *A-Z of powder metallurgy*. Kidlington [u.a.: Elsevier.,(2005).
3. Organic Additives and Ceramic Processing: With Applications in Powder Metallurgy, Ink, and Paint by Daniel J. Shanefield (Hardcover - Aug 31, 1996)

NT1276	SURFACE CHARACTERIZATION LABORATORY	L	T	P	C
		0	1	2	2

(Any EIGHT experiments will be taken)

1. Surface Area Analysis of oxide nano materials
2. Study of Surface functional groups using FTIR ATR mode
3. Contact angle measurement of hydrophobic surfaces
4. Non-Contact mode AFM imaging of thin films
5. MFM imaging of spin coated magnetic oxide thin films
6. STM imaging of HOPG surface
7. SEM imaging of TiO_2 nano tube
8. Corrosion studies with electro chemical workstation

TOTAL: 45 PERIODS

NT1277 NANOELECTRONICS AND SIMULATION LABORATORY 0 1 2 2

LIST OF PROGRAMS:

1. Benzene Single Electron Transistor using VNL.
2. Transport Properties of a Perfect Ribbon using VNL.
3. Electron transport Properties of a graphene ribbon with the distortion using VNL.
4. Electron density and Band structure of semiconductor using VNL.
5. Electron density and Band structure of Bulk crystal using VNL.

6. Transmission spectrum of perfect sheet of grapheme using VNL.
7. Band Structure of 2D nano ribbon using VNL.
8. Band Structure of an armchair ribbon using VNL.
9. Computing the young's modulus of a CNT using molecular dynamics in VNL.
10. Transmission spectrum of perfect sheets of graphene using VNL.
11. Silicon phonon band structure using VNL.
12. V-I characteristics of Single Electron Transistor using MATLAB.
13. Short-Channel Effects in MOSFETs using MATLAB.
14. Gaussian - Prediction of the energies, molecular structures, and vibrational frequencies of molecular systems, along with numerous molecular properties derived from laws of quantum mechanics and the basic computation types.

TOTAL: 45 PERIODS