Rayat Shikshan Sanstha's

Yashavantrao Chavan Institute of Science, Satara (Autonomous)

Undergraduate Program

B. Sc. Nanoscience and Technology Entire

Syllabi of the course

Choice Based Credit System Syllabus

(To be Implemented from Academic Year 2021-22)

Department of Nanoscience and Technology

Preamble:

B. Sc. Nanoscience and Technology (Entire) course is multidisciplinary. The goal of the syllabus is to make the study of Nanotechnology applications interesting and encouraging to the students for higher studies including research.

The new syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabub of other universities and the needs of industries and research. It is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields. The units of the syllabus are well defined, taking into consideration the level and capacity of students.

In general, course objectives have been framed and the curriculum and syllabus have been structured in such a way that each of the subjects meets one or more of these objectives. Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the course. Further each subject paper in the course spells out clear objectives and outcomes which are mapped to the student outcomes. It is expected to inspire and boost interest of the students towards applications of nanotechnology.

Program Objectives:

1) This course is design to develop the ability to work with multidisciplinary teams. design and conduct experiments, as well as to analyze and interpret data.
2) To learn techniques, skills, and modern instrument tools necessary for Research practices.
3) To understand the fundamentals, principles concepts and recent developments in the subject area.
4) This curriculum will inspire and boost interest of the students in Nanoscience to meet desired needs within realistic constraints such as economic, environmental, social, health and safety, manufacturability, and sustainability.

Program Specific Outcomes:

After successful completion of B.Sc. Nanoscience and Technology Entire Course student will be able to:

- Understand the various concepts in Physics, Chemistry, Biotechnology and able to implement it at nanoscale.
- Use the techniques, skills, and modern instrumental tools necessary for Research practices.
- Learn, to design and perform experiments in the labs to demonstrate the concepts, principles and theories learned in the classrooms.
- Develop the ability to work with multidisciplinary approach.
- Identify their area of interest in academic, research and development.
- Perform job in various fields like Research and Development, engineering, education, business and public service, etc. or be an entrepreneur with precision, analytical mind, innovative thinking, clarity of thought, expression, and systematic approach

B.Sc. Part I

1) **Title:** Nanoscience and Technology (Entire)
2) **Year of Implementation:** The syllabus will be implemented from June, 2021 onwards.
3) **Duration:** The course shall be a full time.
4) **Pattern: S**emester examination.
5) **Medium of Instruction:** English.
6) **Structure of Course:**

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA							
COURSE STRUCTURE UNDER CHOICE BASED CREDIT SYSTEM (CBCS)							
B. Sc. NANOSCIENCE AND TECHNOLOGY (ENTIRE)							
B. Sc. I Semester – I							
Sr No	**Course Code**	**Name of the Course**	**Teaching Scheme**				
			Theory		**Practical**		
			No. of lectures /week (1L = 50min)	**Credits**	**Course code**	**No. of lectures / Week**	**Credits**
1	BNTT-101	Physics-I	2	2	BNTP-111 (Physics lab)	3	2
2	BNTT-102	Physics-II	2	2			
3	BNTT-103	Chemistry -I	2	2	BNTP-112 (Chemistry lab)	3	2
4	BNTT-104	Chemistry -II	2	2			
5	BNTT-105	Biotechnology-I	2	2	BNTP-111 (Biotechnology lab)	3	2
6	BNTT-106	Biotechnology-I	2	2			
7	BNTT-107	Mathematics-I	2	2	BNTP-111 (Mathematics lab)	3	2
8	BNTT-108	Mathematics-II	2	2			
9	BNTT-109	Electronics-I	2	2	BNTP-111 (Electronics lab)	3	2
10	BNTT-110	Electronics-I	2	2			
11	BNTT-AECC-1	English-I	2	2		15	10
Total of SEM I			22	22			

B. Sc. I Semester – II							
Sr No	**Course Code**	**Name of the Course**	**Teaching Scheme**				
			Theory		**Practical**		
			No. of lectures /week (1L= 60min)	**Credits**	**Course code**	**No. of lectures / week**	**Credits**
1	BNTT-201	Physics -III	2	2	BNTP-111 (Physics lab)	3	2
2	BNTT-202	Physics -IV	2	2			
3	BNTT-203	Chemistry-III	2	2	BNTP-112 (Chemistry lab)	3	2
4	BNTT-204	Chemistry-III	2	2			
5	BNTT-205	Biotechnology-III	2	2	BNTP-111 (Biotechnology lab)	3	2
6	BNTT-206	Biotechnology-IV	2	2			
7	BNTT-207	Mathematics-III	2	2	BNTP-111 (Mathematics lab)	3	2
8	BNTT-208	Mathematics-IV	2	2			
9	BNTT-209	Electronics-III	2	2	BNTP-111 (Electronics lab)	3	2
10	BNTT-210	Electronics-IV	2	2			
11	BNTT-AECC-2	English-II	2	2			
Total Sem-II			22	22		15	10
Total of Sem-I and Sem-II			44	44		30	20

Student contact hours per week: 37 Hours	• Total Marks for B.Sc.-I (Including English): **1350**
• Theory lectures and practical: 50 Minutes	• Total Credits for B.Sc.-I (Semester I & II): **64**

- **AECC1**- Ability Enhancement Compulsory Course (BNTT-AECC-1 T& BNTT-AECC-2)- English
  BNTE- B. Sc. Nanoscience and Technology Entire. (For Semester I BNTT-101 to BNTT-110 and for Semester II BNTT-201 to BNTT-210)
- Course list as per enclosed Annexure. ***Separate passing is mandatory for Theory, Internal and Practical.***
- Practical Examination will be conducted at semester end for 50 Marks per DSC course (subject).

Semester I

Sr. No	Course Code	Name of course	Name of papers
1	BNTT-101	Physics-I	Mechanics
2	BNTT-102	Physics-II	Properties of Materials at Nanoscale
3	BNTT-103	Chemistry-I	Atomic Structure and Bonding
4	BNTT-104	Chemistry-II	General organic Chemistry
5	BNTT-105	Biotech-I	Cell Biology -I
6	BNTT-106	Biotech-II	Cell Biology- II
7	BNTT-107	Mathematics –I	Differential Calculus I
8	BNTT-108	Mathematics –II	Differential calculus II
9	BNTT-109	Electronics –I	Semiconductor device-I
10	BNTT-110	Electronics –II	Semiconductor device-II
11	BNTT-AECC-1	English-I	English
12	BNTP-111 Lab Course-I		Physical Science
13	BNTP-112-Lab Course-II		Chemical Science
14	BNTP-113Lab Course-III		Biotechnology
15	BNTP -114 Lab Course-IV		Mathematics
16	BNTP-115 Lab Course-V		Electronics

Semester II

Sr. No	Course Code	Name of course	Name of papers
1	BNTT-201	Physics-III	Basics of electrostatics for nanoscale
2	BNTT-202	Physics-IV	Electricity and magnetism in nanomaterials
3	BNTT-203	Chemistry-III	Physical Chemistry
4	BNTT-204	Chemistry-IV	Functional Organic Chemistry
5	BNTT-205	Biotech-III	Mammalian Physiology I
6	BNTT-206	Biotech-IV	Mammalian Physiology II
7	BNTT-207	Mathematics –III	Differential Equation I
8	BNTT-208	Mathematics –IV	Differential Equation II
9	BNTT-209	Electronics –III	Linear Integrated Circuits
10	BNTT-210	Electronics –IV	Digital Electronics
11	BNTT-AECC-2	English-II	English
12	BNTP-211 Lab Course-I		Physical Science
13	BNTP-212-Lab Course-II		Chemical Science
14	BNTP-213Lab Course-III		Biotechnology
15	BNTP -214 Lab Course-IV		Mathematics
16	BNTP-215 Lab Course-V		Electronics

B Sc. Part – I Semester I
BNTT-101: Mechanics
(Lectures: 30, Credit: 02)

Objectives:

1. To understand the fundamentals, principles, physical concept of mechanics.
2. To improve the understanding of mechanics
3. To learn basics of derivatives, ordinary & partial differential equations.
4. To study Newton's laws of motions and applications.
5. To study conservation of energy, center of mass, motion of rockets and examples.
6. To study rotational motion and M.I. of various bodies.

Unit-I **(5)**

Ordinary Differential Equations:

Derivatives, Differential equation; ordinary and partial differential equations, 1st order homogeneous differential equations, 2nd order homogeneous differential equations with constant coefficients, problems

Unit -II **(9)**

Laws of Motion

Frames of reference, Newton's Laws of motion (with proof)., problems

Momentum and Energy: Conservation of linear and angular momentum, work and energy theorem, conservation of energy (Single particle), Dynamics of a system of particles (linear momentum, angular momentum and energy), Centre of mass, Motion of rockets (qualitative treatment only). problems

Unit-III **(7)**

Oscillations

Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations, Forced oscillations, Frequency of nanoscale matters, problems

Unit-IV **(9)**

Rotational Motion:

Angular velocity, angular momentum and Torque, Kinetic energy of rotation and moment of Inertia, Moment of inertia of a spherical shell, solid cylinder (only about axis of symmetry), Motion of spherical Shell and solid cylinder rolling down an inclined plane. Problems

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
3. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
4. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. Additional Books for Reference Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
7. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley.
8. Mathematical physics .B.S. Rajput Pragati publication

Learning Outcomes:

Unit-1 After completion of the unit: Students are able to:

1. Understand basic mathematics used to express physical things,
2. Understand physical significance derivative
3. Solve differential equations

Unit 2 After completion of the unit: Students are able to:

1. Understand Laws of motion
2. Understand concept of momentum
3. Understand Nanoscale vibrations

Unit-3 After completion of the unit: Students are able to:

1. Understand more about how system is conserved,
2. Understand motion of particle and system of particles,
3. Define Centre of mass and centre of gravity. Understand concept of motion of rocket

Unit -4 After completion of the unit: Students are able to:

1. Understand the solution of a problem in angular variables,
2. Determine the linear displacement, speed, and acceleration of a rotating particle or a point on a rotating body.
3. Understand the rolling motion of spherical shell and solid cylinder.

BNTT-102: Properties of Materials at Nanoscale

(Lectures: 30, Credits: 02)

Course Objectives:

1) To inspire and boost interest of the students towards nanoscale material properties.
2) To learn Forces at nanoscale.
3) To learn angle of contact and wettability of the liquid and experimental determination of surface tension and examples.
4) To understand hydrophobic properties of materials.

Unit: I **(06)**

Introduction to Nanoscale

Definition of Nano, Scientific revolution-Feynman's Vision Nanoscience , Nanomaterials definitions - influence of nano over micro/macro, Role of size in nanomaterials , large surface to volume ration, surface effects on the properties. Nature Nanophenomena

Unit: II **(07)**

Forces at Nanoscale

Introduction to fundamental forces,strong and Weak interaction,Van Der Waals forces,Molecular attractions, electrostatics, forces of adhesion, Friction forces at nanoscale ,Friction laws at micro and nanoscale ,Effect of surface interaction on nanoscale friction

Unit: III **(09)**

Elastic Properties of Nanomaterials

Introduction to Stress, Strain And Elasticity of bulk material, Bending of beam, Bending moment, Cantilever (without considering weight of cantilever ,Torsional oscillation, Determination of Rigidity modulus and moment of inertia, Crystalline and Poly-crystalline Materials , Stress – strain relation

Unit: IV **(08)**

Surface Tension

Surface tension (definition), Angle of contact and wettability, Relation between surface tension, excess of pressure and radius of curvature,Applications of surface tension,Hydrophobic and super hydrophobic nanostructured surface,

Reference Books:

1. The big ideas of Nanoscale Science & Engineering- S. Stevens and M. Sutherland, CRC Press.
2. Andrew. N. Cleland "Foundations of Nanomechanics: From Solid – State Theory to Device Applications, Springer International Edition
3. Robert Kelsall, Ian W. Hamley, Mark Geoghegan —Nanoscale Science and Technology John Wiley & Sons, 2006.
4. Wing Kam Liu, Eduard G. Karpov, Harold S. Park —Nano Mechanics and Materials: Theory, Multiscale Methods and Applications, John Wiley & Sons, 2006.
5. https://pubs.rsc.org/en/content/articlelanding/2020/nr/c9nr07084b#!divAbstract

Course Outcomes:

Unit I: After completion of the unit :Students are able to:

1. Understand basic of Nanoscale
2. Understand importance of Nanoscience
3. Define properties of Nanomaterial

Unit II: After completion of the unit: Students are able to:

1. Understand role of fundamental forces at Nanoscale
2. Define forces at nanoscale
3. Understand size dependent effects on forces

Unit III: After completion of the unit: Students are able to:

1. Know about elastic property of matter.
2. Understand concept of Elasticity for Bulk materials and Nanomaterials
3. Understand stress ,strain produced at nanoscale

Unit IV: After completion of the unit :Students are able to:

1. Learn about various properties of liquid matter.
2. Understand applications of surface tension
3. Understand concept of wettability.

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BNTP-111: Physical Science Lab

(Credits-02)

Course Objectives:

1) In this course all the practicals are included in accordance with the theory syllabus.
2) To provide student better understanding of mechanical properties of Bulk and nanosized material.

Experiments:

1) Measurement of length (or diameter) using Vernier caliper, Micrometer Screw gauge and travelling microscope
2) To determine crystalline size using XRD.
3) Determination of Contact angle of thin films.
4) Viscosity by Poiseuille's method
5) Study dynamics of Lattice vibration
6) Calculate stress tensor using AFM Data.
7) Young's Modulus of a material of bar by vibration.

8) Y/□ of a Wire by Searle's method.

9) To determine 'g' by Kater's Pendulum.

10)To study the Motion of a spring and calculate (a) Spring Constant (b) Value of 'g'

11)Poisson ratio for rubber using rubber tube.

12)Determination of surface tension by Jagger's method.

Reference Books:

1. Engineering Practical Physics, S. Panigrah i&B.Mallick, Cengage Learning India Pvt.Ltd. 2015
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna,Kitab Mahal, New Delhi, 11th Edition, 2011
3. B. L. Flint and H.T. Worsnop, Asia Publishing House, 1971,
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn,Heinemann Educational Publishers, 4th Edition, reprinted 1985

Course Outcomes:After completion of this :Student are able to:

1. Understand of mechanics and concepts related to matter.
2. Understand theoretical concepts by performing experiments.
3. Handle different instruments with ease.
4. Determine time period, value of 'g' using various pendulum.

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BNTT -103-Atomic Structure & Bonding

(Theory: 30 Lectures Credits-2)

Course Objectives:

1. To expose the students to various emerging new areas of Nano chemistry and apprise them with their prevalent in their future studies.
2. To study Properties of Nanomaterial also formation of atomic Structure of Nanomaterial.
3. To learn Chemical Bonding in Nanomaterial
4. To study concept of covalent bonding, approach of molecule formation through VBT. & VSEPR.
5. To study the formation of molecule from atomic orbitals through VBT and MOT.

UNIT: I **(08)**

Atomic Structure

Fundamentals: Size & Scale, Units, Scaling, Atoms, Molecules, Clusters and Supramolecules, Structure. Molecular and Crystalline Structures. Black Body radiation, photo electric effect, Compton effect, plank's theory, De Broglie's relationship, experimental verification of wave nature of electron, Schrodinger wave equation (no derivation expected).

UNIT: II **(08)**

Chemical Bonding

Bonding in materials, Chemical Bonds (types and strength) Intermolecular Forces of composites: Metal-Metal composites, Polymer-Metal composites, Metallic,Ionic- Covalent,General characteristics of ionic bonding, Formation of ionic bond, Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability.

UNIT: III **(07)**

Covalent Bonding

Introduction, Lewis theory, VB Approach, of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements, Concept of resonance and resonating structures in various inorganic and organic compounds.

UNIT: IV **(07)**

Molecular Orbital Theory

MO Approach: Rules for the LCAO method, bonding and antibonding. MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) N_2, N^{2+}, N^{2-}, O^{2+}, O^{2-}

Reference Books:

1. Principles of Inorganic Chemistry; By Puri, Sharma & Kalia, Vishal publication. Co., 33rd ed., 2017.
2. Inorganic Chemistry Gulati Shikha, Sharma Gulati JL and Manocha, Shagun,, 1stEdn., CBS Publishers & Distributors , (2017)
3. Valency and Bonding. Weinhold, F.; Landis, C. Cambridge. (2005) pp. 96–100.
4. Quantum Chemistry; By R. K. Prasad, New Age Publication.2006
5. Principles of Structure and Reactivity; By James H. Huheey, Keiter, Medhi; 4thedition Pearson Education India, 2006.
6. Concise Inorganic Chemistry Lee J. D,Wiley India, 5th Edn., 2008.
7. Nanochemistry: A Chemical Approach to Nanomaterials, by G. Ozin and A. Arsenault, RSC Publishing, 2005
8. Nanochemistry and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf, Wiley-VCH, 2nd Reprint (2005)

Course Outcomes:

Unit I: After completion of the unit:Students are able to:

1. Understand conceptual fact of atom and molecule & formation of atomic orbital through quantum approach.
2. Understand basic fundamentals of nanomaterials and atomic structure of materials.

Unit II: After completion of the unit :Students are able to

1. Understand formation of materials through various types of bonds.
2. Understand formation and energetic of ionic bond & structure of ionic solids.

Unit III: After completion of the unit:Students are able to

1. Understand Formation of covalent bond & approach of molecule formation through VBT.
2. Understand VSEPR theory and comparison between linear and nonlinear Molecule.

Unit IV: After completion of the unit :Students are able to

1. Understand formation of molecule from atomic orbitals &LCAO method, bonding, antibonding and nonbonding molecular orbitals.
2. Know Axial and lateral overlapping of atomic orbitals & various diatomic molecules through VBT and MOT.

BNTT -104-General Organic Chemistry

(Theory: 30 Lectures Credits-2)

Course Objectives:

1. To expose the students to various emerging new areas of Chemistry and apprise their applications in various spheres of chemical sciences.
2. To study basic Fundamentals of Organic Chemistry- bond cleavage.
3. To study Concept of chirality,Geometrical isomerism, preparations & reactions in aliphatic hydrocarbons.
4. To learn the concept of nanomaterial and carbon nanomaterials.

UNIT: I **(07)**

Fundamentals of Organic Chemistry

Introduction, Cleavage of Bonds: Homolysis and Heterolysis. Organic molecular species: Nucleophiles and electrophiles. Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Reactive Intermediates: Generation, structure, stability and reaction of Carbocations and Carbanions.

UNIT: II **(09)**

Stereochemistry

Introduction, Type of stereoisomerism, optical isomerism: Concept of chirality (up to two Carbon atoms), Element of symmetry, optical isomerism in tartaric acid, 2, 3dihidroxybutanoic acid, enantiomerism, distereoisomerism and meso compound, Configuration: Geometrical isomerism Threo and erythro; D and L; cis - trans nomenclature.

UNIT :III **(08)**

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

UNIT: IV **(06)**

Introduction to Carbon Nano-materials

Introduction to Carbon materials, nature of the carbon bond, new carbon structures,Type of nanomaterials, Nanoscale carbon materials,isotopes of carbons.

Reference Books:

1. Organic Chemistry by Morrison & Boyd, Pearson Education India. 7thEdn,2010
2. Organic Chemistry, Jonathan Clayden, Nick Greeves, Stuart Warren,2nd Edition, Oxford Publisher, 2014.
3. Stereochemistry Conformation & Mechanism by P.S. Kalsi, New Age International Publisher 8thEdn,2015
4. Organic Reaction Mechanism by V. K. Ahluwalia, Naroso Publishing House. 4thEdn 2011.
5. Carbon Nanomaterials; Yury Gogotsi, Taylor and Francis Group, 2017

6. Nanoscale materials in Chemistry, K J Klabunde, Wiley Interscience 2001
7. The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A. Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag, 2004.
8. Nanostructures and nanomaterials: Synthesis, properties and applications, G. Cao, Imperial College Press, 2006.
9. Carbon Nanotubes: Synthesis, Structure, Properties, and Applications, Edited by M.S. Dresselhaus,G. Dresselhaus, P. Avouris, Springer-Verlag, 2000

Course Outcomes:

Unit I After completion of the unit: Students are able to:

1. Know Concept of fundamentals of organic chemistry- Bond cleavage, Organic molecular species.
2. Understand Preparations and reactions of reactive intermediates.

Unit II After completion of the unit: Students are able to:

1. Understand Basic concepts of stereochemistry.
2. Define types of stereoisomerism enantiomers, diasteromerism.

Unit III After completion of the unit: Students are able to:

1. Understand Basic idea of aliphatic hydrocarbons.
2. Know Preparations and reactions of alkane, alkene and alkynes.

Unit IV After completion of the unit, Students are able to:

1. Know Basic idea of Nanoscience.
2. Understand Structure, Properties of Nano carbonaceous material.

BNTP- 112 : Chemical Science Lab

(Total Credits: 02)

Course Objectives:

1. To provide student with the skills that will be needed in future practical work.
2. To expose the students to the ability to perform accurate quantitative measurements
3. To study organic estimation.
4. To perform organic qualitative analysis of organic compounds.

Practical:

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Determination of amount of acetic acid in commercial vinegar.
6. Determination of alkalinity of water using phenolphthalein and methyl orange indicator.
7. Qualitative analysis of organic compounds.
8. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
   (a) Identify and separate the components of a given organic binary mixture by paper chromatography.

Reference Books:

1. Elementary Practical Organic Chemistry, Part 1: Small scale Preparations, Vogel, A. I.Pearson (2011)
2. Practical Organic Chemistry, Mann, F.G. & Saunders, B.C. Pearson Education (2009)
3. Practical Organic Chemistry, Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. 5th Ed., Pearson (2012)
4. Comprehensive Practical Organic Chemistry Preparation and Quantitative Analysis, Ahluwalia, V.K. & Agrawal, R. University Press (2000).
5. Comprehensive Practical Organic Chemistry: Qualitative Analysis, Ahluwalia, V.K. & Dhingra, S. University Press (2000).
6. Practical Organic Chemistry, Mann, F.G. & Saunders, B.C. Pearson Education (2009)
7. Practical Organic Chemistry, Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R.5th Ed., Pearson (2012)

Course Outcomes: After completion of the Experiment, Students will be able to:

1. Learn measuring skills in practical.
2. Understand theoretical concepts by performing experiments.
3. Develop awareness of minimizing errors.
4. Handle various instruments.

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BNTT- 105- Cell Biology-I

(Theory: 30 Lectures ,Credit-2)

Objectives:

1. To study fundamental principles of prokaryotic & eukaryotic cell.
2. To study different nanostructure cell organelles in body.
3. To study basic bimolecular interactions.
4. To study genetic information of DNA Nanotechnology

UNIT : I **(07)**

Water, pH , Buffer ,Bio molecular Interaction and Cellular Nano-Machine:

Introduction and classification of organisms by cell structure, cytosol, cell theory, Compartmentalization of eukaryotic cells, cell fractionation. Cellular Nano machines and building blocks of life, Phospholipid membrane: Natural Biological Assembly at the Nano- Scale.

UNIT : II **(08)**

Prokaryotic Cell Structure and Functions:

Typical bacterial cell Morphology, size & arrangement of bacteria Structures and functions of capsule and slime layer, flagella, Pilli, cell wall, cytoplasmic membrane, nucleus, ribosome's, mesosomes, and bacterial endospores.

UNIT : III **(09)**

Eukaryotic Cell Structure and Functions:

Ultra structure and functions of cell organelles Cell wall, Plasma membrane,Mitochondria, Chloroplast, Endoplasmic reticulum (in protein segregation), Golgi Apparatus (in protein secretion), Lysosome, Peroxisome, Ribosome's (in protein synthesis), Proteosomes.

Unit : IV **(06)**

Cellular Organization:

DNA Nanotechnology: History and Application, Advance in DNA Nanotechnology

Nucleosome – unit of chromatin Nucleic Acids: The Genetic Information Media and a Template for Nanotechnological Applications.

Reference Books:

1. Lehninger Principles of Biochemistry by Nelson and Cox, Fourth Edition-
2. W.H. Freeman and Company.
3. Cellular structure and function by A. Malcolm Campbell and Christopher
4. Paradise-Momentum press.
5. Molecular biology of the cell by Bruce Albert's- Gerald Science publication.
6. Biochemistry by Lubert Stryer- W.H. Freeman and Company.
7. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th
8. Edition. John Wiley & Sons. Inc.

Learning Outcomes:

Unit I:After completion of this unit: Students should able to know

1. Basic things regarding biomolecular interaction and cellular nanoscale system.
2. Nano-structure present in human body which is useful for in daily metabolism.

Unit II:After completion of this unit: Students should able to know

1. Prokaryotic cell structure.
2. Various functions of prokaryotic cell.

Unit III:After completion of this unit :Students should able to know

1. Eukaryotic cell structure.
2. Various functions of eukaryotic cell.

Unit IV:After completion of this unit students should able to know

1. Genetic information in the form of DNA.
2. Heredity and species differentiation from gene.

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BNTT- 106- Cell Biology-II

(Theory: 30 Lectures,Credit-2)

Objectives:

1. To study membrane transport system.
2. To study movement of nanoparticle through membrane.
3. To study tools of biotechnology.

Unit :I **(09)**

Cytoskeleton:

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments .Biological Nano-Motors: Kinesin and Dynein, Ion Channels: Nano-Pores of High Specificity.

Unit :II **(08)**

Cell Membrane and Permeability:

Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport –Active and passive transport (Uniport, Symport and Antiport), Introduction of cell membrane coating Nanotechnology.

Unit : III **(07)**

Extracellular Matrix:

Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Amyloid Fibrils as Self-Assembled Nano-Scale Bio Assemblies.

Unit :IV **(06)**

Cancer

Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer. Basics of Stem cells, Role of Nanotechnology in Cancer Research.

Reference Books:

1. Cell and Molecular biology by Gerald Carp seventh edition-John Wiley, C 2013 publication
2. Lodish-Molecular Biology of the Cell, fifth edition- W.H. Freeman and Company.
3. Principles of Biochemistry by Moran and Horton fifth edition-Pearson publication.
4. The Cell: a molecular approach by Geoffrey M. Cooper, ASM press 2007- fourth edition.
5. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular
6. Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

Learning Outcomes:

Unit I: After completion of this unit :Students should able to know

1. Cytoskeleton system.
2. Biological Nano-motors and it's functions.

Unit II: After completion of this unit:Students should able to know

1. Mechanism of membrane permeability.
2. Transport of Nanoparticle through the cell membrane , membrane transport system.
3. Membrane coating of Nanotechnology

Unit III:After completion of this unit:Students should able to know

1. Receptors and signal molecules
2. Interaction between nanoparticle and cell biomolecules.

Unit IV:After completion of this unit:Students should able to know

1. Tools of Nanobiotechnology
2. Application of microscopy in Nanobiotechnology.

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BNTP 113 :Biotechnology Lab

(Total Credits: 02)

Objectives:

1. To study structure of prokaryotic and eukaryotic cell.
2. To study staining procedure and solution preparation.
3. To study mechanism and types of cell division.
4. To study classification of plant and animal kingdom.
5. To study membrane permeability.

Practicals

1. Study of structure of any Prokaryotic cell.
2. Staining – Gram staining and Negative staining
3. Study of structure of Eukaryotic Plant cell. (T.S. of Dicot and Monocot)
4. Study of classification of kingdom Plantae
5. Study of classification of kingdom Animalia
6. Determine the pH of soil sample and fruit juice.
7. Preparation of Buffer. (Phosphate buffer and Acetate buffer)
8. Study of plasmolysis and de-plasmolysis.
9. To study mitosis using onion root tips.
10. Isolation of chloroplast from plant leaves
11. Study the effect of temperature and organic solvents on semi permeable Membrane.
12. Study of Botanical garden.

Reference Books:

1. Practical handbook of Biochemistry and Molecular biology by Gerald D.Fasman.
2. Mitosis and meiosis- volume no.61, methods in cell biology.
3. Biology practical handbook- Target publication.

Learning Outcomes:Student should able to

1. Identify of any bacteria.
2. Differentiate prokaryotic and eukaryotic cell.
3. Differentiate Gram positive and Gram negative bacteria.
4. know solution preparation of required concentration pH scale.
5. Know different buffer systems and its role.
6. Know membrane permeability.cell division mechanism.

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BNTT -107- Differential Calculus I
(Theory: 30 Lectures,Credits-2)

Objectives:

1. To study differential calculus.
2. To study limit and continuity of real valued function.

UNIT I: **(09)**

Limit and Continuity of Real Valued Function

Definition of limit of function of one variable, Left Hand side limit and right-hand side limits. Theorems on limit (only statement), Continuous function and their properties. Classification of discontinuity. a) Removable discontinuity b) jump discontinuity of first kind and second kind.

UNIT II: **(07)**

Differential Calculus

Successive differentiation, order derivative of standard functions
$\sin x\,, \cos x\,, e^x, \log(1+x)\,, (1+x)^m, \sin(ax+b)\,e^x, \cos(ax+b)\,e^x$

UNIT III: **(08)**

Mean Value Theorem

Rolle's Theorem (with proof), Geometrical interpretation of Rolle 's Theorem, Mean value theorem, Taylor's theorem with Lagrange's and Cauchy form remainder, Taylor's series (only statement), Maclaurin's series of functions.

Unit IV: **(06)**

Indeterminate Forms

L'Hospital Rule, the form and examples, L' Hospital rule the form and examples.
L' Hospital Rule the form and examples, Maxima and minima for function of two variables.

Reference books:

1. Differential calculus Shanti Narayan, DR. P. K. Mittal; S Chand Pub
2. A Textbook of calculus and differential equations H. T. Dinde, A. D. Lokhande
3. A Textbook of Advanced Calculus.
4. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
5. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.

Learning outcomes:

Unit-I : After completion of the unit:Students are able to:

1. Compare the ideas of limit and continuity.
2. Understand classification of discontinuity
3. Explain the notion of continuity as related to function.

Unit II : After completion of the unit :Students are able to:

1. Understand the rules of differentiation
2. Solve derivatives of given functions.
3. Understand Leibniz theorem

Unit III : After completion of the unit:Students are able to:

1. Understand mean value theorem
2. Compute Mean value theorem
3. Calculate Cauchy's theorem

Unit IV: After completion of the unit:Students are able to:

1. Understand indeterminate forms
2. Compute Mean value theorem L'Hospital Rule
3. Calculate problems related to indeterminate form

BNTT – 108 – Differential Equation I

(Theory: 30 Lectures Credits 2)

Objectives:

1. To solve higher order differential equation.
2. To solve 1st order and 1st degree differential equation.

Unit: I **(07)**

Differential Equation -I

Introduction, First Order Exact Differential Equation, Illustrative examples on exact differential equation, Integrating Factor, Rules to find an integrating factor.

Unit:II **(08)**

First Order Differential Equation

Introduction, Equations solvable for p: Method and problems, Equations solvable for x: Method and problems. Differential equations solvable for y: Method and problems.

Unit: III **(06)**

Methods of Solving Higher Order Differential Equations

Basic theory of linear differential equations and reducing its order, Wronskian and Wronskian's property.

Unit: IV **(09)**

Linear Homogeneous Equations with Constant Coefficient

Introduction, Complementary function and particular integral, General solution of $f(D)y = X$ and solution of the equation $f(D)y = X$, Illustrative examples, The symbolic function of $\frac{1}{f(D)}$, To evaluate $\frac{1}{D-a}X$, short methods for finding particular integral for special cases. To find the particular integral of $f(D)y = X$

Reference books:

1. M. D. Raisinghania, ordinary and partial Differential Equation, Eighteenth Revised Edition 2016,
2. S. Chand and company Pvt Ltd New Delhi.
3. G. V. Kumbhojkar, C. Jamnadas and Co.
4. Differential equations by Gupta-Malik- Mittal -Pundir; Pragati prkashan.
5. A Textbook of advanced calculus and differential equations.

Learning Outcomes:

Unit 1: After completion of the unit: Students are able to:

1. Know about the exact differential equations.
2. Understand the integrating factor.
3. Know the differential equations by using rules to find integrating factor.

Unit 2: After completion of the unit: Students are able to:

1. Know about how to solve differential equation which has 1st order but not 1st degree.
2. Solve equations by using variable methods.

Unit 3: After completion of the unit: Students are able to:

1. Solve differential equations which are used in derivation of physics.
2. Solve differential equations which are used in derivation of statistics.

Unit 4 : After completion of the unit: Students are able to:

1. Define the concept of complementary functions, particular integral, general solution.
2. Solve the problems of linear homogeneous equations with constant coefficient

BNTP- 114: Mathematics Lab

(Total Credits: 02)

Objectives:

1. To study n^{th} order differentiation.
2. To study Numerical differentiation.
3. To study differential equations of first order and first degree.
4. To study linear differential equations.

Practical's

1. Successive Differentiation: n^{th} order derivative
2. Examples on Leibnitz theorem.
3. Lagrange's Mean Value Theorem.
4. Numerical differentiation: Newton's Backward and Forward difference formula.
5. Maxima and Minima of the functions of two variables.
6. Taylor's series
7. Differential Equations of First Order and First Degree. (Linear Differential Equations)
8. Differential Equations of First Order and First Degree. (Bernoulli's Differential Equations).
9. Differential Equation of first order but not of first degree.
10. Linear Differential Equations with Constant Coefficients.
11. Method of solving higher order differential equation.
12. Numerical method for solution of linear equations; Gauss elimination method, Gauss Jordon method

Reference books

1. Differential calculus Shanti Narayan, DR. P. K. Mittal; S Chand Pub
2. A textbook of Advanced Calculus.
3. Numerical Analysis, Goel Mittal- Pragati Prakashan.
4. G.V. Kumbhojkar and H.V. Kumbhojkar, Differential and Integral Calculus.

Learning outcomes:

1. Students should able to solve n^{th} order differentiation.
2. Students should able to solve numerical differentiation.
3. Students can solve the differential equation of first order.
4. Students can solve the examples of linear differential equations with constant coefficients.

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BNTT-109: Semiconductor Devices I
(Theory: 30 Lectures, Credits-2)

Course Objectives:

1. To learn the semiconductor properties of materials
2. To understand the concept of PN junction.
3. To learn the working of semiconductor devices
4. To understand the working principle of opto-electronic devices

Unit I: (**10)**

Semiconductor Basics

Conductor, Semiconductor, Insulator, Introduction to Semiconductor Materials, Carrier Transport Phenomena: Carrier Drift, Mobility, Resistivity, Hall Effect, Hall coefficient hall Voltage.

Unit II: **(08)**

P-**N Junction Diode**

Q-Formation of Depletion Layer, Space Charge, Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction, Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics

Unit III: **(06)**

Applications of PN Junction:

Zener and Avalanche Breakdown Mechanism, Zener diode as voltage regulator, photodiode, Schottky diode, Tunnel diode, Solar cell: circuit symbol, characteristics and applications

Unit IV: (**06)**

Optoelectronic Devices:

Light- emitting diodes and lasers: Photon absorption and emission, Inter-band emission and absorption in semiconductors, Laser diodes, Light- emitting diodes.

Course Outcomes:

Unit I: After completion of the unit, Students are able to:

1. Understand the basic concepts of semiconductor properties of material
2. Understand carrier transport phenomena in semiconductor

Unit II: After completion of the unit, Students are able to:

1. Understand formation of PN junction
2. Working of PN junction

Unit III: After completion of the unit, Students are able to:

1. Know about application of PN junction in photodiode Schottky diode, Tunnel diode
2. Understand working of solar cell and its characteristics

Unit IV: After completion of the unit, Students are able to:

1. Understand Photon absorption and emission in semiconductor
2. Understand working of optoelectronic devices Laser diodes, Light- emitting diodes

Reference Books:

1. R. S. Sedha, Textbook of Applied Electronics, S. Chand Publication
2. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
3. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
4. Dennis Le Croissette, Transistors, Pearson Education (1989)
5. L. Thereja, Basic Electronics Solid State, S. Chand & Company LTD
6. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
7. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)
8. Mitin V V, Kochelap V A, Stroscio M A, Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications: Cambridge University Press.

BNTT-110: Semiconductor Devices II
(Theory: 30 Lectures, Credits-2)

Course Objectives:

1. To learn working of BJT
2. To learn construction and working of Field effect transistors
3. To learn about unipolar devices

Unit: I **(10)**

Bipolar Junction Transistors (BJT)

PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Base-Width Modulation, Modes of operation, Regions of Operation, Input and Output Characteristics of CB, CE and CC Configurations, Current gains α and β, DC load line and Q point, stability, stability factors, Leakage Currents in transistor and their relations,

UNIT: II **(08)**

Amplifiers

Transistor biasing and Stabilization circuits- Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor S. Transistor as a two port network, h-parameter equivalent circuit. Small signal analysis of single stage CE amplifier. Input and Output impedance, Current and Voltage gains.

Unit: III **(08)**

Field Effect Transistors

JFET: Type of FET, Symbol, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics, Parameters of FET.

Unit: IV **(04)**

Unipolar Devices

UJT, Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression,

Course Outcomes:

Unit I: After completion of the unit, Students are able to:

1. Understand construction and working of BJT
2. Understand I/O characteristics of BJT

Unit II: After completion of the unit, Students are able to:

1. Understand Construction and working of JFET
2. Understand Construction and working of MOSFET

Unit III: After completion of the unit, Students are able to:

1. Understand construction and working of UJT
2. Understand application of UJT as relaxation oscillator

Unit IV: After completion of the unit, Students are able to:

1. Understand manufacturing process of CMOS Integrated Circuits
2. Understand Perspective — Trends in Process Technology

Reference books:

1. R. S. Sedha, Textbook of Applied Electronics, S. Chand Publication
2. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
3. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
4. B. L. Thereja, Basic Electronics Solid State, S. Chand & Company LTD
5. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
6. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)
7. Digital Integrated Circuits: A Design Perspective, Jan M. Rabaey, Prentice- Hall of India

BNTP-115: ELECTRONICS LAB
(Total Credits: 02)

Objectives:

1. To gain knowledge in designing basic electronic circuits and to study their operation practically.

Practicals

1. To familiarize with basic electronic components (R, C, L, diodes, transistors) digital Multimeter, Function Generator and Oscilloscope.
2. Measurement of Amplitude, Frequency & Phase difference using Oscilloscope.
3. Study of the I-V Characteristics of p-n junction Diode,
4. Study of the I-V Characteristics of Zener diode
5. Study of Zener diode as a voltage regulator
6. Study of the I-V Characteristics of UJT and design relaxation oscillator.
7. Study of the output and transfer I-V characteristics of common source JFET.
8. Study of I-V characteristics of solar cell.
9. Study of I/O characteristics of CE amplifier.
10. Study of I/O characteristics of CB amplifier.
11. Study of transistor as switch
12. Study of I-V characteristics of solar cell.

Reference Books:

1. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002).
2. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
3. Dennis Le Croissette, Transistors, Pearson Education (1989)
4. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
5. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
6. R. S. Sedha, Textbook of Applied Electronics, S. Chand Publication

Learning outcomes: After completion of this course students are able to

1. Understand working of various semiconductor devices
2. Analyze the characteristics of semiconductor devices.

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B. Sc. Part – I Semester II

BNTT -201: Basics of Electrostatics for Nanoscale materials

(Lectures: 30, Credits: 02)

Course Objectives:

1) To understand effects of fundamental forces of universe on the Nanomaterial .
2) To study dielectric properties of materials at Nanoscale .
3) To study Gradients, divergence, curl and their physical significance in Nanotechnology

Unit: I **(08)**

Basic Vector Analysis for nanomaterial engineering :

Concept of triple product of vectors, scalar triple product and its significance, vector triple product, Scalar and Vector fields,gradient, divergence, Curl and their significance,Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

Unit: II **(07)**

Electrostatics

Coulomb's Law , Electric field intensity, Field due to point and continuous charges , Gauss's law and application , Electric potential , Electric field, Equipotential surfaces, Calculation of electric field from potential

Unit: III **(05)**

Electrostatic-II

Capacitor Dielectrics Capacitance of an isolated spherical conductor, parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field,

UNIT: IV **(10)**

Nano-Dielectric

Introduction to nanodielectrics. Nano ceramics: Dielectrics, ferroelectrics and magnetoceramics, Electric field in free space, conductors, dielectric constant , Dielectric polarization , Dielectric strength, Capacitance, Energy density.Piezo and pyroelectric effect.

Reference Books

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajanand Choudhury, TataMcGraw, 2012
2. Electricity and Magnetism, Edward M. Purcell, McGraw-HillEducation,1986
3. Introduction to Electrodynamics, D.J. Griffiths, Benjamin Cummings.PHI learning privet limited, 3rd Edition., 1998
4. Applications of Vector Analysis and Complex Variables in Engineering
   Authors: Strack, Otto D. L.
5. Nanoscale materials -Liz Marzan and Kamat
6. Energy Harvesting with Piezoelectric and Pyroelectric Materials: Volume 72 (Materials Science Foundations) Paperback – Import, 21 February 2011 by Nantakan Muensit
7. http://namlab.de/research/dielectric-materials-1/capacitor-dielectrics

Course Outcomes:

Unit I: After completion of the unit students are able to:

1) Understand complex vector functions.

2) Define gradient, divergence and curl.
3) Understand significance of gradient, divergence and curl

Unit II: After completion of the unit students are able to:

1) Know to the electrostatics at nanoscale .
2) Understand basic concept of electrostatic field, electric flux and electric dipole.
3) Understand concept of potential due to point charge.

Unit III: After completion of the unit students are able to:

1) Get advance knowledge of electrostatic force.
2) Understand concept of parallel plate, cylindrical and spherical condenser.
3) Understand energy per unit volume in electrostatic field.

Unit VI: After completion of the unit students are able to:

1) Understand concepts of nanodielectric, application of dielectric material.
2) Define dielectric medium, polarization and displacement vector.
3) Understand relation between three electric vectors.

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BNTT- 202: Electricity and Magnetism in Nanomaterial

(Lectures: 30, Credits: 02)

Course Objectives:

1) To study electrical properties of nanomaterials
2) To study phenomena of magnetism at nanomaterials.
3) To learn electromagnetic induction laws.
4) To study Electromagnetic Field Redistribution in Metal Nanoparticle

Unit: I **(07)**

Electrical properties of materials

Electrical: Over view of Free Electron Theory of Metals – Electronic and Ionic Conductivity of Materials – Classification of Materials Based on the Conduction Properties – Metals – Semiconductor – Insulators – Electrical transport at Nanoscale – Fundamentals of Superconductivity.

Unit: II **(08)**

Nanostructure Magnetism

Introduction of dia-, para- and ferro-magnetic materials, Magnetic fundamentals Domains and the magnetization process Hysteresis curve in ferromagentic material ,Phenomena of Magnetostriction .

Unit:III **(05)**

Electromagnetic Fields

Biot-Savart's law & its applications- straight conductor, Divergence and curl of magnetic field Faraday’s laws, Induced emf ,Transformer and motional EMF , Electromagnetic Field Redistribution in Metal Nanoparticle

Unit: IV **(10)**

Maxwell’s Equations and Electromagnetic Wave Propagation

Equation of continuity of current, Displacement current, Maxwell's equations, energy density in electromagnetic field, polarization

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths,Benjamin Cummings.PHI learning PVT, 3rd Edition., 1998,

2. Feynman Lectures Vol.2, R. P. Feynman, R.B.Leighton, M. Sands, Pearson Education,2008

3. Elements of Electromagnetics, M.N.O. Sadiku, Oxford University Press.2010

4. Electricity and Magnetism, J.H. Fewkes&J. Yarwood. Vol. I, 1991, Oxford Univ.Press

5. Fundamentals of physics Halliday, Resnik,Wiley India publication, 8th edition

6. The big ideas of Nanoscale Science & Engineering- S. Stevens andM. Sutherland, CRCPress.

7. Magnetic microscopy of Nanostructures‖ , Hans P.O And Hopster H. Springer ,2004

8. Fundamentals of Nanomagnetism , Springer ,2004.

9. Handbook of Spin Transport and Magnetism, Edited by Evgeny Y. Tsymbal, Igor Zutic, Tailor and Francis, 1st edition.

10. Nanoscale Magnetism ICNM-2007, June 25 -29, Istanbul, Turkey, Series: Springer Proceedings in Physics, Vol. 122.

Course Outcomes:

Unit I: After completion of the unit students are able to:

1) Differentiate between metal Semiconductor and Insulator based on conduction property
2) Understand effect of size on electrical property of material .
3) Understand Electrical property at Nanoscale

Unit II: After completion of the unit students are able to:

1) Know formation of magnetic forces, and their mathematical representation.
2) Know applications Magnetic anisotropy at nanoscale;
3) Understand Magnetostriction and the effect of stress;
4) Understand Domains and magnetization process.

Unit III: After completion of the unit students are able to:

1) Learn about electromagnetism.
2) Understand concept of self and mutual inductance.
3) Determine energy stored in magnetic field.

Unit IV: After completion of the unit students are able to:

1) Understand Maxwell's equations for electromagnetism
2) Understand concept of conservation of charge.
3) Learn divergence and curl of electric & magnetic fields in Maxwell's Equations.
4) Study the EM wave propagation through vacuum & isotropic dielectric medium.

BNTP-211: Physical Science Lab

(Credits- 02)

Course Objectives:

1. To understand of concept of electricity and magnetism
2. To learn measuring skills in practical..
3. To understand the measurement of electrical quantities by using Multimeter.
4. To determine capacitance and Impedance.

Experiments:

1) Measurement of Constant of Ballistic Galvanometer:
2) To compare capacitance using De'Sauty's bridge.
3) Impedance of series LCR circuit.
4) To study a series LCR circuit and determine its (a) Resonant Frequency,(b) Quality Factor.
5) To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
6) To verify the Thevenin/ Norton theorem.
7) Frequency of A.C. mains by sonometer (A) magnetic wire (B) nonmagnetic wire
8) To use a Multi-meter for measuring (a)Resistances, (b) AC and DC Voltages, (c)DC Current, (d) checking electrical fuses.
9) Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
10) Zener diode as voltage regulator.
11) Bridge rectifier with Pi filter.
12) Output characteristics of transistor –CE mode

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint & H. T. Worsnop, Asia PublishingHouse, 1971
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna,Kitab Mahal, NewDelhi, 11th Edition, 2011
3. Engineering Practical Physics, S. Panigrahi & B. Mallick, Cengage Learning India Pvt.Ltd.,2015
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, Heinemann Educational Publisher, 4th Edition, reprinted 1985

Course Outcomes:

After completion of this practical course students are able to

1. Better understanding of electricity and concepts related to magnetism
2. Handle different instruments with ease.
3. Learn measuring skills in practical.

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BNTT -203 Physical Chemistry

(Theory: 30 Lectures, Credits 2)

Course Objectives:

1) To learn fundamentals and application of current chemical and scientific theories in Physical Chemistry. .
2) To study identify the endothermic and exothermic reaction.
3) To study basic concepts of Thermodynamics of nanoscale.
4) To study Phase transitions in nanoparticles.

UNIT: I **(07)**

Ionic Equilibria

Types of electrolytes, degree of ionization, factors affecting degree of Ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect, Buffer solutions. Solubility and solubility product of sparingly soluble salts .

UNIT: II **(06)**

Chemical Kinetics

Introduction, rate of reaction, Definition and units of rate constant, Factors affecting rate of reaction (Nature of reactant, concentration, pressure, temp catalyst), Order and molecularity of reaction, First order reaction (Derivation not expected). Characteristics of first order reaction Pseudo-unimolecular reactions.

UNIT: III **(07)**

Thermochemistry:

Introduction, Review of Thermodynamics and laws of Thermodynamics (only statement) Second law of Thermodynamics and its different statements, Carnot's cycle, its efficiency, Carnot's Theorem (Heat engine) exothermic endothermic reaction, important principles and definitions of thermochemistry.

UNIT: IV **(10)**

Thermodynamics at Nanoscale:

Different Approaches to Nano thermodynamics-surface thermodynamics-Phase transitions in nanoparticles-quasi chemical description of solid nanoparticles- size dependent interface energy thermodynamics of confined fluids in nanopores-structural properties of nanoclusters-Hill'sapproach to Nano thermodynamics

Reference Books:

1) Solid State Chemistry and its applications, A.R. West John Wiley & Sons, 2003.
2) Physical Chemistry, P. W. Atkins, Oxford University press, 7th edition, 2002.
3) Thermodynamics A Core Course- R. C. Srivastava, S. K. Saha and A. K. Jain, Prentice-Hall of India, 2nd edition, 2004.
4) Chemical Kinetics-K. J. Laidler, Pearson Education,2004
5) Physical Chemistry by Ira N. Levine Published by McGraw-Hill Science August 29th 2001
6) David R. Gaskell, ―Introduction to the Thermodynamics of Materials, Taylor & Francis, 2002.
7) Nanotechnology, American Scientific Publishers, 2005.
8) Nonlinear Dynamics of Nanosystems Günter Radons, Benno Rumpf and Heinz Georg Schu ster, Wiley publishers, 2010

Course Outcomes:

Unit 1: After completion of the unit:Students are able to

1) Understand degree of ionization and factor affecting on degree of ionization.
2) Know measurement of pH scale, common ion effects, buffer solution.
3) Know concept of solubility and solubility product of sparingly soluble salt.

Unit 2: After completion of the unit: Students are able to

1) Understand rate of reaction order of reaction, molecularity of reaction.
2) Know concept of first and second order of reaction.

Unit 3: After completion of the unit:Students are able to

1) Understand Laws of Thermodynamics
2) Know identify the endothermic and exothermic reaction

Unit 4: After completion of the unit: Students are able to

1) Know basic concepts of Nano Thermodynamics surface thermodynamics
2) Understand phase transitions in nanoparticles-quasi chemical description of solid nanoparticles- size dependent interface energy

BNTE -204 Functional organic chemistry

(Theory: 30 Lectures, Credits 2)

Course Objectives:

1. To Understand underlying theoretical principles of fundamental organic chemistry and industrials chemistry.
2. To learn reaction and synthesis of alkyl halides
3. To study the basic term of solute, solvent, polar solvent, nonpolar solvent, saturated solution, normality, and molarity.
4. To learn advance application and relation in carbon Nanotubes

UNIT: I **(05)**

Alkyl Halides

Introduction, nomenclature, classification, structure. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile . Williamson's ether Synthesis: Elimination vs substitution. Alkyl Halides: Types of Nucleophilic Substitution (SN1, SN2 and SNi).

UNIT: II **(06)**

Aryl Halides

Introduction, nomenclature, classification, structure; Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann Reactions, from aniline. , electrophilic substitution, reaction with ammonia, nucleophilic substitution. Reactions (Chlorobenzene)

UNIT: III **(07)**

Basic Concepts in Chemistry

Introduction, Definition and Explanation of following terms- Solute, Solvent, Solution, Polar solvent, Non-Polar solvent, Saturated solution, Unsaturated solution, Super saturated solution, Normality, Equivalent weight, Molecular weight, Molarity, Acidity of base, Basicity of acid, Percentage solution, ppt, ppm, ppb solutions,

Mole Fraction, Weight fraction, Problems based on Normality, Molarity, mole fraction, mixed solution.

UNIT: IV **(12)**

Carbon Nanotubes

Introduction to organic and Inorganic Nanoparticles: Size, Shape, Chemical and Physical properties.The Structure of Carbon Nanotubes- Nomenclature, Structure of Single Walled Carbon Nanotubes and Structure of Multiwalled Carbon Nanotubes carbonaceous materials-Bucky ball.

Reference Books:

1) Organic Chemistry, Jonathan Clayden, Nick Greeves, Stuart Warren,2nd Edition,Oxford Publisher, 2014.
2) Organic Reaction Mechanism by V. K. Ahluwalia, Naroso Publishing House. 4thEdn 2011.
3) Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
4) The Chemistry of Nanomaterials: Synthesis, Properties and Applications, C.N.R. Rao, A.
5) Nanostructures and nanomaterials: Synthesis, properties and applications, G. Cao, Imperial College Press, 2006.
6) Graphene, Carbon Nanotubes, and Nanostructures: Techniques and Applications, James E. Morris, Krzysztof Iniewski, CRC Press, 2013
7) Carbon Nanotubes: Synthesis, Structure, Properties, and Applications, Edited by M.S. Dresselhaus,G. Dresselhaus, P. Avouris, Springer-Verlag, 2000

Learning Outcomes:

Unit 1: After completion of the unit:Students are able to:

1) Understand reaction and synthesis of alkyl halides
2) Know mechanism of the elimination and substitution reaction.

Unit 2: After completion of the unit:Students are able to:

1) Know reaction and synthesis of aryl halides
2) Understand mechanism of the nucleophilic substitution reaction.

Unit 3: After completion of the unit: Students are able to:

1) Understand basic term of solute, solvent, polar solvent, nonpolar solvent, saturated solution, normality, and molarity.
2) Calculate of equivalent weight, molecular weight, mole fraction, percentage of solution, ppt, ppm, ppb solutions, mole fraction etc.

Unit 4: After completion of the unit: Students are able to:

1) Know brief information about carbon nanotubes.
2) Understand carbon nanotubes and their relation with other carbon materials

BNTP - 212 Chemistry Lab

(Total Credits: 02)

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Course Objectives:

1) To provide a core for future studies in chemistry and allied subjects, in aspects of chemistry as specified below and an introduction to basic practical skills, including safe working practices (risk, hazard and control measures) laboratory report writing, error and accuracy.
2) To evaluate the risks associated with an experiment and understand how to militate against those risks.
3) To study instrumental and non – instrumental experiments.

Practical

1) Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
2) Determination of enthalpy of ionization of acetic acid.
3) Study of solubility of benzoic acid in water and determine ΔH
4) pH measurements: Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (Use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH meter.
5) Preparation of buffer solutions: a. Sodium acetate-acetic acid. b. Ammonium chloride-ammonium hydroxide. Measurement of the pH of buffer solutions and comparison of the values with theoretical Values.
6) To investigate the reaction between $K_2S_2O_8$ and KI with equal initial concentration of reactants.
7) Equivalent weight: To determine equivalent weight of metal (mg) by hydrogen displacement method using Eudiometer
8) Estimation of aniline. 8. Estimation of amide.
9) Preparations: Mechanism of various reactions involved to be discussed, Recrystallization, determination of melting point and calculation of quantitative yields to be done.
10) Preparations:Bromination of Phenol/Aniline b. Nitration of nitrobenzene c. Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone
11) Preparations of derivatives of organic compounds a. Nitration b. Oximes of aldehydes & ketones
12) Preparations of derivatives of organic compounds c) 2,4dinitropherylhydrazone of aldehydes & ketones d) Oxalate e) Sublimation

Reference Books:

1) Elementary Practical Organic Chemistry, Part 1: Small scale Preparations, Vogel, A. I.
2) Pearson (2011)
3) Practical Organic Chemistry, Mann, F.G. & Saunders, B.C. Pearson Education (2009)
4) Practical Organic Chemistry, Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. 5th Ed., Pearson (2012)
5) Inquiry-based Experiments in Chemistry Valerie LudwigLechtanski Oxford University Press, 2000
6) Laboratory Manual for Principles of General Chemistry, J A Beran John Wiley & Sons, 6th Edition 2000
7) Dean's Handbook of Organic Chemistry by John A. Dean; George W. Gokel Publication Date: 2004

8) A. Senior Practical Physical Chemistry, Khosla, B. D.; Garg, V. C. & Gulati, R. Chand & Co.New Delhi (2011).

Course outcomes: After completion of the Experiments, Students will be able

1) Know measuring skills in practical.
2) Understand theoretical concepts by performing experiments.
3) Know errors minimization
4) Handle various instruments

BNTT- 205- Mammalian physiology I

(Theory: 30 Lectures, Total Credit-2)

Objectives:.

1) To know working mechanism of these systems.
2) To know action of nanoparticle on these systems.
3) To study digestive, respiratory, circulatory, cardiac system

UNIT: I **(08)**

Digestive System:

Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice. Characteristics and types of Nanomaterial of Gastrointestine.

Unit: II **(09)**

Respiratory System:

Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift. Fate of nanoparticles in body. Respirocytes; a Mechanical Artificial Red Cell: Exploratory Design in Medical Nanotechnology.

Unit: III **(06)**

Circulatory System

Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood. Nanotechnology to detect and kill various circulatory diseases with one example.

Unit: IV **(07)**

Cardiac System:

Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat. Nanoparticles: Blood Components Interactions. Application of Nanotechnology in Cardiovascular Nanomedicine.

Reference Books:

1) Guyton, A. C. & Hall, J.E. (2006). Textbook of Medical Physiology, XI
2) edition-Hercourt Asia PTE Ltd. /W.B. Saunders Company publication.
3) Comparative animal physiology by Philip C. Withers.
4) Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009.
5) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Learning Outcomes:

Unit I:After completion of this unit :Students are able to

1) Know composition of various components required for digestion..
2) Know mechanism of Digestive system

Unit II:After completion of this unit:Students are able to

1) know mechanism of Respiratory system.
2) know effect of Nanoparticles on respiration.

Unit III:After completion of this unit:Students are able to know

1) Mechanism of Circulatory system.
2) Mechanism of blood formation and its composition.

Unit IV:After completion of this unit:Students are able to know

1) Mechanism of Cardiac system.
2) Effects of Nanoparticles on various organs

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BNTT- 206- Mammalian physiology II

(Theory: 30 Lectures, Total Credit-2)

Objectives:

1) To study nervous, endocrine, immunity and excretion system.
2) To study interaction between antigen - antibody.
3) To study mechanism of these systems and interaction with nanoparticle.

Unit: I **(08)**

Nervous System

Nervous coordination Mechanism of generation & propagation of nerve impulse, structure of synapse: - chemical and electrical synapse, synaptic conduction, salutatory conduction, threshold stimulus, All or None rule, Neurotransmitters.

Unit: II **(09)**

Endocrine System

Mechanism of action of hormones (insulin and steroids) Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions. Nanotechnology in neuroscience, nanotube microelectrodes neurotransmitter measurements in the brain.

Unit: III **(06)**

Excretion and Osmoregulation

Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation,Excretion and Toxicity of nanoparticles. Concept of tissue, Role of nanotechnology in tissue engineering. Role and effect of osmoregulation.

Unit: IV **(07)**

Immunity System

Overview of immune system, innate and adaptive immunity, cells and organs of theimmune system, Types of immune response, **Antigen:** Introduction to the concept of immunogenicity, antigenecity, factors influencing immunogenicity, epitopes, haptens, pattern recognition receptors, **Antibody:** Basic structure of antibody, antibody classes and biological activities, antigenic determinants and immunoglobulin's, B cell receptors, monoclonal antibodies**.**

Reference Books:

1) Guyton.A.C. & Hall J.E.Textbook of Medical Physiology, XI edition-Hercourt Asia PTE Ltd. /W.B.

Saunders Company publication.

2) Immunology by Kuby, 5thedition- W.H. Freeman and Company. Tortora, G.J. & Grabowski, S. (2006).
3) Principles of Anatomy & Physiology XI Edition. John wiley & sons,Inc.

Learning Outcomes:

Unit I:After completion of this unit:Students should able to know

1) Mechanism of Nervous system.
2) Structure and functions of neurotransmitters.

Unit II:After completion of this unit:Students should able to know

1) Mechanism of Endocrine system.
2) Mechanism of hormone formation and its function.

Unit III:After completion of this unit:Students should able to know

1) Mechanism of excretory system.
2) Mechanism and role of osmoregulation.

Unit IV:After completion of this unit:Students should able to know

1) Structure of antigen and antibody.
2) Interaction between antigen and antibody.
3) Mechanism of Immune system.

BNTP-213 : Biotechnology Lab

(Total Credits: 02)

Objectives:

1) To study different immunological techniques which are help to study antigens antibody interaction.
2) To study different blood group components and analysis of different body organs.

Practicals

1) Finding the coagulation time of blood.
2) Determination of blood groups.
3) Counting of mammalian RBCs.
4) Determination of TLC and DLC.
5) Determination of action of an enzyme (α amylase).
6) Determination of Hemoglobin.
7) Study of DOT Elisa.
8) Study of Radial Immunodiffusion.
9) latex Agglutination
10) Rocket Imunnoelectrophoresis
11) Demonstration of dialysis.
12) Isolation of Mitochondria from goat liver.

Reference Books:

1) Practical immunology by Frank C.Hay.
2) Practical physiology by G.K.Pal and Pravati Pal.
3) Clinical biochemistry by Plummer.

Learning Outcomes:

1) Students should able to determine different blood group.
2) Students should able to know mechanism of interaction between antigen and antibody.
3) Students should able to know different components of blood.
4) Students should able to know different immunological techniques.

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BNTT- 207- Differential Equations I
(Theory: 30 Lectures ,Credits-2)

Objectives:

1. To study partial differentiation.
2. To study various functions and integrals related to calculus.

UNIT: I **(06)**

Partial Differentiation

Introduction, Chain Rule without proof and its examples, Euler's Theorem on Homogeneous Functions and its examples, Application to the partial derivative.

UNIT: II **(09)**

Jacobian

Definition of Jacobian and examples, Properties of Jacobian
If J is Jacobian of u, v with respect to x, y, and J' is Jacobian of x, y, with respect to u, v, then JJ'=1
If J is Jacobian of u, v, w with respect to x, y, z and J' IS Jacobian of x, y, z with respect to u, v, w then JJ'=1

UNIT: III **(07)**

Gamma and Beta Function

Introduction, Definition of Gamma function, Properties of Gamma function. Illustrative examples on Gamma function. Introduction of Beta functions, Properties of Beta function, Illustrative examples on Beta function.

UNIT: IV **(08)**

Double Integral

Introduction, The evaluation of double integral, Area under the curve by double integral, Examples on double integral. Triple integral, Illustrative examples on it.

Reference books:

1) Applied Mathematics II; G.V. Kumbhojkar, C. Jamnadas and co.
2) Differential Calculus; Shanti Narayan, DR. P. K. Mittal; S Chand Pub.
3) A textbook of Advanced Calculus.

Learning outcomes:

Unit-I :After completion of this unit:Students should able to know

1. Partial differentiation of functions of two variables.
2. Euler's Theorem for partial derivatives of homogeneous functions.

Unit-II:After completion of this unit: Students should able to get

1. Adequate exposure to global and local a concern that explores them many aspects of Mathematical Science.
2. Knowledge about the concept of Jacobian to solve examples.

Unit-III :After completion of this unit:Students should able to

1. Use Gamma and Beta functions to evaluate integrals.
2. Solve integrating problems easily.

Unit-IV :After completion of this unit:Students should able to

1. Evaluate the double integral.
2. Find the area under the curve by using double integral

BNTT -208-Differential Equation II
(Theory: 30 Lectures, Credits-2)

Objectives:

1. To solve simultaneous differential equation.
2. To solve total and partial differential equation of first and second order.

Unit: I **(09)**

Simultaneous and Total Differential Equation

The method of variation of parameter, Simultaneous differential equation, Introduction, Simultaneous differential equation of 1st order and 1st degree, Illustrative examples Total differential equation, Introduction, Condition of integrability, Method of solving the integrable equation, Geometric interpretation, Illustrative examples.

UNIT: II **(08)**

Partial Differential Equation

Order and degree of partial differential equation.

Concept of Linear and non-linear partial differential equation. Formation of 1st order Partial differential equation.

Unit: III **(07)**

Linear Partial Differential Equation of 1^{st} Order

Introduction, Lagrange's equation, Lagrange's method of solving equation, Examples Charpit's Method and its examples.

Unit IV **(06)**

Classification of 2^{nd} Order Differential Equation

Classification of 2nd order differential equation into elliptic, parabolic, hyperbolic form through illustration only.

Reference books:

1. M.D. Raisinghania, ordinary and partial Differential Equation, Eighteenth Revised Edition 2016, R-2S. Chand and company Pvt Ltd New Delhi.
2. Differential equations by Gupta-Malik- Mittal -Pundir; Pragati prkashan.
3. A Textbook of advanced calculus and differential equations.

Learning Outcomes:

Unit 1 :After completion of this unit:Students should able to

1. Explain concept of differential equation
2. Solve differentiate simultaneous and total differential equation.

Unit 2:After completion of this unit: Students should able to

1. Find the order partial differential equation
2. Find the degree of partial differential equation and forms the 1st order partial differential equation.

Unit 3 :After completion of this unit:Students should able to know

1. About Charpit's method
2. About Lagrange's method.
3. Use of these methods to solve the differential equation of higher order.

Unit 4:After completion of this unit: Students should able to

1. classify the 2nd order differential equation into elliptic, parabolic and hyperbolic form.
2. apply Mathematical knowledge, skills and formulae to draw the relevant conclusion from the given information.

BNTP – 214: Mathematical Science Lab
(Total Credits: 02)

Objectives:

1.To study Jacobian theorem.
2.To study numerical methods for solving differential equation
3.To study Laplace transform
4.To study methods of solving Linear partial differential equation of first order.

Practicals

1. Euler's Theorem on homogeneous function.
2. Jacobian I
3. Jacobian II
4. Lagrange's method for undetermined multiplier.
5. Examples on Double Integral
6. Numerical Methods for differential equations; Picard's Method.
7. Numerical Methods for differential equations; Euler's Method.
8. Numerical Methods for differential equations; Euler's Modified Method.
9. Simultaneous Differential Equations and Total differential Equations.
10. Laplace Transform1.
11.Examples on Charpit's Method.
12. Numerical method for solution of linear equations; Examples Gamma functions.

Reference books

1. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Pub.
2. Differential Calculus; Shanti Narayan, DR. P. K. Mittal; S Chand Pub.
3. Applied Mathematics II; G.V. Kumbhojkar, C. Jamnadas and co.
4. Numerical Analysis, Goel Mittal- Pragati Prakashan.

Learning Outcomes:Students should able to know

1. Euler's Theorem for partial derivatives of homogeneous functions.
2. Concept of Jacobian to solve examples.
3. Lagrange's method for undetermined multiplier.
4. Laplace transforms.
5. Concept of Simultaneous Differential Equations and Total differential equations.
6. Numerical differentiation

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BNTT-209- Linear Integrated Circuits

(Theory: 30 Lectures, Credits-2)

Objectives:

1) This course provides comprehensive idea about working principle, operation and characteristics of Linear Integrated Circuits.
2) Students should get knowledge of Op-Amp and its applications.
3) Students should get familiarize with data converters devices.

UNIT: I **(06)**

Operational Amplifiers

Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open and closed loop configuration, Frequency Response. CMRR, Slew Rate and concept of Virtual Ground.

UNIT: II **(09)**

Applications of Op-Amps

(1) Inverting and non-inverting amplifiers, (2) Summing and Difference Amplifier, (3) Differentiator, (4) Integrator, (5) Wein bridge oscillator,(6) Comparator and Zero-crossing detector, and (7) Active low pass and high pass Butterworth filter (1st order only).

UNIT: III **(09)**

D-A and A-D Conversion:

4 bit binary weighted and R-2R D-A converters, circuit and working. Accuracy and Resolution. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

UNIT: IV **(06)**

Clock and Timer (IC 555):

Introduction, Block diagram of IC 555, a stable and mono-stable multi-vibrator circuits.

Reference Books:

1. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
2. Pulse, switching and Digital circuit, David A. Bell 5th edition, Oxford University Press.
3. Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, Oxford University Press.
4. Digital Principles and Applications, A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw
5. Integrated circuits, K. R. Botkar, Khanna Publication

Learning Outcomes:

UNIT: 1:After completion of this unit: Students are able to :

1) Understand ideal and Practical characteristics Operational Amplifier (IC 741),
2) Explain concept of Open and closed loop configuration
3) Explain concept of Frequency Response. CMRR. Slew Rate

UNIT: 2 :After completion of this unit:Students are able to:

1) Explain applications of Op-Amps as Inverting and non-inverting amplifiers
2) Explain Op-Amps as Summing and Difference Amplifier, Differentiator and Integrator
3) Explain working of Op-Amp as Wein bridge oscillator, Comparator and Zero-crossing detectorr

UNIT: 3:After completion of this unit: Students are able to:

1) Understand working of DAC
2) Understand accuracy and resolution
3) Explain 4 bit binary circuit

UNIT: 4;After completion of this unit:Students are able to:

1) Explain construction and working of Clock and Timer (IC 555)
2) Explain astable and monostable multivibrator circuits using IC 555

BNTT-210- Digital Electronics

(Theory: 30 Lectures, Credis-2)

Objectives:

1. To provide comprehensive idea about working principle, operation and characteristics Digital Electronics Systems.

2. To get idea about Combinational and Sequential logic circuits Analysis and Design

UNIT: I **(06)**

Number System and Codes

Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, BCD code. Binary, octal and hexadecimal arithmetic; addition, subtraction by 2's complement method, multiplication.

UNIT: II **(04)**

Logic Gates and Boolean Algebra

Truth Tables of OR, AND, NOT, NOR, NAND, XOR, XNOR, Universal Gates, Basic postulates and fundamental theorems of Boolean algebra.

UNIT: III **(06)**

Combinational Logic Analysis and Design

Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh map minimization up to 4 variables for SOP).

UNIT : IV **(14)**

Arithmetic Circuits:

Binary Addition. Half and Full Adder. Half and Full Subtractor, 4- bit binary Adder / Subtractor.

Data Processing Circuits: Multiplexers, De-multiplexers, Decoders, Encoders. Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master-slave JK Flip-Flop.

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter, Synchronous Counter.

Reference Books:

1) Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
2) Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
3) Digital Systems: Principles & Applications, R. J. Tocci, N. S. Widmer, 2001, PHI Learning.
4) Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
5) R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

Learning Outcomes-

UNIT 1:After completion of this unit:Students are able to:

1) Know number system and conversions of number systems.
2) Represent of signed and unsigned numbers,
3) Understand BCD code representation.
4) Understand Binary arithmetic operations.

UNIT 2 :After completion of this unit:Students are able to:

1) Understand working of basic logic gates
2) Understand basic postulates and fundamental theorems of Boolean algebra.

UNIT 3 :After completion of this unit:Students are able to:

1) Understand standard representation of logic functions (SOP and POS),

2) Understand minimization techniques (Karnaugh map minimization up to 4 variables for SOP).

UNIT 4 :After completion of this unit:Students are able to:

1) Understand arithmetic circuits: Adder, Subtractor
2) Understand data processing circuits: Multiplexers, De-multiplexers, Decoders, Encoders.
3) Understand sequential circuits: Flip-Flops,Shift registers counters

BNTP-215: ELECTRONICS LAB-2

(Total Credits: 02)

Objectives:

1) To gain knowledge in designing basic Digital circuits
2) To study circuits operation practically.

Practicals

1) To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
2) To investigate the use of an op-amp as an Integrator.
3) To investigate the use of an op-amp as a Differentiator.
4) Study of basic logic gate
5) Study universality of NAND and NOR gate
6) (a) To design a combinational logic system for a specified Truth Table.(b)To convert Boolean expression into logic circuit & design it using logic gate ICs. c)To minimize a given logic circuit.
7) Half Adder and Full Adder.
8) Half Subtractor and Full Subtractor.
9) To design an Astable Multivibrator of given specification using IC 555 Timer.
10) To design a Monostable Multivibrator of given specification using IC 555 Timer.
11) To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
12) To build JK Master-slave flip-flop using Flip-Flop ICs

Reference Books

1) Digital Principles and Applications, A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw
2) OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition., 2000, Prentice Hall
3) R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
4) Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill

Learning Outcomes: After completion of this: Students are able to:

1) Know the design procedure of various applications of Op-Amp
2) Know about designing of data converters with desire specifications
3) Design of various arithmetic circuits
4) Design of various combinations and sequential circuits and study their operations practically.

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