Rayat Shikshan Sanstha's

YASHAVANTRAO CHAVAN INSTITUTE OF SCIENCE, SATARA

(AN AUTONOMOUS INSTITUTE)

Syllabus for Bachelor of Nanoscience and Technology Part – 2

1. **Title:** B. Sc. Nanoscience and Technology(Entire)
2. **Year of Implementation:** The syllabus will be implemented from June, 2019 Onwards.
3. **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 vigour and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi 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.
4. **General objectives of the course:**
   1) An ability to function on multidisciplinary teams.
   2) An ability to apply knowledge of mathematics, science, and engineering.
   3) An ability to design and conduct experiments, as well as to analyze and interpret data.
   4) An ability to use the techniques, skills, and modern instrumental tools necessary for Research practices.
   5) The students are expected to understand the fundamentals, principles concepts and recent developments in the subject area.
   6) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, health and safety, manufacturability, and sustainability.
5. **Duration:** 3 Years – Fulltime
6. **Pattern: S**emester examination.
7. **Medium of Instruction:** English.
8. **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. II S E M E S T E R – III (Duration – 6 Months)									
Sr. No	**Course Code**	**Name of the Course**	**TEACHING SCHEME**						
			Theory			**Practical**			
			No. of lectures /Week	**Clock Hours/ week**	**Credits**	**Course Code**	**No. of lectures /Week**	**Clock Hours/ Week**	**Credits**
1	BNTT-301	Physics-V	2	2	2	BNTP 311 LAB 1 (Physics)	3	3	2
2	BNTT-302	Physics-VI	2	2	2				
3	BNTT-303	Chemistry-V	2	2	2	BNTP312 LAB 2 (Chemistry)	3	3	2
4	BNTT-304	Chemistry-VI	2	2	2				
5	BNTT-305	Biotech-V	2	2	2	BNTP 313LAB 3 (Biotechnology)	3	3	2
6	BNTT-306	Biotech-VI	2	2	2				
7	BNTT-307	Statistics-I	2	2	2	BNTP 314 LAB 4 (Statistics)	3	3	2
8	BNTT-308	Statistics-II	2	2	2				
9	BNTT-309	Instrumentation-I	2	2	2	BNTP 315 LAB 5 (Instrumentation)	3	3	2
10	BNTT-310	Instrumentation-II	2	2	2				
11	BNTT-AECC-2	EVS-I	2	2	2				
	Total of SEM III		**22**	**22**	**22**		**15**	**15**	**10**

B. Sc. II S E M E S T E R – IV (Duration – 6 Months)									
Sr. No	**Course Code**	**Name of the Course**	**TEACHING SCHEME**						
			Theory			**Practical**			
			No. of lectures /Week	**Clock Hours/ week**	**Credits**	**Course Code**	**No. of lectures /Week**	**Clock Hours/ Week**	**Credits**
1	BNTT-401	Physics-VII	2	2	2	BNTP 411 LAB 1 (Physics)	3	3	2
2	BNTT-402	Physics-VIII	2	2	2				
3	BNTT-403	Chemistry-VII	2	2	2	BNTP412 LAB 2 (Chemistry)	3	3	2
4	BNTT-404	Chemistry-VIII	2	2	2				
5	BNTT-405	Biotech-VII	2	2	2	BNTP 413 LAB 3 (Biotechnology)	3	3	2
6	BNTT-406	Biotech-VIII	2	2	2				
7	BNTT-407	Statistics-III	2	2	2	BNTP 414 LAB 4 (Statistics)	3	3	2
8	BNTT-408	Statistics-IV	2	2	2				
9	BNTT-409	Instrumentation-III	2	2	2	BNTP 415 LAB 5 (Instrumentation)	3	3	2
10	BNTT-410	Instrumentation-IV	2	2	2				
11	BNTT-AECC-2	EVS-I	2	2	2				
	Total of SEM III		**22**	**22**	**22**		**15**	**15**	**10**
	Total of SEMIII & SEMIV		**44**	**44**	**44**		**30**	**30**	**20**

Student contact hours per week : 37 hr.	Total Marks for B.Sc.-II (Including Environmental Science) :**1350**
Theory lectures and practical : 60 min.	Total Credits for B.Sc.-II (Semester III & IV) :**64**
AECC2- Ability Enhancement Compulsory Course(BNTT-AECC-2 & BNTT-AECC-2)Environmental Science **BNTT- B. Sc. Nanoscience and Technology Entire**. (for Semester III BNTT-301 to BNTT-310 and for Semester IV BNTT-401to BNTT-410) 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). Passing Criteria - minimum40%	

Semester III

Sr. No	Course Code	Name of course	Name of papers
1	BNTT-301	Physics-V	Waves, Oscillation and sound
2	BNTT-302	Physics-VI	Thermal Physics
3	BNTT-303	Chemistry-V	Physical Chemistry
4	BNTT-304	Chemistry-VI	Organic Chemistry
5	BNTT-305	Biotech-V	Biomolecules and General Microbiology I
6	BNTT-306	Biotech-VI	Biomolecules and General Microbiology II
7	BNTT-307	Statistics-I	Statistical Methods for Physical Sciences-I
8	BNTT-308	Statistics-II	Statistical Methods for Physical Sciences-II
9	BNTT-309	Instrumentation-I	Electronic Instrumentation
10	BNTT-310	Instrumentation-II	Measurement Techniques
11	BNTT -AECC-2	Environmental Science	Environmental science
12	BNTP -311-LAB-1		Physical Science
13	BNTP -312-LAB-2		Chemical Science
14	BNTP -313-LAB-3		Biotechnology
15	BNTP -314-LAB-4		Statistics
16	BNTP -315-LAB-5		Instrumentation

Semester IV

Sr. No	Course Code	Name of course	Name of papers
1	BNTT-401	Physics-VII	Modern Physics
2	BNTT-402	Physics-VIII	Optic, lasers and Crystallography
3	BNTT-403	Chemistry-VII	Organic Chemistry
4	BNTT-404	Chemistry-VIII	Analytical Chemistry
5	BNTT-405	Biotech-VII	Nanobiology I
6	BNTT-406 T	Biotech-VIII	Nanobiology II
7	BNTT-407 T	Statistics-III	Statistical Methods for Physical Sciences-III
8	BNTT-408 T	Statistics-IV	Statistical Methods for Physical Sciences-IV
9	BNTT-409 T	Instrumentation-III	Analytical Instrumentation I
10	BNTT-410 T	Instrumentation-IV	Analytical Instrumentation II
11	BNTT -AECC-2	Environmental Science	Environmental science
12	BNTP -411-LAB-1		Physical Science
13	BNTP -412-LAB-2		Chemical Science
14	BNTP -413-LAB-3		Biotechnology
15	BNTP -414-LAB-4		Statistics
16	BNTP -415-LAB-5		Instrumentation

Other Features:

A. Library: Text books, Journals and Periodicals, reference books for advance studies.

B. Specific Equipment's Necessary to run the course: Computers, LCD projectors, Visualizers, Smart board.

C. Laboratory Equipment's:

1) pH meter
2) Weighing Balance
3) Conductometer
4) Compound microscope
5) Micropipettes
6) Micro-Centrifuge
7) Colorimeter
8) Refrigerator (258 L)
9) Autoclave
10) Incubator
11) Muffle Furness
12) Waterbath
13) Cooling Centrifuge
14) UV-tansilluminator
15) CRO
16) Function Generator
17) Electronics Experimental Kits
18) UV-Vis Spectrophotometer.
19) FTIR Spectrophotometer.

D. Learning Outcomes:

1) After successful completion of the course the student will be able to use the techniques, skills, and modern instrumental tools necessary for Research practices.
2) The students are expected to understand the fundamentals, principles concepts and recent developments in the subject area.
3) The practical course is framed in relevance with the theory courses to improve the understanding of the various concepts in particular subject.
4) Ability to communicate effectively.

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(AUTONOMOUS)

Syllabus introduced from June, 2019

B. Sc. II. Nanoscience and Technology (Entire)

B. Sc. Part – II Semester III
Paper: BNTT - 301: (Physics V: Waves, Oscillation and Sound)
Credit- 2

Objectives:

1) To study the Lissajous figures
2) To study the gyroscopic motion and its application
3) To study the properties of sound
4) To study the applications of Precessional

UNIT1: Oscillations (08)

Simple Harmonic Oscillations in an Electrical System, Sup**e**rposition of two co-linear harmonic Oscillations-Linearity and superposition principle-1) Oscillations having an equal frequencies 2) Oscillations having different frequencies (beats), Lissajous figures with equal and unequal frequencies and their uses.

UNIT 2:Precessional Motion (08)

Precession, torque necessary for precession, nutation, gyroscope, Lanchester's rule, gyrostatic pendulum, motion of rolling disc and hoop, gyroscopic applications-
1) Riding on a bicycle 2) Refilling of barrels of guns and rifles.

UNIT 3: Wave Motion (06)

Transverse waves on a string, travelling and standing waves on a string, normal modes of a string, group velocity, phase velocity, plane waves, spherical waves, intensity of a wave.

UNIT4: Sound (08)

Transducers and their characteristics, pressure microphone, moving coil loud speaker. **Acoustics of Buildings:** Reverberation time, factors affecting acoustics of buildings, Sabine's Experimental work and formula, optimum reverberation time.

Learning Outcomes:

1) Student will understand the SHM and its solution.
2) Student will able to understand plane waves, spherical waves.
3) Student will able to define transducers and their types.
4) Student will able to understand concept of acoustic of building.
5) Student will able to understand Sabine’s experimental work.

Reference Books:

1. Physics volume I –Halliday and Resnick. Edition 8th John Wiley and sons publications (UNIT 2)
2. Text book of optics for B.Sc. Classes- Brij Lal and N. Subrahmanyam, S. Chand & Company Ltd. New Delhi, 2006
3. Properties of matter - D. S. Mathur, S. Chand Publications.
4. Sound - Khanna and Bedi, Atma ram and sons.
5. Waves and oscillations-R. N. Choudhari 2nd Edition, New age publishers.(UNIT-1)
6. Physics of waves-Harvard Georgie, Prentice hall publication ,8th Edition (UNIT-3,4)
7. The Physics of vibration and waves- H.J Pain, 6th edition John Wiley and sons (UNIT-1)

8. Acoustics, waves, and oscillations- S.N. SEN, 2nd edition New age international publisher (UNIT-3)
9. The theory of sound-J.W.S Rayleigh 2nd edition .Dover publications(UNIT-3)
10. Mechanics ,wave motion, heat- Francis Weston Sears, 2nd edition Addison-Wesley Pub.(UNIT-1)
11. Electronics circuits and applications- Bernard Grob Glencoe/McGraw-Hill School Pub Co (March 1, 1982)(UNIT-4)

B. Sc. Part – II Semester III
Paper: BNTT - 302: (Physics VI: Thermal Physics)
Credit- 2

Objectives

1) To study the properties of ideal and real gases.
2) To study the laws of thermodynamics.
3) To study the black body radiation spectrum.
4) To study macrostates and microstates.

UNIT 1: Kinetic Theory of gases (09)

1) Ideal and Real gas–

Interpretation of temperature, Andrew experiment and curve, critical constants, Relation between critical constants and Van der Waal's constant), Principle of thermometry, types of thermometer, Platinum resistance thermometer.

2) Transport phenomena-

Mean free path, transport of momentum (viscosity), Energy (conduction) and mass (Diffusion), law of equipartition of energy (no derivation) and it's application to specific heat of gases; mono-atomic and diatomic gases.

UNIT2: Thermodynamics-I (07)

Thermodynamical state, Thermodynamic equilibrium, zeroth law of thermodynamics, first law and internal *energy*, conversion of heat into work, various thermodynamical processes (application of first law*)*: general relation between Cp and Cv, work done during isothermal and adiabatic processes, reversible and irreversible processes

UNIT3: Thermodynamics-II (07)

Second law of thermodynamics (different statements), Carnot's reversible engine, Carnot's cycle, efficiency of Carnot's engine, Carnot's theorem), Entropy, entropy changes in reversible and irreversible processes, entropy-temperature diagram, third
Law of thermodynamics

UNIT 4: Theory of radiation (07)

Black body radiation, spectral distribution, concept of energy density, derivation of Planck's law, deduction of Wien's distribution law, Rayleigh-Jeans law, Stefan Boltzmann law and Wien's displacement law from Planck's law, phase space, macrostate and microstate.

Learning Outcomes:

1. Student will understand kinetic theory of gases.
2. Student will able to understand thermodynamical state, equilibrium and various processes.
3. Student will able to understand Carnot's theorem, working of Carnot's engine.
4. Student will able to define concept of black body radiation.

Reference Books:

1. Treaties on Heat- Saha and Shrivastava The Indian press,
2. Heat and Thermodynamics- Brijlal and Subramanyam S. Chand and Co. Ltd, Delhi(UNIT-1,2,3,4)
3. Heat and Thermodynamics, M. W. Zemansky and R.Dittman,7th edition, The McGraw Hill company(UNIT-1,2,3,4)
4. Thermal Physics, S. Garg, R. Bansal and C. Ghosh,2nd Edition, Tata McGraw hill Publishing, Co. Ltd(UNIT3)
5. Fundamentals of physics –Haliday Resnik 6th Edition Wiley publication(UNIT-4,5)
6. Mathematical Physics of Black Body Radiation- Claes Johnson, Icarus I Ducation 2012
7. Introduction to quantum mechanics-David J. Griffith, Cambridge University Press; 3 edition (August 16, 2018)
8. http://web.uni-miskolc.hu/~www_fiz/KovacsE/InfEng_Quantum.pdf
9. Mechanics wave motion, heat-Francis Sears, Published by Addison-Wesley Publishing Company (1958)(UNIT-1,2,3)
10. Kinetic theory of gases-Earle H. Kennary First Edition, McGraw Hill company , New York, London(UNIT-1)

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B. Sc. Part – II Semester III
BNTP - 311: Lab 1- Physical Science
Credit- 2

Objectives:

1) In this course all the practicals are included in accordance with the theory syllabi.
2) This practical course will provide student better understanding of wave mechanics and Thermodynamics.

PRACTICALS

1) To study Lissajous figures using CRO
2) Determine velocity of sound using Kundts tube
3) Determine frequency of sound using resonating bottle
4) To determine Thermal conductivity of a bad conductor by Lee's method
5) Stefan's constant
6) To study the sensitivity of CRO
7) Study of transducer- To study the variation of thermo-emf across the two junctions of thermocouple with temperature
8) To determine value of planks constant.
9) Determine velocity of sound using CRO
10) To determine the coefficient of thermal conductivity of copper by Searle's method
11) Colpitts oscillator
12) To study of Focaults pendulum

Learning Outcomes:

1) Students learn to operate CRO and different application of CRO.
2) Student will learn to handle different instruments with ease.
3) Student will learn about application of transducers in daily life.

Reference Books:

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

B. Sc. Part – II (Semester III)
Paper: BNTT - 303: (Chemistry V: Physical Chemistry)
Credit- 2

Objectives:

1) Student will have a firm foundation in the fundamental and application of chemical and scientific theories including physical chemistry.
2) To make the learner proficient in analyzing the various observations and chemical phenomena presented to him during the course.
3) To study of properties of solution and phase equilibria.
4) To study of terms in conductance and electrochemistry.

UNIT1: Solutions (06)

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule and Fractional distillation, distillation of immiscible liquid, partial solubility of liquid.

UNIT 2: Phase Equilibrium (08)

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver).

UNIT3: Conductance (08)

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid base).

UNIT4: Electrochemistry (08)

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes, Standard electrode potential, Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge.

Learning Outcomes:

Student will able to know

1. Colligative properties of solutions, Raoults law, Leverrule
2. Component and degree of freedom of system
3. Phase diagram of one and two component systems.
4. Basic terms in conductance, Kohlrausch Law, transparent number and its experimental determination using Hittorf method
5. Basic terms in electrochemistry, types of electrode, determination of cell potential.

Reference Books:

1. Textbook of Physical chemistry, P. L. Sony, O. P. Dharmarha, U. N. Das by Sultan Chand and S. publication.(UNIT1,2,3,4)
2. Principle of physical chemistry Puri Sharma, Patania by Vishal publishings. Co.44th edition. (UNIT1,2,3,4)
3. Textbook of physical chemistry, A. S. Negi, S. C. Anand New age internationalpublishers.2nd edition. (UNIT1,2,3,4)
4. Physical chemistry, W. Atkins low priced edition.(UNIT1,3)
5. Physical chemistry, G. K. Vermulapalli by Printice hall of India Pvt. Lmt eastern economy edition.
6. Physical chemistry, N. Kunda, S. K. Jain by S. Chand and company lim LCSE

B. Sc. Part – II (Semester III)
Paper: BNTT - 304: (Chemistry VI: Organic Chemistry)
Credit- 2

Objectives:

1) To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.
2) To enhance student sense of enthusiasm for chemistry and to involve them in intellectually stimulating experience of learning in a supportive environment.
3) To study of preparation and reaction of acid, amines and diazonium salt.
4) To study of preparation and reaction of alcohols, phenol, aldehyde and ketone.

UNIT 1: Carboxylic acids and their derivatives (06)

Carboxylic acids (aliphatic and aromatic) *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell – Vohlard – Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons)

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion.

Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin Reaction.

UNIT 2: Amines and Diazonium Salts (06)

Amines (Aliphatic and Aromatic): (Upto 5 carbons)

Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, and Hofmann Bromamide reaction.

Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Diazonium salts: *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes (methyl orange)

UNIT 3: Alcohol and Phenols (10)

Alcohols: *Preparation:* Preparation of alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Schotten – Baumann Reaction.

UNIT 4: Aldehyde and ketone (08)

Aliphatic and aromatic: (Formaldehye, acetaldehyde, acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$. Iodoform test. Aldol Condensation, Wittig reaction. Clemensen reduction and Wolff Kishner reduction.

Learning Outcomes:

Students will able to know

1) Preparation and reaction of carboxylic acids
2) Preparation of amines and diazonium salt
3) Preparation and reaction of alcohol and phenol
4) Reaction and mechanism of some name reactions.
5) Preparation and reaction of Aldehyde and ketones.

Reference Books:

1. Advanced Organic Chemistry, Arun Bahl, B. S. Bahl by S.Chand.(UNIT 1,2,3,4)
2. Textbook of organic Chemistry, Raj K. Bansal By New age international publisher 5th edition. (UNIT 1,2,3,4.)
3. Organic Chemistry Morrison Boyd, Bhattacharjee By Pearsons publications 6th edition. (UNIT 1,2,3,4)
4. Organic reaction mechanism V. K. Ahulwalia by Narosa publication. (UNIT 1)
5. Reaction Rearrangment and Reagent S. N. Sanyal By Bharati Bhavan publication. (UNIT 4)
6. Study guide to organic Chemistry, Morrison and Boyd By Pearsons publications 6thedition. (UNIT 1, 2)
7. Organic Chemistry, Clayden, Greeves, Warren and Wothers Oxford University press 7th edition.
8. Advanced Organic Chemistry, Jerry March By Willy publications 4th edition.

B. Sc. Part – II (Semester III) BNTP - 312: Lab 2- Chemical Science

Credit- 2

Objectives:

1) The aim of the practical course is 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 with an understanding of the theory and interpretation of experimental results, perform calculations on these results.

PRACTICALS

A. Physical Chemistry

Conductance

1. Determination of cell constant
2. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
3. Perform the following conductometric titrations:
   i. Strong acid vs. strong base
   ii. Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:

1. Strong acid vs. strong base
2. Weak acid vs. strong base
3. Potassium dichromate vs. Mohr's salt

Phase Equilibria

1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
2. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
3. Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

B. Organic Chemistry

I) Organic Qualitative Analysis:

Acids: Salicylic acid, phthalic acid, aspirin, cinnamic acid, Succinic acid, Oxalic acid, Phenol: β napthol, p-nitro phenol, m-nitro phenol.

Base: p-nitro aniline, o-nitro aniline, m-nitro aniline, diphenyl amine.

Neutrals: Acetamide, ethyl methyl ketone, Acetophenone, Benzophenone, Benzaldehyde, methyl acetate, chloro benzene, bromo benzene, Nitrobenzene, m- dinitrobenzene, naphthalene, thiourea.

II) Organic Estimation:

1. Estimation of Acetone
2. Estimation of Aspirin

III) Organic Preparations:

1. Preparation of p– nitroacetanilide
2. Preparation of Dihydropyrimidone

3. Preparation of Benzoic acid
4. Preparation of Benzamide

Learning Outcomes:

Student will able to know

1. Equivalent conductance degree of dissociation, and dissociation constant of acid.
2. Conductometric and potentiometric titration
3. Qualitative organic analysis.
4. Organic estimation and preparation.

Reference Books:

1. Vogel, A. I., Tatchell, A. R., Furnis, B. S., Hannaford, A. J. & Smith, P. W. G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition,1996
2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*,R. Chand & Co.New Delhi (2011).
4. Ahluwalia, V. K. & Agarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press

B. Sc. Part – II (Semester III)
Paper: BNTT - 305: (Biotechnology V: Biomolecules and General Microbiology I)
Credit- 2

Objectives:

1) To study structure and functions of important Biomolecules.
2) To study nutrient media for bacterial isolation.
3) To study different culture techniques for isolation of bacteria.
4) To study the methods of bacterial cultivation for industrial production.

UNIT1: **(08)**

Carbohydrates:

Carbohydrates: Monosaccharides, Disaccharides, Polysaccharides Classification. Introduction to: Structural Polysaccharides, Storage Polysaccharides, Complex Polysaccharides.

UNIT2: **(08)**

Lipids and Nucleic acid:

Lipid Classification, Fatty Acids, Triacylglycerols, Glycerophospholipids, Sphingolipids, Cholesterol. Storage Lipids, Lipids as Signals, Cofactors and pigments.

Nucleic acids: Deoxyribose nucleic acid (DNA), Ribonucleic acid (RNA) Components of Nucleic acids, Nucleotides, Purines and Pyrimidines, Structure and types of nucleic acids.

UNIT3: **(07)**

Microbial Nutrients:

Common nutrient requirements, requirements for carbon, hydrogen and oxygen, types of microorganisms based on nutritional requirements.

Culture media: Synthetic or defined media, complex media, types of media, selective media, differential media.

UNIT4: **(07)**

Pure culture techniques:

Isolation of pure cultures, spread plate, streak plate, pour plate method, colony morphology and growth.

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, purification and preservation.

Learning outcomes:-

1) Students will able to know functions of different carbohydrates in biological system.
2) Students will able to understand culture media for microbial growth.
3) Students will able to know functions of different lipids & nucleic acid in biological system.
4) Students will able to know different pure culture techniques for the isolation of micro-organisms.

Reference Books:

1. Lehninger's Principles of Biochemistry by D. L. Nelson and M. M. Cox, CBS Publications, 2000.(UNIT 1, 2)
2. Biochemistry by Lubert Stryer, 4th Edition.(UNIT 1, 2)
3. General Microbiology by Stanier, Adelberg and Ingraham, The Macmillan Press Ltd, Hong Kong.(UNIT 3, 4)
4. Cell biology, genetics, molecular biology, evolution and ecology verma, agarwal 2005 S. Chand and company (UNIT 1, 2)
5. Biochemistry; Satyanarayana Chakrapani, Books & Allied Pvt Ltd(UNIT 1, 2)
6. Lodish-molecular Biology of the cell, W. H. Freeman and company (UNIT 1, 2)
7. Microbiology by Pelczar, TATA Mc-Graw Hill.(UNIT 3, 4)

B. Sc. Part – II (Semester III)
Paper: BNTT - 306:(Biotechnology VI: Biomolecules & General Microbiology II)
Credit- 2

Objectives:

1) To study structure and functions of biological nanostructures.
2) To study the importance and deficiency of vitamins.
3) To study microbial growth and its characteristics.
4) To study bacterial reproduction and their control.

UNIT 1 **(08)**

Proteins:

Overview of amino acids and protein, Peptide bond, Primary, Secondary, Tertiary and Quaternary Structures. Fibrous protein, globular proteins. Protein Stability, Protein folding and denaturation.

UNIT 2 **(08)**

Enzymes and Vitamins:

Enzymes: Classification, Overview of structure, function and mechanism of action of enzymes.

Vitamins and Minerals: Importance and role of vitamins, Types of vitamins, water soluble and fat soluble vitamins. Minerals, micro-nutrients, macro-nutrients, roles and functions, disorders of mineral deficiency.

UNIT 3 **(07)**

Microbial growth:

Microbial growth, Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. The influence of environmental factors on growth: solutes and water, pH, temperature, oxygen concentration, pressure, radiation.

UNIT 4 **(07)**

Bacterial Reproduction:

Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria. Control of Microorganisms: By physical, chemical and chemotherapeutic Agents.

Learning Outcomes:

1) Students will able to know functions of protein in biological system.
2) Students will able to know structure and classification of enzymes.
3) Students will able to know mechanism of enzyme action.
4) Students will able to know role of vitamins in biological system.
5) Students will able to know role of minerals in biological system.
6) Students will able to know growth mechanism of micro-organisms.

Reference Books:

1. Lehninger's Principles of Biochemistry by D. L. Nelson and M. M . Cox,CBS Publications,2000.(Unit1, 2)
2. Biochemistry by Lubert Stryer, 4thEdition. (Unit1, 2)
3. General Microbiology by Stanier, Adelberg and Ingraham, TheMacmillan Press Ltd,H.
4. Cell biology, genetics, molecular biology, evolution and ecologyverma, agarwal 2005 S. Chand and company.(Unit 4)
5. Biochemistry; Satyanarayana Chakrapani, Books & Allied Pvt Ltd (Unit 2)
6. Lodish-molecular Biology of the cell, W. H. Freeman and company
7. Microbiology by Pelczar. TATA Mc-Graw Hill.(Unit 3)

B. Sc. Part – II Semester III
BNTP - 313: Lab 3- Biotechnology
Credit- 2

Objectives:

1) To study different staining techniques of bacteria and its biochemical characterization.
2) To study preparation of media and sterilization techniques.
3) To study separation of amino acids by paper chromatography.
4) To study estimation of proteins and carbohydrates by different methods.

PRACTICALS

1) Isolation of bacteria & their biochemical characterization.
2) Staining methods: simple staining, Gram staining, negative staining and hanging drop.
3) Preparation of media & sterilization methods, methods of Isolation of bacteria from different sources.
4) Determination of bacterial cell size by micrometry.
5) Enumeration of microorganism - total & viable count.
6) Separation of Amino acids by paper chromatography.
7) Qualitative tests for Carbohydrates, lipids and proteins.
8) Determination of total amino acid concentration by ninhydrin method.
9) Estimation of protein concentration by Biuret method or Lowry method.
10) Estimation of reducing sugar concentration by DNSA method.
11) To study the growth curve of *E.coli* bacteria.
12) Estimation total sugar concentration by i) Phenol-H_2SO_4 method ii) Anthrone method

Learning outcomes:-

1) Students will able to know isolation and characterization of bacteria from different sources.
2) Students will able to know qualitative estimation of biomolecules.
3) Students will able to know technique of paper chromatography.
4) Students will able to know growth of *E.coli* bacteria.
5) Students will able to know quantitative estimation of carbohydrates.

Reference Books:

1. Practical Biochemistry: An Introductory Course by Fiona Frais.
2. Textbook of Practical Biochemistry by David Plummer.
3. Laboratory Mannual in Biochemistry by S. Jayaraman.

B. Sc. Part – II Semester III
Paper: BNTT - 307: (Statistical Methods for Physical Sciences I)
Total Credit- 2

Objectives:

1) To introduce the techniques of data collection and its interpretation.
2) To compute various measures of central tendencies and to interpret them.
3) To develop analysis skill of students to use appropriate Statistical techniques to solve problems in real life.

UNIT1 **(07)**

Meaning and scope of statistics in industry and physical sciences, population and sample, census method, sampling method. Primary and Secondary data, ungrouped and grouped data, qualitative data (attributes) and quantitative data (variables)

UNIT 2 **(08)**

Scales of measurement - nominal, ordinal, interval and ratio scale. Frequency distribution, Graphical representation using Histogram, Frequency curve, Ogive Curve, Boxplot.

UNIT3 **(09)**

Concept of central tendency, criteria for good measures of central tendency. Arithmetic mean (A.M.), Geometric mean (G.M.), Harmonic mean (H.M.) and their properties. Computations of A.M., G.M., H.M., for grouped and ungrouped data. Comparison between averages in accordance with requirements of good average.

UNIT 4 **(06)**

Concept of positional averages. Median, mode and their properties, Computations of median and mode for ungrouped and grouped data.

Learning Outcomes:

Students will able to:

1) Understand need of Statistics, types of data (Primary, secondary, Grouped, Ungrouped, Qualitative and Quantitative data),
2) Scales of measurement, graphical tools (Histogram, Frequency curve, Boxplot).
3) Define-Mathematical Averages (A.M., G.M., H.M.) and their computation.
4) Positional Averages (Median, Mode) and their computation.

Reference Books:

1. Elhance D. N., Fundamental of Statistics (1978)(Unit 1,2,3,4)
2. Agarwal B. L. Basic Statistics (2015); New age international (p) Ltd.(Unit 1,2,3,4)
3. S. P. Gupta, Statistical Methods (2014)(Unit 1,2)
4. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi (2014)(Unit 4)

B. Sc. Part – II Semester III
Paper: BNTT - 307: (Statistical Methods for Physical Sciences II)
Credit- 2

Objectives:

1) To compute various measures, dispersion, moments, skewness, kurtosis, and to interpret them.
2) To develop analysis skill of students to use appropriate Statistical techniques to solve problems in real life.

UNIT 1: Measures of Dispersion (12)

Concept of dispersion, requirements of a good measure of dispersion, measures of dispersion, absolute and relative measures of dispersion. Range, mean deviation, standard deviation and their relative measures. Variance, coefficient of variation and its use. Concepts of measures of skewness and kurtosis.

UNIT 2: Correlation (06)

Concept of correlation, Bivariate data, scatter diagram, Karl Pearson's coefficient of correlation, Spearman's Rank Correlation coefficient.

UNIT 3: Regression (05)

Regression: concept, lines of regression, least square method, regression coefficients, relation between correlation and regression coefficients.

UNIT 4: Multiple and Partial Correlation and Regression (07)

Concept of multiple linear regression, Plane of regression, Yule's notation, fitting of regression plane by method of least squares. Definition of partial regression coefficients and their interpretation. Residual: definition, order, properties. Concept of multiple and partial correlation. Definition, derivation and properties of multiple and partial correlation coefficients.

Learning Outcomes:

Students will able to:

1) Define measures of dispersion, Absolute (Range, Q.D., M.D., S.D.) and relative measures of dispersion, variance and Coefficient of variation, Skewness and Kurtosis
2) Define correlation, Types of correlation (Karl Pearson's, Spearman's Rank correlation)
3) Regression, lines of Regression, Relation between Correlation and Regression
4) Define multiple and partial correlation and regression, and their computation.

Reference Books:

1. Elhance D. N., Fundamental of Statistics(1978)(Unit 1)
2. Agarwal B.L. Basic Statistics(2015); New age international (p) Ltd.(Unit 1)
3. S. P. Gupta, Statistical Methods(2014) (Unit 1,2,3,4)
4. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi(2014)(Unit 2,3, 4)

B. Sc. Part – II Semester III
BNTP - 314: Lab 4 – Computational Methods
Credit- 2

Objectives:

1) To make students are familiar with presentation of data using graphical and computational methods.
2) To assess relation between two variable and model it in mathematical form.
3) To make students are familiar with different measures of dispersions
4) To make students are familiar with Moments, Skewness and Kurtosis

PRACTICALS

1. Graphical presentation of the frequency Distribution-I
2. Graphical presentation of the frequency Distribution-II
3. Measures of central tendency (Grouped Data)
4. Measures of central tendency (Ungrouped Data)
5. Measures of Dispersion (Grouped Data)
6. Measures of Dispersion (Ungrouped Data)
7. Moments, Skewness and Kurtosis (Ungrouped Data)
8. Moments, Skewness and Kurtosis (Grouped Data)
9. Correlation and regression
10. Multiple Correlation
11. Partial Correlation
12. Multiple Regression

Learning Outcomes:

Students will able to

1) Represent given data using appropriate method.
2) Compute correlation between variable and also transform this relation in mathematical form such that anyone can use it.
3) Compute Measures of Dispersion
4) Compute Moments, Skewness and Kurtosis

B. Sc. Part – II Semester III
Paper: BNTT - 309: (Instrumentation I: Electronic Instrumentation)
Credit- 2

Objectives:

1) This course provides comprehensive idea about working principle, operation and characteristics of different transducers.
2) To provide knowledge about selecting transducers.
3) Students are get familiarize with various signal conditioning systems.
4) Students are get familiarize with data acquisition systems.

UNIT 1 **(02)**

General Block diagram of Instrumentation system, Classification of transducers, selecting of transducer, Electrical Transducers and their parameters

UNIT 2 **(15)**

Sensors and Transducers

Electro acoustic transducers: microphone and speaker.

Force/Pressure transducers: resistance pressure transducer, strain gauge, and load cell. Temperature Transducers: Thermistor, Thermocouple and RTD, Fiber Optical sensors, Smart sensors.

UNIT 3 **(04)**

Signal Conditioner: Introduction to Instrumentation Amplifier and active filters.

Voltage to frequency convertors (V/F), frequency to voltage convertors (F/V).

UNIT 4 **(09)**

Data Acquisition System: Block diagram of DAS, objective of DAS, single channel and multi channel Data Acquisition System, computer based data acquisition system and data loggers.

Learning Outcomes:

Students will able to understand

1) General Block diagram of Instrumentation system, Classification of transducers Selecting parameters of transducers
2) Principle, Construction and working of various types of transducers
3) Use of signal conditioning in instrumentation
4) Concept of Data Acquisition System

Reference Books:

1. H. S. Kalsi, Electronic Instrumentation, TMH(2006) (Unit 1,2,3,4)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice- Hall (2005).(Unit 3)
3. Nakra B. C., Chaudry K, Instrumentation Measurement and analysis, TMH (Unit 1,2,3,4)
4. A. K. Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons (2007) (Unit 1,2,3,4)
5. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).(Unit 1,2,3,4)
6. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)
7. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
8. Oliver and Cage, "Electronic Measurements and Instrumentation", TMH (2009).
9. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann- 2008).

B. Sc. Part – II Semester III
Paper: BNTT - 310: (Instrumentation II: Measurement Techniques)
Total Credit- 2

Objectives:

1) To discuss about units, standards, error analysis and characteristics of measurement systems.
2) Explain basic concepts and definitions in measurement.
3) Describe the various AC and DC bridge configurations for relevant parameter measurement.
4) Elaborate discussion about the importance of various instruments in Measurement.

UNIT 1 **(06)**

Principle of Measurements

Measurement and error: Static and dynamic characteristics of an instrument, error in the measurements and types of static error, dynamic response of an instrument, significant figure and rounding off the numbers, statistical analysis

System of units of measurement: fundamental and derived units, international system of units, other system of units.

Standard of measurements: classification of standard, standard for mass, length and volume, electrical standard, international standards.

UNIT 2 **(10)**

Resistance measurement- Voltmeter-Ammeter method and Whetstone Bridge method, measurement of low resistance: Kelvin's bridge method. **Inductance measurement:** Maxwell's bridge, **capacitance measurement**: Schering Bridge, **frequency measurement:** Wien bridge,

Voltage and Current measurement: Introduction, basic DC ammeter, basic DC voltmeter

UNIT 3 **(06)**

Digital Instruments: Introduction, Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time, Q-meter, complex impendence measurement meters and digital LCR Q-meter.

UNIT 4 **(08)**

Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Delay lines, Probes and Transducers, Specification of an Oscilloscope. Oscilloscope measurement Techniques, Special Oscilloscopes – Storage Oscilloscope, Sampling Oscilloscope. Spectrum Analyzer.

Learning Outcomes:

Students will able to understand

1) Static and dynamic characteristics of an instrument, Analyses error in the measurements, Concept of significant figure, Perform statistical analysis, Fundamental and derived units, different types of Standards.
2) Measurement of Resistance, Capacitance, Inductance, Frequency.
3) Principle and working of various types of Digital instruments.
4) Functioning of CRO

Reference Books:

1. H. S. Kalsi, Electronic Instrumentation, TMH(2006) (Unit 1,2, 3, 4)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice- Hall (2005) (Unit 2,3)
3. M. M. S. Anand, Electronic Instruments and Instrumentation Technology, Prentice-Hall (2005) (Unit 1, 2,3)
4. O. Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003) (Unit 2,3)
5. A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons (2007). (Unit 2)
6. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)
7. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
8. Oliver and Cage, "Electronic Measurements and Instrumentation", TMH (2009).
9. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann- 2008).

B. Sc. Part – II Semester III
BNTP - 315: Lab 3- Instrumentation
Credit- 2

Objectives:

1) To study the characteristics of various types of transducers
2) To understand the working of instrumentation amplifier.
3) To study the various types of data converters

PRACTICALS

1) Study of Uncertainty &Errors
2) Study of instrumentation amplifier
3) Study of Load Cell
4) Study of LVDT
5) Study of Thermistors
6) Study of LDR
7) Study of Photodiode
8) Study of Phototransistor
9) Study of Analog to Digital Converter
10) Study of Digital to Analog Converter
11) Study of Fiber optic sensor

Learning Outcomes

Students will get understand working of various types of transducers and signal conditioning devices.

B. Sc. Part – II Semester IV
Paper: BNTT - 401: (Physics VII: Modern Physics)
Total Credit- 2

Objectives:

1) To study the dynamics of particle.
2) To study the Schrödinger wave equation and its application
3) To study nuclear reactions

UNIT 1-Classical Dynamics of Particles (07)

Planck's constant and light as a collection of photons; photoelectric effect and Compton effect; De Broglie wavelength; Davisson Germer experiment, failure of Rutherford model, Bohr's Quantization rule,, Wave Particle duality, Heisenberg uncertainty principle.

UNIT 2-Schrodinger Equation and its formalism (08)

Matter wave and wave amplitude, Schrödinger equation (Non-relativistic particles), momentum and energy, physical interpretation of wave function, normalization of wave function, Probability, probability current density in1-D.

UNIT 3-Applications of Schrödinger Equation (06)

1-D infinitely rigid box- energy eigen values, Eigen functions and normalization, Quantum mechanical tunneling- Step potential (Quantitative) and potential barrier (qualitative).

UNIT 4-Radio activity and nuclear fission and fusion (09)

α-Decay, β-decay- energy released, Pauli's prediction of neutrino, γ -ray emission, Mass deficit, relativity and generation of energy, emission of neutrons, fusion and thermonuclear reaction.

Learning Outcomes:

Students will able

1) To learn about the classical nature of particle before studying the quantum mechanical nature.
2) To learn about how write the Schrödinger equation for particles.
3) To understand the basic knowledge about atom; like nucleus size and shape.
4) To understand the idea about relativity and energy generation

Reference Books:

1. Fundamentals of physics- Haliday -Resnick, Wiley India edition 8th Edition (Unit 4)
2. Fundamentals of modern physics- Peter J Nolan,1st edition,Published by Physics Curriculum & Instruction(Unit 1)
3. Modern Physics notes- by Muhammad Ali Malik.(Unit 1,2,3,4)
4. Modern Physics –Paul A. Tipler 6th editionW. H. Freeman and Company ,New York. (Unit 1,2,3,4)

B. Sc. Part – II Semester IV
Paper: BNTT - 402: (Physics VIII: Optics, lasers and Crystallography)
Credit- 2

Objectives:

1) To study the interference and diffraction pattern of waves.
2) To study the properties and applications of LASER and optical fiber
3) To study the crystal structure.

UNIT1 **(06)**

Interference of light:

Interference in thin films: parallel and wedge - shaped films, Michelson's interferometer and its applications to measure (i) wavelength of light (ii) refractive index of thin film, construction and working of Fabry-Perot interferometer, superiority of F-P interferometer over Michelson's interferometer.

UNIT 2: Diffraction of light: **(06)**

Fraunhofer diffraction: multiple slits and diffraction grating, Fresnel diffraction: half period zones, zone plate, Fresnel diffraction pattern of a straight edge, a slit and wire using half-period zone analysis.

UNIT3: Crystallography: **(08)**

Crystal structure (Elementary idea), lattice and basis, Unit cell, fundamental type of lattices, miller indices, lattice planes, simple cubic, FCC and BCC lattices, reciprocal lattices, Brags law, powder method of X ray diffraction, analysis of cubic crystal structure

UNIT4 **(10)**

Optical fibers:

Principle and structure, type of optical fibers, numerical aperture (definition only) and pulse dispersion in step index fiber, fiber optic communication system (quantitative treatment only), advantages of optical fibers

Laser system:

Absorption, spontaneous and stimulated emission, Einstein coefficients (only definitions), population inversion, optical and electrical pumping, properties of lasers, Ruby laser, Helium-Neon laser, uses of laser, idea of holography(qualitative treatment only).

Learning Outcomes:

1) Understanding interferometer & uses of various interferometer.
2) Student will able to understand concept of Fresnel diffraction.
3) Student will able to analyze structure of crystal using X-ray diffraction.
4) Student will able to define Absorption, spontaneous and stimulated emission.
5) Student will able to understand concept of optical fiber.

Reference Books:

1. Principles of Optics ,B.K.Mathur,1995,Gopal Printing
2. Text book of optics for B.Sc.Classes- BrijLal and N.Subrahmanyam, S.Chand & Company Ltd. New Delhi, 2006
3. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill (Unit1,2,4)
4. Optics- 2nd Edition, Ajay Ghatak, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi,
5. Laser and non linear optics by B. B.Laud,3rd Edition ,Published 2011 by New Age International Publisher
6. Optics and atomic Physics- SatyaPrakash,1st Pragati Prakashan,Meerut.
7. Solid state physics - Kittle,7th Edition.Wiley and sons publications(Unit 3)
8. Physics of light and optics- Justine Peatros, MichealWare,Brigham Young University,2013 Edition(Unit 1,2, 4)
9. Introduction to optics- F.Pedrotri,3rd edition,Pearson Education .(Unit 1,2, 4)
10. Optical fiber communication -V S Bagad,Technical Publications ,Pune(Unit 4)
11. Introduction to modern solid state physic-Yuri. MGalperin(Unit 3)
12. Solid state physics-M.Wahab,3rd Edition,Narosa Publishing House
13. Solid state physics-Ashcroft Mernin, DavidN. Holt Rinehart & Winston; 2 edition (1 January 2002) (Unit 3)

B. Sc. Part – II Semester IV
BNTP - 411: Lab 1- Physical Science
Credit- 2

Objectives:

1) In this course all the practicals are included in accordance with the theory syllabi.
2) This practical course will provide student better understanding of optics and concept related identification crystals Structure.

PRACTICALS

1. To study the Schusters method of optical leveling.
2. To determine resolving power of prism
3. Calibration of spectrometer
4. Diffraction due to cylindrical obstacle
5. Diffraction at straightedge.
6. Measurement and identification of spectral lines
7. To determine wavelength of given laser light using Diffraction grating
8. To study divergence of laser beam
9. To determine crystal structure of given sample using X-ray diffraction pattern
10. Fresnel's bi-prism
11. Absorption spectrum of $KMnO_4$ solution
12. Thickness of thin film

Learning Outcomes:

1) This practical course will provide student better understanding of optics and crystalline structure.
2) Student will learn to handle different instruments with ease.
3) Student will understand types of spectrum and analysis of spectral distribution.
4) Student will learn to identify the crystal structure from XRD pattern and will understand the changes in properties of crystal according to structure.

Reference Books:

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

B. Sc. Part – II (Semester IV)
Paper: BNTT - 403: (Chemistry VII: Inorganic Chemistry)
Credit- 2

Objectives:

1) To expose the students to various emerging new areas of chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.
2) To enhance student sense of enthusiasm for chemistry and to involve them in an intellectually stimulating experience of learning in a supportive environment
3) To study the properties d and f block element.
4) To study the all coordination theory with example.

UNIT 1 Chemistry of elements of first transition series (6)

Position of elements in periodic table: characteristics of d-block elements with special reference to i) Electronic structure ii) Oxidation states, iii) Magnetic character iv) colored ions v) Complex formation.

UNIT 2 Study of f-block elements (8)

Lanthanides: Introduction of f-block elements, Positions of Lanthanides in the Periodic Table, Electronics Configurations, Lanthanide contraction, Oxidation states, Magnetic properties, Occurrence, Separation of lanthanides by Ion exchange method.

Actinides: Position in periodic table, Electronic configuration, Oxidation States.

General methods of preparation of Transuranic elements. i) Neutron capture – followed by β decay. ii) Accelerated projectile bombardment. iii) Heavy ion bombardment.

UNIT 3 Coordination Chemistry (10)

Introduction - Definition and formation of co-ordinate covalent bond in BF_3 -NH_3, $[NH_4]^+$and H_2O. Distinguish between double salt and complex salt, Werner's theory-Postulates. The theory as applied to cobalt amines viz. $CoCl_3.6NH_3$, $CoCl_3.5NH_3$, $CoCl_3.4NH_3$, $CoCl_3.3NH_3$. Description of the terms- ligand, co-ordination number, co-ordination sphere, effective atomic number. IUPAC nomenclature of coordination compounds. Isomerism in complexes with C.N. 4 and 6. Geometrical Isomerism, Optical Isomerism, Structural Isomerism-Ionisation Isomerism, Hydrate Isomerism, Coordination Isomerism, Linkage Isomerism and Co-ordination position Isomerism Crystal field splitting of 'd' orbital in octahedral, tetrahedral. Limitations of CFT.

UNIT4 Catalysis (08)

Introduction, Classification of catalytic reactions – Homogeneous and Heterogeneous. Types of catalysis, Characteristics of catalytic reactions, Mechanism of catalysis. i) Intermediate compound formation. ii) Adsorption.

Learning Outcomes:

Students will able to know

1) Properties of d and f block element and also know separation of Lanthanides.
2) Complex formation of 3d series element.
3) Students will able to know Werner's theory, IUPAC nomenclature of coordination compounds.
4) Students will able to know Isomerism in complexes with C.N. 4 and6, Crystal field splitting of 'd' orbital in octahedral, tetrahedral.
5) Classification of catalytic reactions –Homogeneous and Heterogeneous, catalytic reactions, mechanism of catalysis.

Reference Books:

1. Modern Inorganic Chemistry, R. D. Madan by S. Chand 2nd edition.(UNIT3,)
2. Inorganic Chemistry, Wahid U. Malik, G. D. Tuli and R. D. Madan By S Chand Publication.(UNIT1,UNIT2,UNIT3)
3. Basic Inorganic Chemistry F. Albert Cotton, Geoffery Wilkinsons, Paul L. Gauy by Wiley student edition 6th edition.(UNIT3)
4. Inorganic Chemistry Principle structure and Reactivity By James E. Huheey, Ellen A. Keiter, Keiter, Medhi by Pearsons publications 4th edition.(UNIT3)
5. Concise Inorganic chemistry, J. D. Lee by Wiley India Editor 5th edition.(UNIT1,2, 3)
6. Inorganic Chemistry By Atkins, Overtone Rource, Weller, Armstrons By Oxford University press.
7. Essential Physical Chemistry, B.S. Bahl, G. D. Tuli, Arul Bahal by S. Chand publication.(UNIT4)
8. Chemistry Dr. S. S. Cheema, Lali Sharma, Dr. R. K. S. Negi, Dr. S. C. Bhatia by Dhilon group of publication New Delhi.(UNIT4)

B. Sc. Part – II (Semester IV)
Paper: BNTT - 404: (Chemistry VIII: Analytical Chemistry)
Credit- 2

Objectives:

1) Development of analytical skills of the students.
2) To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences
3) To study of purification and separation method.
4) To study of chromatography and quantitative analysis.

UNIT 1 Purification and Separation Method (06)

Distillation techniques, Distillation of liquid mixtures, Types of distillation , Types of columns and packing, Condensers, Vacuum distillation, Spinning-band distillation, Steam distillation, Kiigelrohr distillation, Isopiestic or isothermal distillation, recrystallization techniques, Filtration, Choice of solvents, Petroleum ethers, Mixed solvents Sublimation. Solvent extraction: Classification principal and efficiency of technique mechanism of extraction salvation and chelation.

UNIT 2 Water Analysis (06)

Introduction, hardness (Temporary and permanent) Sterilization and disinfection of water; Chemical methods (Aeration, use of KMnO4, ionization, bleaching powder) and physical methods of sterilization (Boiling, exposure to sunlight and UV light, Irradiation with ultrasound) Measurement of water quality by chemical and physical examination: Color Taste, Turbidity, Alkalinity, Suspended solids, Hydrogen ion concentration, Acidity, Biological oxygen demand(BOD), Chemical oxygen demand(COD), Dissolved oxygen(DO).

UNIT3 Chromatography (06)

Introduction, Basic Principle of Chromatography, Basic terms, Classification of Chromatography Paper Chromatography- Principle, Methodology-types of papers and treatment, sample loading, choice of solvent, development-ascending, descending, circular, location of spots, determination of Rf value, Applications, advantages and disadvantages Thin layer chromatography; Principle, Solvent system, stationary phases, preparation of TLC plate, Detecting reagents, methodology-sample loading, development, detection of spot, Rf value, Applications, advantages and disadvantages, Comparison of paper chromatography and TLC, column chromatography, gas chromatography.

UNIT 4 Quantitative Analysis (06)

Theoretical principle involved in quantitative analysis –

Volumetric analysis

i) Calibration of apparatus ii) General principle involve in volumetric analysis
iii) Standardization of solution Primary & Secondary std; Preparation of std soln.
iv) Classification of titration; Redox titration; theory of indicators; Titration curves.

Gravimetric analysis

i) Definition & types of gravimetric analysis ii) Precipitation technique with respect to theory iii) Solubility consideration; Common ion effect; diverse Ion effect; PH; Temperature and nature of solubility. iv) Digestion v) Nucleation vi) Co & post precipitation vii) Filtration &

washing viii) Drying &Ignition.

Learning Outcomes:

1) Students will learns the concept of purification techniques, separation techniques
2) Defines vacuum distillation, steam distillation, etc
3) Students will understand water analysis techniques, its purification, etc
4) Gains knowledge of hardness, BOD, COD,
5) Students will understand principle and working of paper TLC, column and gas chromatography.
6) Student understands volumetric analysis, gravimetric analysis.

References Books:

1. Industrial chemistry by B. K. Sharma, Goel Publishing Housing, 1Stedition.(UNIT 2)
2. Chemical Principles, 3rd Ed. Robert S. Boikess Edward Edelson, Harper International Ed.(UNIT 2)
3. Principles of Environmental Chemistry, 2nd Ed. James E. Girard Jones and Bartlett.(UNIT 2)
4. Systematic Experiment in Chemistry Arun Sethi New Age International Publisher. (UNIT 1)
5. Vogels Textbook of Quantitative Inorganic Analysis J. Bassett, R. C. Denney,
6. G. H. Jeffary J. Medha (UNIT 1)
7. Instrumentation methods of chemical analysis, Chatwal –Anand, Himalaya publishing House (UNIT 3)
8. Khopkar, S. M. *Basic Concepts of Analytical Chemistry*. New Age, International Publisher, 2009.AdditionalReading.(UNIT 3,UNIT4)
9. Analytical chemistry, Walter E. Harris.(UNIT 4)

B. Sc. Part – II Semester IV
BNTP - 412: Lab 2- Chemical Science
Credit- 2

Objectives:

1) The aim of the practical course is the ability to perform accurate quantitative measurements with and understanding of the theory and use contemporary chemical instrumentation, interpret experimental result, perform the calculation these results and draw reasonably, accurate conclusion.
2) To expose the students to the ability to present scientific and technical information resulting from laboratory experimentation in both written and oral formats.

PRACTICALS

1. Semi-micro qualitative analysis using H_2S of mixtures - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:Cations : NH^{4+}, Pb^{2+}, Ag^{+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sn^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+},Ba^{2+}, Sr^{2+}, Ca^{2+},K^{+}
   Anions : CO_3^{2-} , S^{2-}, SO^{2-}, $S_2O_3^{2-}$, NO^{3-}, CH_3COO^{-}, Cl^{-}, Br^{-}, I^{-}, NO_3^{-},SO_4^{2-}, PO_4^{3-}, BO_3^{-},C_2O_4, F^{-}*(Spot tests should be carried out wherever feasible)*
2. Estimate the amount of nickel present in a given solution as bis (dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.
3. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
4. Gravimetric estimation of Barium.
5. Gravimetric estimation of iron.
6. Preparation of ferrous ammonium sulphate.
7. Preparation of tetramminocopper (II)sulphate.
8. Estimation of total hardness of a given sample of water by complexometric titration.
9. Thin layer chromatography.
10. Colorimeter (anyone)

a) Draw calibration curve (absorbance at λ max vs. concentration) for various concentrations of a given coloured compound ($KMnO_4$/ $CuSO_4$) and estimate the concentration of the same in a given solution.

b) Determine the composition of the Fe^{3+}salicylic acid complex solution by colorimetric method.

11. Chemical Kinetics

a) To study the hydrolysis of methyl acetate in presence of HCl and H_2SO_4 and to determine the relative strength of acids.
b) To study the effect of acid strength (0.5 M and 0.25 M HCl) on hydrolysis of an ester.
c) To study the kinetics of the reaction between $K_2S_2O_8$ and KI in solution with unequal initial concentration of the reactants

Learning Outcomes:

1) Student will able to know semi micro qualitative analysis and gravimetric analysis.
2) Student will able to know complexometric titration
3) Student will able to understand measurement of colorimetric parameters (Absorption and Transmission).
4) Student will able to know kinetics of reaction.

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education,2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson,2009.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

B. Sc. Part – II(Semester IV)
Paper: BNTT - 405: (Biotechnology VII: Nanobiology I)
Credit- 2

Objectives:

1) To study role of microbes in Nanotechnology.
2) To study nanomaterials synthesis by biological methods.
3) To study different concepts of immunology and vaccination.
4) To study the antigen-antibody reaction for detection of disease.

UNIT1- **(08)**

Role of Microbes in Nanotechnology:

Microbial synthesis of nanomaterials- Concepts and introduction

Bacteria mediated Nanomaterials synthesis – Methodology, Mechanism and applications, Fungi mediated nanomaterials synthesis – Methodology, Mechanism and applications, Advantages of microbial/biogenic nanomaterials synthesis methods

UNIT2- **(07)**

Nanomaterials synthesis:

Yeast mediated nanomaterials synthesis – Methodology, Mechanism and applications, Plant mediated nanomaterials synthesis – Methodology, Mechanism and applications, Antimicrobial activity of nanomaterials- concept of MIC, MBC, possible mechanisms of the antimicrobial activities, Isolation and enrichment of metal tolerant microorganisms

UNIT3- **(08)**

Concepts of immunology:

T lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T- cells), T-cell receptors, genome rearrangements during B-lymphocyte differentiation, B cell receptors, monoclonal antibodies, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

UNIT4- **(07)**

Vaccines & Vaccination:

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA.

Learning outcomes:

1) Students will able to know mechanism of nanoparticle synthesis by bacteria and fungi.
2) Students will able to know role of microbes in Nanotechnology.
3) Students will able to know mechanism of formation of antibodies.
4) Students will able to know metal tolerance of micro-organisms.

Reference Books:

1. Immunocytochemical_Methods_and_Protocols1st_.(Unit 3, 4)
2. Golds by RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, NewYork.(Unit 3, 4)
3. NANO: The Essentials by T. Pradeep Mc Graw Hill education. (Unit 1, 2)
4. Synthesis of Nanoparticales and nanomateriale synthesis by biological approches_Abdullaeva_Springer publication

B. Sc. Part – II (Semester IV)
Paper: BNTT - 406: (Biotechnology VIII: Nanobiology II)
Credit- 2

Objectives:

1) To study basic things of Nanotechnology.
2) To study concept and applications of Nanochips.
3) To study concept and applications of Nanomedicine.
4) To study disease treatment with the help of Nanomadicine.

UNIT1 - **(09)**

The Canvas of Nano and Nanochips:

The Canvas of Nano: Nano and nature, Nano –The Beginning, Applications of Nano in biology.

Nanochips**:** Nanoparticles and quantum dots as molecular labels. Diagnostic Nanochips, lab on chips (micro fluidic technology) and microelectromechanical systems (MEMS). Nanoprobes for analytical applications.

UNIT2- **(07)**

Nanodiagnostics:

Nanotechnology in molecular imaging. Materials for use in diagnostic and therapeutic applications. Diagnosis using Nanomaterials, Nanoparticles for bioanalytical applications, Nanoparticles for MRI, X- Ray, ultrasonography, gamma ray imaging.

UNIT3- **(06)**

Nanobiosensor:

Biosensor and nanobiosensor basic concepts, characterization, perception, Different types of nanobiosensors; Nanobiosensors for medical diagnostics.

UNIT4- **(08)**

Nanomedicine:

Concept of disease, Cause and molecular/cellular progression of key diseases including infectious, inherited diseases, immunological diseases and cancer. Approach to developing nanomedicines. Various kinds of nanosystems in use. Nanodrug administration nano-devices for drug delivery and diagnostics. Introduction to the potentials, applications and challenges of nanomedicine. Nanomedicine and tissue engineering, nanobiomachines and nanorobots.

Learning outcomes:-

1) Students will able to know concept and applications of Nano.
2) Students will able to know mechanism of nanochips for disease diagnostics.
3) Students will able to know use of nanoparticles for different diagnostics techniques.
4) Students will able to know mechanism of nanobiosensor.
5) Students will able to know mechanism of nanobiomachines and nanorobots.

Reference Books:

1. NANO: The Essentials by T. Pradeep Mc Graw Hilleducation.(Unit 1,2,3,4)
2. Mark_A._Ratner,_Daniel_Ratner_Nanotechnology(Unit 1,2,3,4)
3. A. K. Bandyopadhyay; Nanomaterials. (Unit 1,2,3,4)
4. Glen_E._Fryxell,_Glen_E._Fryxell; Environmental applications of Nanomaterials.

B. Sc. Part – II Semester IV
BNTP - 413: Lab 3- Biotechnology
Credit- 2

Objectives:

1) To determine leucocytes count in blood.
2) To study different techniques of ELISA.
3) To study synthesis of nanoparticles by biological method.
4) To study antibacterial activity of silver nanoparticles.
5) To study drug diffusion on agar plates.

PRACTICALS

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Double diffusion.
5. Antigen capture ELISA
6. Antibody capture ELISA
7. Synthesis of silver nanoparticles from plant.
8. Synthesis of silver nanoparticles from bacteria
9. Synthesis of silver nanoparticles by green root method.
10. Antibacterial activity of silver nanoparticles
11. To study Drug Diffusion
12. Demonstration of design of nano-diagnostics device.

Learning outcomes:-

1) Students will able to determine the concentration of leucocytes in blood.
2) Students will able to know synthesis of nanoparticles using bacteria and plants.
3) Students will able to know mechanism of drug diffusion.
4) Students will able to know design of Nano diagnostics device.

Reference Books

1. Immunocytochemical_Methods_and_Protocols__1st_
2. Larsson, L. I. (1988) Immuno cytochemistry: Theory and Practice. CRC, Boca, Raton, FL.

B. Sc. Part – II Semester IV
Paper: BNTT - 407: (Statistical Methods for Physical Sciences –III)
Credit- 2

Objectives:

1) To know the basic concepts of probability.
2) To distinguish between random and non random experiments.
3) To find probabilities of various events.
4) To introduce students with some univariate probability distribution.

UNIT1 **(06)**

Concept of experiment with random outcome, sample space, finite and countably infinite sample space, discrete sample space, events, types of events, power set. Simple examples on events.

UNIT2 **(09)**

Classical (apriori) definition of probability of an event, axiomatic definition of probability.
Theorems on probability: i) $P(\Phi) = 0$, ii) $P(A^c) = 1 - P(A)$
iii) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, iv) If A is subset of B then $P(A) \leq P(B)$
v) $0 \leq P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$ simple examples. Conditional probability and independence of events: Independence of two events, properties and examples. Definition of conditional probability, Bayes theorem and applications. Simple examples.

UNIT3 **(06)**

Discrete random variable, probability mass function (p.m.f.), cumulative distribution function (c.d.f.), properties of c.d.f., and examples. Definition of expectation of random variable, properties of expectation, expectation of function of random variable, definition of mean and variance of univariate distribution, Examples.

UNIT4 **(09)**

Univariate probability distributions:
Definitions of discrete uniform distribution, Bernoulli distribution, Binomial distribution Poisson distribution, exponential distribution and Normal distribution.
Mean and variance of these distributions, important properties of these distributions. Applications of these distributions.

Learning Outcomes:

Students will able to

1) Define sample space (Finite and countably infinite), Power set. Identify and explain different types of event.
2) Explain classical and axiomatic definition of probability. Compute probabilities using different relationship between probabilities.
3) Define Probability Mass Function (pmf), Cumulative Distribution Function (cdf)
4) Explain different univariate probability distribution. Compute Expectation and variance of univariate distribution.

Reference Books:

1. Gupta S.P. Statistical Methods; Sultan Publication.(2014) (Unit 2,3)
2. Agrawal B.L., Basic Statistics, New Age International Publishers (2015)(Unit 3,1)
3. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics; Sultan Chand and Sons(2014)(Unit 3,1,4)

B. Sc. Part – II Semester IV
Paper: BNTT - 408: (Statistical Methods for Physical Sciences –IV)
Credit 2

Objectives:

1) To make students familiar with the concept of testing of hypothesis and to construct test and also to identify distribution of test for large samples.
2) To construct test for testing hypothesis and also to identify distribution of test for small samples.
3) To understand the Exact sampling distribution and it's Normal approximation

UNIT 1: (05)

Concept of sampling for finite population: SRS, SRSWR, SRSWOR, Stratified, systematic Sampling, Sampling error

UNIT 2: (10)

Exact Sampling Distributions:

Chisquare distribution: definition, chisquare variate as the sum of square of n i.i.d. S.N.V., statement of p.d.f., mean, variance, additive property, normal approximation and examples.
Students t distribution: definition, nature of probability curve, statement of mean and variance, normal approximation, examples. F-distribution: definition, interrelationship between normal, chi-square, t and F Distribution.

UNIT 3: (07)

Notion of random sample from probability distributions, statistic, sampling distribution of statistic. Critical region, idea of one & two tailed test, type I and II errors, level of significance, p – value. Large sample tests: Statement of Central Limit Theorem (CLT) for i.i.d.r.v.s, construction of test statistic and identification of its probability distribution

a) Test for proportion :i) H_O: $P = P_O$ ii) Ho: $P_1 = P_2$
b) Tests for means: i) H_O: $\mu = \mu_O$ ii) Ho: $\mu_1 = \mu_2$

UNIT 4 (08)

Small sample tests: If $X_1, X_2, \ldots\ldots, X_n$ is a r. s. from (μ, σ^2)then $\bar{x}$ and $S^2$are Independently distributed (without proof), construction of test statistic and identification of distribution of test statistic.

a) T tests for means: i) H0 : $\mu = \mu_O$(σunknown)
b) i) Ho: $\mu_1 = \mu_2$ ($\sigma_1 = \sigma_2$unknown) unpaired ttest.
   ii) Ho: $\mu_1 = \mu_{2b}$ (paired t test), iv) H0: $\rho = \rho_o$

Learning Outcomes:

Students will able to:

1) Sampling (SRS, SRSWR, SRSWOR, Stratified, Systematic Sampling), Sampling error.
2) Exact sampling distributions (Chi-square, Student t, F- distribution),Statement of pdf and Normal approximation.
3) Explain concepts of Hypothesis, Critical region, Types of errors, size of test. Develop test statistic to test hypothesis. Identify which test is appropriate in given situation
4) Develop test statistic to test hypothesis. Identify which test is appropriate in given situation

References:

1. Kapoor V. K. and Gupta S.C., Fundamental of Mathematical Statistics (2008),(Unit 1,2)
2. Rohatgi V. K., Saleh A. K. and Md. Ehsan: An Introduction to probability and Statistics.(Unit 1)
3. Programmed Statistics B. L. Agarwal. New Age International Publishers(Unit 2)
4. Kale B. K.: A first course on parametric inference.
5. Cochran W. G.: Sampling techniques. (Unit 3,4)
6. Murthy M. N.: Sampling Theory and Methods.
7. S.P. Gupta : Statistical Methods Sultan and Chand(Unit 3,4)

B. Sc. Part – II Semester IV
BNTP - 414: Lab 4: Computational Methods
Credit- 2

Objectives:

1) To assess relation between three variable and model it in mathematical form.
2) To make students able to apply knowledge of t, chi-square , F distribution
3) To make students able to analyze both small and large data using testing of hypothesis
4) To make students able to analyze attributes and to create simulated data set.

PRACTICLES

1. Sampling for finite population
2. Application of Chi-square Distribution
3. Application of Student –T Distribution
4. Application of F-Distribution
5. Large Sample Test
6. Small Sample Test
7. Applications of Probability
8. Applications of Bayse Theorem
9. Applications of Binomial Distribution
10. Applications of Poisson Distribution
11. Applications of Exponential Distribution
12. Applications of Normal Distribution

Learning Outcomes:

Students will able to

1) Analyze real life situations using testing of hypothesis.
2) Draw simulated data set from given population.
3) Study applications of distributions

B. Sc. Part – II (Semester IV)
Paper: BNTT - 409: (Instrumentation III: Analytical Instrumentation-I)
Credit- 2

Objectives:

1) To understand the materials are characterized by various spectroscopy
2) To study the basic knowledge of the spectroscopy
3) To study the principle of spectroscopy.

UNIT 1 **(08)**

Ultraviolet Spectroscopy:

Introduction, nature of electromagnetic radiation, electromagnetic spectrum, brief review of atomic and molecular theory.

Ultraviolet Spectrophotometry: Instrumentation, radiation sources, detectors, readout module, filters, monochromators and performance, grating system for single beam and double beam UVspectrophotometry.

UNIT2 **(08)**

Visible Spectrophotometry: Instrumentation, radiation sources, detectors, readout module, filters, monochromators and performance, grating system for single beam and double beam Vis Spectrophotometry.

UNIT 3 **(07)**

Fluorescence Spectrophotometry: Introduction, Theory of Fluorescence: Principle, working and construction, instrumentation for fluorescence measurement: Sources, Monochromator and Detectors.

UNIT4 **(07)**

Phosphorescence Spectrophotometry:

Introduction, Theory of Phosphorescence: Principle, working and construction, instrumentation for Phosphorescence measurement: Sources, Monochromator and Detectors.

Learning Outcomes:

1) Students will able to understand concept of electromagnetic spectrum.
2) Students will able to understand Instrumentation of Ultraviolet spectrophotometry.
3) Students will able to know construction and working of beam for UV Spectrophotometry and IR spectrophotometry.
4) Students will able to understand principle and construction of fluorescence spectrophotometry.
5) Students will able to understand principle and construction of phosphorescence spectrophotometry.

Reference Books:

1. UV-Visible Reflection Spectroscopy of Liquids Jukka Räty Kai-Erik Peiponen Toshimitsu Asakura ISBN 978-3-540-45093-1 (eBook) DOI 10.1007/978-3- 540-45093-1 Springer series in optical Sciences. (UNIT1)
2. Analytical absorption spectrophotometry in the visible and ultraviolet the principles. Sommer *Professor of Analytical Chemistry J. E. Purkyne University Brno, Czechoslovakia.* ISBN 0-444-98882-3 (UNIT1, UNIT2)
3. Fundamentals of UV-visible spectroscopy Hewlett-Packard publication number12-5965-5123E (UNIT2)
4. Ultraviolet and Visible Spectroscopy Edited by. Helmut Giinzler, Alex Williams Copyright OWILEY-VCH Verlag GmbH,2001. (UNIT1, UNIT2)
5. An Introduction to Fluorescence Spectroscopy PerkinElmer2000.(UNIT3)
6. Principles of Fluorescence Spectroscopy Third Edition Joseph R. Lakowicz 2006, 1999, 1983 Springer Science+Business Media, LLC.(UNIT3)
7. Fluorescence and phosphorescence spectroscopy Stephen G. Schulman Pergamon Press.(UNIT3, UNIT4)

B. Sc. Part – II (Semester IV)
Paper: BNTT - 410: (Instrumentation IV: Analytical Instrumentation-II)
Credit- 2

Objectives:

1) To study the characterization techniques.
2) To calculate the crystalline size of materials by using X-Ray Diffraction.
3) To study the basic principle of SEM, TEM and AFM microscopies.

Unit I: **(9)**

Infrared Spectroscopy:

Introduction, Theory of IR spectroscopy, Instrumentation, radiation sources, detectors, readout module. Advantages, applications, interpretation of Infrared (IR) spectra.

Raman Spectroscopy: Introduction, Theory of Raman spectroscopy, Instrumentation, radiation sources, detectors, readout module, application.

Unit II: **(6)**

X-Ray Diffraction(XRD):

Introduction, Theory of XRD, Production of X-rays and X-ray spectra, instrumental units: sources, X –ray tube, crystal monochromators, detectors for measurement of X- ray radiation. X-ray spectroscopy- Principle, absorption, emission and diffraction of X-rays, Bragg's Law, and applications.

Unit III: **(8)**

Atomic Absorption and Emission Spectroscopy

Atomic Absorption Spectrometry (AAS): Introduction, Theory of AAS, Instrumentation for Atomic Absorption Spectrometry, Nebulizer and atomizer.

Atomic Emission Spectroscopy (AES): Introduction, Theory of AES, Instrumentation, spectroscopic sources, atomic emission spectrometer.

Unit IV: **(7)**

Microscopy:

Introduction of Scanning Electron Microscopy (SEM): Construction, principle and working. Atomic Force Microscopy (AFM): Construction, principle and working. Transmission Electron Microscopy (TEM): Construction, principle and working.

Learning Outcomes:

1) Students will able to understand Construction and working of Raman spectrometry.
2) Students will able to understand application of IR and Raman spectrometry
3) Students will able to understand principle of XRD construction and working of XRD.
4) Students will able to know principle, construction and working of Atomic Absorption Spectrometry and atomic Emission Spectrometry.
5) Students will able to know construction, working and principle of SEM, TEM, AFM

Reference Books:

1. Infrared and Raman spectroscopy: principles and spectral interpretation. Larkin, Peter (Peter J.) ISBN:978-0-12-386984-5. (UNIT 1)
2. Introductory Raman Spectroscopy (Second edition) Elsevier, 2003 John R. Ferraro, Kazuo Nakamoto and Chris W. Brown ISBN:978-0-12-254105-6 (UNIT 1)
3. D. Cullity-Elements of X-RAY DIFFRACTION SECOND EDITION. ISBN 0-201-01174-3. Elsevier,2003.(UNIT 2)
4. Atomic Force Microscopy/Scanning Tunneling Microscopy 3, Samuel H. Cohen and Marcia L. Light body, Kluwer Academic Publishers. (UNIT4)
5. Analytical Atomic Absorption Spectroscopy SELECTED METHODS Jon C. Van Loon 1980 A Subsidiary of Harcourt Brace Jovanovich, Publishers. (UNIT3)
6. Atomic Absorption Spectrophotometry *By* W. T. Elwell *And* J. A. F. Gidley 1966 Pergamon Press Ltd. (UNIT3)
7. Microscopy for Nanotechnology, by Nan Yao. Zhong Lin Wang Kluwer Academic Publishers. (UNIT4)
8. Microscopy Applications in Materials Science, Solid-state Physics and Chemistry, S. Amelinckx, D. van Dyck, J. van Landuyt , G. van Tendeloo, VCH Verlagsgesellschaftmb H, Weinheim (Federal Republic of Germany)(UNIT4)

B.Sc. – II SEMESTER – IV
BNTP – 415: Lab 5 Analytical Instrumentation
Credits: 02

Objectives:

1) To gain knowledge in characterization techniques
2) To study analysis of the materials by using characterization technique.

PRACTICALS

1. Data interpretation and plotting
2. Studies on UV-Visible spectrophotometer
3. Studies on X-Ray Diffractions
4. FT-IR spectra interpretation
5. FT-RAMAN spectra interpretation
6. Fluorescence spectra interpretation
7. Phosphorescence spectra interpretation
8. Scanning Electron Microscope image interpretation
9. Atomic Force Microscope image interpretation
10. Analysis of atomic absorption spectra

Learning Outcomes:

1) Student will able to know principle and working of various characterization techniques.
2) Student will able to have an idea about the crystal structure of materials by using XRD.
3) Student will able to understanding the atoms stretching in materials by using IR spectrometer.
4) Student will able to study about the morphology of materials by using SEM, TEM and AFM images.
5) Student will able to calculate the surface area of colloidal materials by using image of SEM, TEM and AFM.

Reference Books:

1. Instrumental Analysis Lab manual, M. J. Prushan. CHM 311, 2018.

Evaluation Scheme
B. Sc. Nanoscience and Technology
Semester III

Course Code	Name of the Course	ESE	Internal Exam		Course Code	Practical		Submission		Total
			ISE I	ISE II Online Test		Exam	Journal	Case study/ Educational Tour/ Seminar	Day to day Performance	
BNTT-301	Physics-V	30	5	5	BNTP 311 LAB 1 Physics	30	05	05	05	125
BNTT-302	Physics-VI	30	5	5						
BNTT-303	Chemistry-V	30	5	5	BNTP 312 LAB 2 Chemistry	30	05	05	05	125
BNTT-304	Chemistry-VI	30	5	5						
BNTT-305	Biotech-V	30	5	5	BNTP 313 LAB 3 Biotechnology	30	05	05	05	125
BNTT-306	Biotech-VI	30	5	5						
BNTT-307	Statistics-I	30	5	5	BNTP 314 LAB 4 Statistics	30	05	05	05	125
BNTT-308	Statistics-II	30	5	5						
BNTT-309	Instrumentation-I	30	5	5	BNTP 315 LAB 5 Instrumentation	30	05	05	05	125
BNTT-310	Instrumentation-II	30	5	5						
BNTT-AECC-2	EVS-I	40	5	5						50
Total of SEM III										**675**

Semester IV

Course Code	Name of the Course	ESE	Internal Exam		Course Code	Practical		Submission		Total
			ISE I	ISE II Online Test		Exam	Journal	Case study/ Educational Tour/ Seminar	Day to day Performance	
BNTT-401	Physics-VII	30	5	5	BNTP 411 LAB 1 Physics	30	05	05	05	125
BNTT-402	Physics-VIII	30	5	5						
BNTT-403	Chemistry-VII	30	5	5	BNTP 412 LAB 2 Chemistry	30	05	05	05	125
BNTT-404	Chemistry-VIII	30	5	5						
BNTT-405	Biotech-VII	30	5	5	BNTP 413 LAB 3 Biotechnology	30	05	05	05	125
BNTT-406	Biotech-VIII	30	5	5						
BNTT-407	Statistics-III	30	5	5	BNTP 414 LAB 4 Statistics	30	05	05	05	125
BNTT-408	Statistics-IV	30	5	5						
BNTT-409	Instrumentation-III	30	5	5	BNTP 415 LAB 5 Instrumentation	30	05	05	05	125
BNTT-410	Instrumentation-IV	30	5	5						
BNTT-AECC-2	EVS-I	40	5	5						50
Total of SEM IV										**675**
Total of SEM III & IV										**1350**