B.Sc. Part - II
Syllabus for B.Sc. II Nanoscience and Technology (Entire) introduced from June, 2019 Course Structure:

B.Sc. II Semester III								
TEACHING SCHEME								
Sr. No.	Theory				Practical			
	Paper Code	No. of lectures/ Week	Clock Hours/ week	Credits	Paper Code	No. of lectures/ Week	Clock Hours/ week	Credits
1.	BNTT-301	2	2	2	BNTP-311	4	4	2
2.	BNTT-302	2	2	2				
3.	BNTT-303	2	2	2	BNTP-312	4	4	2
4.	BNTT-304	2	2	2				
5.	BNTT-305	2	2	2	BNTP-313	4	4	2
6.	BNTT-306	2	2	2				
7.	BNTT-307	2	2	2	BNTP-314	4	4	2
8.	BNTT-308	2	2	2				
9.	BNTT-309	2	2	2	BNTP-315	4	4	2
10.	BNTT-310	2	2	2				
11.	BNTT-AECC-2	2	2	2				
	Total of SEM III	22	22	22		20	20	10
Total No. of Credits for Semester III = 32								

B.Sc. II Semester IV								
TEACHING SCHEME								
Sr. No.	Theory				Practical			
	Paper Code	No. of lectures/ Week	Clock Hours/ week	Credits	Paper Code	No. of lectures/ Week	Clock Hours/ week	Credits
1.	BNTT-401	2	2	2	BNTP-411	4	4	2
2.	BNTT-402	2	2	2				
3.	BNTT-403	2	2	2	BNTP-412	4	4	2
4.	BNTT-404	2	2	2				
5.	BNTT-405	2	2	2	BNTP-413	4	4	2
6.	BNTT-406	2	2	2				
7.	BNTT-407	2	2	2	BNTP-414	4	4	2
8.	BNTT-408	2	2	2				
9.	BNTT-409	2	2	2	BNTP-415	4	4	2
10.	BNTT-410	2	2	2				
11.	BNTT- AECC-2	2	2	2				
	Total of SEM III	22	22	22		20	20	10
Total No. of Credits for Semester IV = 32								
Total No. of Credits for Semester III + IV = 64								

Student contact hours per week 42 hr.	Total Marks for B.Sc. -II (Including Environmental Science) :**1400**
Theory lectures and practical : 50 min.	Total Credits for B.Sc. -II (Semester III & IV) : **64**
AECC2 - Ability Enhancement Compulsory Course(BNTT -AECC-2 & BNTT -AECC-2)Environmental Science **BNTE- 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 co nducted at semester end for 50 Marks per DSC course (subject). Passing Criteria -minimum40%	

Semester - III

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

Semester - IV

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

B. Sc. Part – II Semester III
BNTT - 301: Waves, Oscillation and Sound
(Lectures: 30, Credit: 02)

Course Objectives: Students should :

1] Study the Lissajous figures
2] Study the gyroscopic motion and its application
3] Study the properties of sound
4] Study the applications of Precessional

UNIT -1 : [08 Lectures]

Oscillations

Simple Harmonic Oscillations in an Electrical System, Superposition 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 : [08 Lectures]

Precessional Motion

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 : [06Lectures]

Wave Motion

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.

UNIT -4 : [08Lectures]

Sound

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.

Reference Books :

1. Physics volume I –Halliday and Resnick. John Wiley and sons publications, Edition 8th, 2007.

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. ChandPublications, 2010.
4. Sound - Khanna and Bedi, Atma ram and sons, 1971.
5. Waves and oscillations-R. N. Choudhari 2nd Edition, New agepublishers, 2010.
6. Physics of waves-Harvard Georgie, Prentice hall publication ,8th Edition, 2015.
7. The Physics of vibration and waves- H.J Pain, 6th edition John Wiley and sons 2005.
8. Acoustics, waves, and oscillations- S.N. SEN, 2nd edition New age inter national Publisher, 2013.
9. The theory of sound-J.W.S Rayleigh 2nd edition .Doverpublications, 1945.
10. Mechanics ,wave motion, heat- Francis Weston Sears, 2nd edition Addison-Wesley Pub., 1964.
11. Electronics circuits and applications- Bernard Grob Glencoe/McGraw-Hill School Pub Co (March 1 1982)

Course Outcomes:

Unit - I : After completion of the unit, Students will be able to:

1] Understand the SHM and its solution.
2] Understand Lissajous figures.

Unit - II : After completion of the unit, Students will be able to:

1] Know basic of gyroscopic motion.
2] Understand application of gyroscopic motion.

Unit - III : After completion of the unit, Students will be able to:

1] Understand plane waves, spherical waves.
2] Define transducers and their types.

Unit - IV : After completion of the unit, Students will be able to:

1] Understand concept of acoustic of building.
2] Understand Sabine's experimental work.

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BNTT - 302: Thermal Physics
(Lectures: 30, Credit: 02)

Course Objectives: Student should :

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

UNIT -1 : [09 Lectures]

Kinetic Theory of gases

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.

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.

UNIT -2 : [07 Lectures]

Thermodynamics - I

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

UNIT -3 : [07Lectures]

Thermodynamics - II

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 : [07Lectures]

Theory of radiation

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.

Reference Books :

1. Treaties on Heat- Saha and Shrivastava The Indianpress,1973.
2. Heat and Thermodynamics- Brijlal and Subramanyam S. Chand and Co. Ltd, Delhi, 2010.
3. Heat and Thermodynamics, M. W. Zemansky and R.Dittman,7th edition, The McGraw Hill company, 2007.
4. Thermal Physics, S. Garg, R. Bansal and C. Ghosh,2nd Edition, Tata McGraw hill Publishing, Co.Ltd, 2013.
5. Fundamentals of physics –HalidayResnik6thEdition Wileypublication, 2015.
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).http://web.uni-miskolc.hu/~www_fiz/KovacsE/InfEng_Quantum.pdf
8. Mechanics wave motion, heat-Francis Sears, Published byAddison-Wesley Publishing Company (1958).
9. Kinetic theory of gases- Earle H. Kennary First Edition, McGraw Hill company , NewYork, London, 1901.

Course Outcomes:

Unit - I : After completion of the unit, Students will be able to :

1] Understand kinetic theory of gases.
2] Know Transport phenomenon.

Unit - II : After completion of the unit, Students will be able to:

1] Understand thermodynamical state and equilibrium.
2] Understand thermodynamical process.

Unit - III : After completion of the unit, Students will be able to:

1] Understand Carnot's theorem, working of Carnot's engine.
2] Know laws of thermodynamics.

Unit - IV : After completion of the unit, Students will be able to:

1] Define concept of black body radiation.
2] Understand macrostate and microstate.

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BNTP - 311: Physical Science Lab
(Credit- 02)

Course Objectives : Should be :

1] Learn all the practical's that are included in accordance with the theory syllabi.
2] Provide student better understanding of wave mechanics and Thermodynamics.

Experiments:

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'smethod
5] Stefan'sconstant
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

Reference Books:

1. Engineering Practical Physics, S. Panigrahi& B. Mallick, Cengage Learning India Pvt. Ltd., 2015.
2. AText Book of Practical Physics, Indu Prakash and Ramakrishna, Kitab Mahal,New Delhi.11th Edition, 2011
3. 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, 1985.

Course Outcomes :

After completion of the practical, Students will able to:

1] Operate CRO and different application of CRO.
2] Handle different instruments withease.
3] Learn about application of transducers in daily life.

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BNTT - 303: Physical Chemistry
(Lectures: 30, Credits- 02)

Course 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 Vapor pressure-composition and temperature composition curves of ideal and non-ideal solutions.
4] To study criteria of phase equilibrium
5] To study of terms in conductance and electrochemistry.

UNIT - I : [06 Lecture]

Solutions

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 - II : [08 Lecture]

Phase Equilibrium

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).

UNIT - III : [08 Lecture]

Conductance

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).

UNIT - IV : [08 Lecture]

Electrochemistry

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.

Reference Books:

1. Physical Chemistry (Atkins and de Paula) Oxford University Press,10th Ed. 2014
2. Physical Chemistry (Berry, Rice and Ross) Oxford University Press, 2nd Ed. 2000
3. Methods in Physical Chemistry (Schäfer, Schmidt), Rolf Schäfer, Peter C. Schmidt,Wiley VCH Verlag GmbH & Co. KGaA, 2012
4. Electrochemical Methods: Fundamentals and ApplicationsAllen J. Bard, Larry R. Faulkner, John Wiley and Sons, 2nd edition, 2000
5. The Laws of Thermodynamics: A Very Short Introduction by Peter Atkins Oxford University Press, USAPublished April 19th 2010
6. Physical Chemistry by Ira N. Levine Published by McGraw-Hill Science August 29th 2001
7. Physical Chemistryby David W. Ball Published by Brooks Cole d August 20th 2002

Course Outcomes:

Unit - I : After completion of the unit, Students will be able to

1] Basic concept of solution, composition curves of ideal and non-ideal solutions
2] Colligative properties of solutions, Raoults law, Leverrule

Unit - II - After completion of the unit, Students will be able to

1] Component and degree of freedom of system
2] Phase diagram of one and two component systems.

Unit - III - After completion of the unit, Students will be able to

1] Basic terms in conductance, Kohlrausch Law, transparent number and its experimental determination using Hittorf method.
2] Conductometric titrations (only acid base).

Unit - IV - After completion of the unit, Students will be able to

1] Basic terms in electrochemistry, types of electrode, determination of cell potential.
2] Concentration cells withtransference and without transference. Liquid junction potential and salt bridge.

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BNTT - 304: Organic Chemistry
(Lectures: 30, Credits- 02)

Course 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 - I : [06 Lectures]

Carboxylic acids and their derivatives

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 - II : [06 Lectures]

Amines and Diazonium Salts

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. Diazoniumsalts: Preparation: fromaromatic amines. Reactions: conversionto benzene, phenol, dyes (methyl orange)

UNIT - III : [10 Lectures]

Alcohol and Phenols

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 (alkali. $KMnO_4$, 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 diazoniumsalts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. ReimerTiemann Reaction, Gattermann-Koch Reaction, Schotten – Baumann Reaction.

UNIT - IV : **[08 Lectures]**

Aldehyde and ketone

Aliphatic and aromatic: (Formaldehye, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO3. Iodoform test. Aldol Condensation, Wittig reaction. Clemensen reduction and Wolff Kishner reduction.

Reference Books:

1. Advanced Organic Chemistry Francis A. Carey, Richard A. Sundberg Paperback Springer ,5th Edition, 2007.
2. Organic Chemistry Jonathan Clayden, Nick Geeves, Stuart Warren Oxford University Press 2nd Edition, 2012
3. Name Reactions and Reagents in Organic Synthesis Bradford P. Mundy, Michael G. Ellerd, Frank G. Favaloro Wiley-Interscience 2nd Edition, March 2005
4. Organic reaction mechanism V. K. Ahulwalia by Narosa publication. Published by Alpha Science International, Ltd January 30th 2011.
5. Organic Chemistry Paula Y. Bruice Prentice Hall 6th Edition, 2010
6. Organic Chemistry, Clayden, Greeves, Warren and Wothers Oxford University press 7th edition. 2001
7. Advanced Organic Chemistry, Jerry March by Willy publications 5th edition. 2001
8. March's Advanced Organic Chemistry. Reactions, Mechanisms, and Structure Michael B. Smith, Jerry March 6th Edition, 2007
9. Organic Chemistry by Morrison & Boyd, Pearson Education India. 7th Edn,2010

Course Outcomes:

Unit - I : After completion of the unit, Students will be able to

1] Preparation and reaction of carboxylic acids
2] Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids

Unit - II : After completion of the unit, Students will be able to

1] Preparation of amines and diazonium salt
2] Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Unit - III : After completion of the unit, Students will be able to

1] Preparation and reaction of alcohol and phenol
2] Reaction and mechanism of some name reactions.

Unit - IV : After completion of the unit, Students will be able to

1] Preparation and reaction of Aldehyde and ketones.
2] Some reduction reaction involve aldehyde and ketones.

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BNTP - 312: Chemical Science Lab
(Credits- 02)

Course 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.
3] To study instrumental and non- instrumental practical.
4] To study the organic Qualitative analysis, organic preparation, organic estimation practical.

Experiments:

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: 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 ofAcetone

2] Estimation ofAspirin

III] Organic Preparations:

1] Preparation of p– nitroacetanilide

2] Preparation of Dihydropyrimidone

3] Preparation of Benzoic acid

4] Preparation of Benzamide

Reference Books:

1. Inquiry-based Experiments in Chemistry Valerie Ludwig Lechtanski Oxford University Press, 2000
2. Laboratory Manual for Principles of General Chemistry, J A Beran John Wiley & Sons, 6th Edition 2000
3. Dean's Handbook of Organic Chemistry by John A. Dean; George W. Gokel Publication Date: 2004
4. Senior Practical Physical Chemistry, Khosla, B. D.; Garg, V. C. & Gulati, R. Chand & Co. New Delhi (2011).
5. Comprehensive Practical Organic Chemistry, Ahluwalia, V. K. & Renu Agarwal Orient Black Swan (2004)

Course outcomes:

After completion of the Experiments, Students will be able to understand

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.

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BNTT- 305 : Biomolecules and General Microbiology - I
(Lectures : 30, Credits : 02)

Course objective :

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.

Unit - I : [08Lectures]

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

Unit - II : [08Lectures]

Lipids and Nucleic acid

Lipid Classification, FattyAcids, Triacylglycerols, Glycerophospholipids, Sphingolipids Cholesterol. Storage Lipids, Lipids as Signals, Cofactors, and Pigments.

Applications of Nanocapsules :

Nanocapsule for efficient delivary of pesticides,fertilizers and other agrochemicals, Liposomal nanocapsules in food Science and agriculture

Unit - III : [07 Lectures]

Microbial Nutrients:

Culture media:

Synthetic or defined media, complex media, types of media, selective media, differential media. Common nutrient requirements, requirements for carbon, hydrogen, and oxygen, types of microorganisms based on nutritional requirements.

Unit - IV : [07 Lectures]

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.

Reference books :

1. Lehninger's Principles of Biochemistry by D. L. Nelson and M. M. Cox, CBS Publications, 2000
2. Biochemistry by Lubert Stryer, 4th Edition

3. General Microbiology by Stanier, Adelberg and Ingraham, The Macmillan Press Ltd, Hong Kong.
4. Cell biology, genetics, molecular biology, evolution and ecology verma, agarwal S.Chand and company 2005
5. Biochemistry Satyanarayana_Chakrapani Books nad Allied P Ltd.
6. Lodish-molecular biology of the cell W.H.Freeman & Co.Ltd

Course Outcomes:

Unit - I : After completion of unit, Student will be able to:

1] Know structures of different carbohydrates, classification of carbohydrates.
2] Know functions of different carbohydrates in biological system.

Unit - II : After completion of unit, Student will be able to :

1] Classify lipids, structures of different lipids, functions of lipid in biological system.
2] Students should able to know structure and types of nucleic acid, functions of nucleic acid in biological system.

Unit - III : After completion of unit, Student will be able to

1] Know nutrient requirements for micro-organism's.
2] Know composition of different nutrient media.
3] Know classification of micro-organism's based on their nutrient media, carbon and energy source.

Unit - IV : After completion of unit, Student will be able to:

1] Students should able to know cultivation and maintenance of micro-organism's.
2] Students should able to know techniques for isolation of micro-organism's.
3] Students should able to know purification and preservation of pure culture of micro-organism's.

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BNTT - 306 : Biomolecules and General Microbiology - II
(Lecture : 30, Credits : 02)

Course objective :

1] Study structure and functions of biological nanostructures.

2] Study microbial growth and it's characteristics.

3] To study bacterial reproduction and their control.

Unit - I : Proteins: **[08 Lectures]**

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 - II : Enzymes and Vitamins **[08 Lectures]**

Enzymes : Classification, Overview of structure, function and mechanism of actions of enzymes Vitamins and Minerals: Importance and role of vitamins, Types of vitamins, water soluble and fat soluble vitamins. Minerals, micro nutrients, macronutrients, roles and functions, disorders of mineral deficiency.

Unit - III : Microbial growth : **[07 Lectures]**

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, activity, pH temperature oxygen concentration pressure radiation.

Unit - IV : Bacterial Reproduction : **[07 Lectures]**

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

Fermentation :-

Definition, basic concepts of fermentation traditional fermentations (wine, beer), contemporary fermentations (vinegar and citric acid, antibiotics).

Fermentation for Nanomaterial isolation.

References :

1. Lehninger's Principles of Biochemistry by D. L. Nelson and M. M. Cox, CBS Publications, 5th edition,2000.
2. Biochemistry by Lubert Stryer, ,4th Edition ,2002.
3. General Microbiologyby Stanier, Adelberg and Ingraham, The Macmillan Press Ltd, H.
4. Cell biology, genetics, molecular biology, evolution and ecology verma, agarwal S.Chand and company,2005.
5. Biochemistry Satyanarayana_Chakrapani Books nad Allied P Ltd.
6. Lodish-molecular bilogy of the cell W.H.Freeman & Co.Ltd
7. Textbook of B.Sc.II sem III Microbiology paper V-VI
8. Biochemistry –4 th edition - U.Satyanarayanan& U. Chakrapani

Course Outcomes :

Unit - I : After completion unit, Student will be able to :

1] Know formation of proteins with the help of amino acids.
2] Understand functions of protein in biological system.

Unit - II : After completion unit, Student will be able to :

1] Know structure and classification of enzymes, mechanism of enzyme action.
2] Understand role of vitamins and minerals in biological system.

Unit - III : After completion unit, Student will be able to :

1] Understand growth mechanism of micro-organism's and measure growth of micro-organism's.
2] Know different cultures for microbial growth.

Unit IV: After completion unit, Student will be able to :

1] Know reproduction of micro-organism's.
2] Know control of micro-organism's.

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BNTP - 313 : Biotechnology Lab
(Credits : 02)

Course objective :

1] To study different staining techniques of bacteria.
2] To study the biochemical characterization of bacteria.
3] To study isolation and characterization of bacteria from different sources.
4] To study preparation of media and sterilization techniques.
5] To study separation of amino acids by paper chromatography.
6] To study estimation of proteins by different methods.
7] To study estimation of carbohydrates by different methods.

Experiments:

1] Isolation of bacteria & their biochemical characterization.
2] Staining methods: simple staining, Gram staining, negative staining, 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-H2SO4 method ii) Anthrone method

References:

1. Practical Biochemistry: An Introductory Course by Fiona Frais.
2. A Textbook of Practical Biochemistry by David Plummer McGraw Hill Education; 3 edition 2017.
3. Laboratory Mannual in Biochemistry by S. Jayaraman. APC, 3rd edition ,2018.

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

1] Know isolation and characterization of bacteria from different sources.
2] Know qualitative estimation of biomolecules.
3] Know technique of paper chromatography, different staining, sterilization techniques
4] Quantitative estimation of carbohydrates, proteins, amino acids.
5] Students should able to know preparation of nutrient media for bacterial isolation.

****

BNTT-307: Statistical Methods for Physical Sciences I
(Lectures: 30, Credits- 02)

Course 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.

UNIT -1 : **[07 Lectures]**

Meaning and scope of statistics :

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 Lectures]**

Scales of measurement -

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

UNIT -3 : **[09 Lectures]**

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 Lectures]**

Concept of positional averages

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

Reference Books :

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

Course Outcomes:

Unit - I : After completion unit, Student will be able to :

1] Understand the scope of statistics in industry.

2] Understand the scope of statistics in physical sciences.

Unit - II : After completion unit, Student will be able to :

1] Understand need of Statistics, types of data (Primary, secondary, Grouped, Ungrouped, Qualitative and Quantitative data)

2] Understand the scale of measurement.

Unit - III : After completion unit, Student will be able to :

1] Scales of measurement, graphical tools (Histogram, Frequency curve, Boxplot).

2] Define-Mathematical Averages (A.M., G.M., H.M.) and their computation.

Unit - IV : After completion unit, Student will be able to :

1] Positional Averages (Median, Mode) and their computation.

2] Concept of positional averages.

****

BNTT - 308: Statistical Methods for Physical Sciences II
(Lectures: 30, Credits: 02)

Course 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 Lectures]

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 Lectures]

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

UNIT - 3 : Regression [05 Lectures]

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

UNIT - 4 :Multiple and Partial Correlation and Regression [07Lectures]

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.

Reference Books :

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

Course Outcomes :

Unit - I : After completion unit, Student will be able to :

1] Understand the standard deviation

2] Understand the Concept of dispersion

Unit - II : After completion unit, Student will be 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

Unit - III : After completion unit, Student will be able to :

1] Define correlation, Types of correlation (Karl Pearsons, Spearman sRank correlation)

2] Regression, lines of Regression, Relation between Correlation and Regression

Unit - III : After completion unit, Student will be able to:

1] Define multiple and partial correlation and regression, and their computation.

2] Understand Residual: definition, order, properties.

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BNTP-314: Computational Methods
(Credit- 02)

Course 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

Experiments:

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

Reference Books:

1] Barlow R. E. and Proschan Frank: Statistical Theory of Reliability and Life Testing. Holt Rinebart and Winston Inc., New Yark.
2]ParimalMukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing.
3] Hogg R.V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
4] Gupta S. C. &Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi.
5] Gupta S. C. &Kapoor V.K.: Applied Statistics. Sultan Chand & sons, New Delhi.
6]Gupta S.P: Statistical Methods, Sultan Chand and Sons, New Delhi.
7] Waikar and Lev: Elementary Statistical Methods.

Course Outcomes:

After completion of the practical, Students will be 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

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BNTT - 309: Electronic Instrumentation
(Lectures: 30, Credit- 02)

Course 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 Lectures]**

General Block diagramof Instrumentation system, Classificationof transducers, selecting of transducer, Electrical Transducers and their parameters

UNIT - 2 **[15 Lectures]**

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 Lectures]**

Signal Conditioner :

Introduction to Instrumentation Amplifier and active filters. Voltage to frequency convertors (V/F), frequency to voltage convertors (F/V).

UNIT - 4 **[09 Lectures]**

Data Acquisition System :

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

Reference Books :

1. Electronic Instrumentation,H. S. Kalsi, TMH(2006)

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

Course Outcomes:

Unit - I : After completion of this unit, Students will be able to :

1] Understand the classification of transducers
2] How to select transducers according to their parameters

Unit - II : After completion of this unit, Students will be able to :

1] Principle, Construction and working of various types of transducers
2] Working of smart sensors

Unit - III : After completion of this unit, Students will be able to :

1] Use of signal conditioning ininstrumentation
2] Understand the working of filters.

Unit - IV : After completion of this unit, Students will be able to :

1] Understand concept of Data Acquisition System
2] Understand concept of Data Loggers

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BNTT - 310 : Measurement Techniques
(Lectures : 30, Credits - 02)

Course Objectives :

1] To discuss about units, standards, error analysis and characteristics of measurement systems.
2] Explain basic concepts and definitions inmeasurement.
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 Lectures]**

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 Lectures]**

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 Lectures]**

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 Lectures]**

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.

Reference Books:

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

Course Outcomes:

Unit - I : After completion unit, Students will be able to:

1] Understand Static and dynamic characteristics of an instrument
2] Analyses error inthe measurements, Perform statistical analysis,
3] Identify Fundamental and derived units, different types of Standards.

Unit - II : After completion unit, Students will be able to :

1] Measure Resistance, Inductance, Capacitance, Frequency.
2] Perform Current and Voltage measurements

Unit - III : After completion unit, Students will be able to :

1] Learn working of Digital Instruments such as digital multimeter, frequency meter, LCR Q meter, etc
2] Use these instruments for measurements

Unit IV: After completion unit, Students will be able to:

1) Understand functioning of CRO
2) Understand functioning of Spectrum Analyzer

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BNTP - 315: Instrumentation Lab
(Credit - 02)

Course Objectives :

1] Study the characteristics of various types of transducers
2] Understand the working of instrumentation amplifier.
3] Study the various types of data converters

Experiment:

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

Reference Books :

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

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

1] Understand working of various types of transducers
2] Understand working of signal conditioners.
3] Understand working of Data converters

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B.Sc. II Semester IV
BNTT- 401: Modern Physics
(Lectures: 30, Credit- 02)

Course Objectives :

1] Study the dynamics of particle.

2] Study the Schrödinger wave equation and its application

3] Study nuclear reactions

UNIT - I : [7 Lectures]

Classical Dynamics of Particles

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 [08 Lectures]

Schrodinger Equation and its formalism

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 in 1-D.

UNIT - 3 [06Lectures]

Applications of Schrödinger Equation

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

UNIT - 4 [09Lectures]

Radio activity and nuclear fission and fusion

β -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.

Reference Books:

1. Fundamentals of physics- Haliday -Resnick, Wiley India edition 8th Edition, 2012.
2. Fundamentals of modern physics- Peter J Nolan, Published by Physics Curriculum & Instruction, 1st edition, 2006
3. Modern Physics notes- by Muhammad Ali Malik, 2018
4. Modern Physics –Paul A. Tipler W.H. Freeman and Company, New York, 6th edition, 2012.

Course Outcomes:

Unit - I : After completion of the unit, Students will be able to:

1] Learn about the classical nature of particle before studying the quantum mechanical nature.

2] Understand failure of Rutherford model, Bohr, atomic structure.

Unit - II : After completion of the unit, Students will be able to:

1] Know concept of probability.

2] Learn about Schrödinger equation for particles (matter wave).

Unit - III : After completion of the unit, Students will be able to:

1] Understand the basic knowledge of eigen function, eigen values.

2] Know concept of quantum mechanical tunneling.

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

1] Understand about radio activity & reaction.

2] Understand fusion and fission reaction.

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BNTT - 402: Optics, lasers and Crystallography
(Lectures 30, Credit- 02)

Course Objectives :

1] Study the interference and diffraction pattern of waves.
2] Study the properties and applications of LASER and optical fiber
3] Study the crystal structure.

UNIT -1 : [06 Lectures]

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 : [06Lectures]

Diffraction of light :

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.

UNIT -3 : [08Lectures]

Crystallography :

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

UNIT -4 : [10Lectures]

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, Einsteincoefficients (onlydefinitions), population inversion, optical and electrical pumping, properties of lasers, Rubylaser, Helium-Neon laser, uses of laser, idea of holography(qualitative treatment only).

Reference Books :

1. Principles of Optics ,B.K.Mathur, GopalPrinting, 1995.
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, McGraw-Hill, 1976.
4. Optics, Ajay Ghatak, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi, 2nd Edition,1992.
5. Laser and non linear optics by B. B.Laud, ,Published by New Age International Publisher, 3rd Edition, 2011.
6. Optics and atomic Physics- Satya Prakash PragatiPrakashan,Meerut, ,1steditон, 2017.
7. Solid state physics - Kittle, Wiley and sons publications, 7th Edition, 1996.
8. Physics of light and optics- Justine Peatros, MichealWare,Brigham Young University, 2013.
9. Introduction to optics- F.Pedrotri, Pearson Education,3rd edition, 2006.
10. Optical fiber communication -V S Bagad,Technical Publications ,Pune, 2009.
11. Introduction to modern solid state physic-Yuri. M Galperin, 2014.
12. Solid state physics-M.Wahab,3rd Edition,Narosa PublishingHouse, 2015
13. Solid state physics-Ashcroft Mernin, DavidN. Holt Rinehart & Winston; 2 edition (1 January 2002).

Course Outcomes:

Unit - I : After completion of the unit, Students will be able to:

1] Understanding interferometer & uses of various interferometer.
2] Know application of Michelson's interferometer

Unit - II : After completion of the unit, Students will be able to:

1] Understand concept of Fresnel diffraction.
2] Understand Fraunhofer diffraction

Unit - III : After completion of the unit, Students will be able to :

1] Analyze structure of crystal using X-ray diffraction.
2] Know basics of crystal structure.

Unit - IV : After completion of the unit, Students will be able to :

1] Define Absorption, spontaneous and stimulated emission.
2] Student will able to understand concept of optical fiber.

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BNTP - 411: Physical Science Lab
(Credit- 02)

Course Objectives :

1] Provide better understanding of optics and concept related identification crystals Structure.

Experiments :

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 straight edge.
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

Reference Books :

1. Engineering Practical Physics, S. Panigrahi& 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. 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, 1985,

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

1] Provide better understanding of optics and crystalline structure.
2] Handle different instruments with ease.
3] Types of spectrum and analysis of spectral distribution.
4] Identify the crystal structure from XRD pattern and will understand the changes in properties of crystal according to structure.

****

BNTT - 403: Inorganic Chemistry
(Lectures: 30, Credits- 02)

Course 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 and position d and f block element.

4] To study the all coordination theory with example.

5] To learn various types of catalyst.

UNIT - I : [6 Lecture]

Chemistry of elements of first transition series

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 - II [8 Lecture]

Study of f-block elements

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 decay.

ii] Accelerated projectile bombardment.

iii] Heavy ion bombardment.

UNIT - III : **[10 Lecture]**

Coordination Chemistry

Introduction - Definition and formation of co-ordinate covalent bond in BF3 -NH3, [NH4]+and H2O. Distinguish between double salt and complex salt, Werner's theory-Postulates. The theory as applied to cobalt amines viz. CoCl3.6NH3, CoCl3.5NH3, CoCl3.4NH3, CoCl3.3NH3. Description of the terms- ligand, co-ordination number, coordination 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.

UNIT -IV : **[08 Lecture]**

Catalysis

Introduction, Classification of catalytic reactions – Homogeneous and Heterogeneous. Types of catalysis, Characteristics of catalytic reactions, Mechanism of catalysis.

i] Intermediate compound formation.

ii] Adsorption.

Reference Books

1. Concise Inorganic chemistry, J. D. Lee by Wiley India Editor 5th edition 2008
2. Synthesis of Inorganic Materials, U. Schubest and N. Husing Wiley VCH, 2000.
3. Advanced Inorganic Chemistry: F.A. Cotton, G. Wilkinson, C.A. Murillo, M.Bochmann 6th Edn. (2003)
4. Inorganic Chemistry: Shriver and Atkins, 4th edn. (2003) Oxford.
5. "d- and f- block Chemistry", C. J. Jones, p. 78, 85 and 122. Tutorial Chemistry Texts, E. W. Abel (Ed.), Royal Society of Chemistry, Cambridge (2001).

6. Organo transition MetalChemistry, Anthony F.Hill, Royal Society of Chemistry,Tutorial Chemistry Text, 2002.
7. Homogeneous Catalysis: Mechanisms and Industrial Applications, S.Bhaduri and D. Mukesh, Wiley, New York, 2000
8. Homogeneous Catalysis: Understanding the Art, P.W.N.M. van Leeuwen, Kluwer Academic Publishers, 2003
9. Catalysis: Principles and Applications, B.Vishwanathan, S. Sivasankar and A.V. Ramaswamy (Narosa Pub. House, New Delhi, 2004)

Course Outcomes :

Unit - I : After completion of the unit, Students will be able to

1] Properties of d and f block element.

2] Complex formation of 3d series element.

Unit - II : After completion of the unit, Students will be able to

1] Properties of d and f block element and also know separation of Lanthanide

2] Position ofActinides.

Unit - III : After completion of the unit, Students will be able to

1] Werner's theory, IUPAC nomenclature of coordination compounds.

2] Isomerism in complexes with C.N. 4 and6, Crystal field splitting of'd' orbital in octahedral, tetrahedral.

Unit - IV : After completion of the unit, Students will be able to

1] Classification of catalytic reactions –Homogeneous and Heterogeneous,

2] Catalytic reactions, mechanism of catalysis.

****

BNTT - 404:Analytical Chemistry
(Lectures: 30, Credit- 02)

Course 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 Hardness of water, method of sterilization, BOD, COD, DO.

5] To study of chromatography Technics

6] To learn quantitative analysis.

UNIT - I : [06 Lecture]

Purification and Separation Method

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 - II : [06 Lecture]

Water Analysis

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: Colour Taste, Turbidity, Alkalinity, Suspended solids, Hydrogen ionconcentration, Acidity, Biological oxygen demand(BOD), Chemical oxygen demand(COD), Dissolved oxygen(DO).

UNIT - III : **[06 Lecture]**

Chromatography

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 - IV : **[06 Lecture]**

Quantitative Analysis

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.

References Books :

1. Industrial chemistry by B. K. Sharma, Goel Publishing Housing, 1St edition 2011
2. Principles of Environmental Chemistry, James E. Girard Jones and Bartlett. 2nd Ed. 2009
3. Systematic Experiment in Chemistry Arun Sethi New Age International Publisher. 2006
4. Vogels Textbook of Quantitative Inorganic Analysis J. Bassett, R. C. Denney 5 th.
5. Basic Concepts of Analytical Chemistry. Khopkar, S. M. New Age, International Publisher, 2009. Additional Reading.
6. Dean's Analytical Chemistry by Pradyot Patnaik Publication Date: 2004
7. Instrumental Methods Of Chemical Analysis By (author) Gurdeep R Chatwal Sham K. Anand Himalaya Publishing House 01 Aug 2016

Course Outcomes:

Unit - I : After completion of the unit, Students will be able to

1] Concept of purification techniques, separation techniques

2] Defines vacuum distillation, steam distillation, etc

Unit - II : After completion of the unit, Students will be able to

1] Water analysis techniques, its purification, etc

2] Gains knowledge of hardness, BOD, COD,

Unit - III : After completion of the unit, Students will be able to

1] Principle and working of paper TLC, column and gas chromatography.

2] Various types of chromatography technics.

Unit - IV : After completion of the unit, Students will be able to

1] Calibration of apparatus, General principle, and standardization of volumetric analysis

2] Definition and types of gravimetric analysis.

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BNTP- 412: Chemical Science Lab
(Credits - 02)

Course 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.

3] Semi micro qualitative analysis and gravimetric analysis.

4] Student will able to know complexometric titration

5] Student will able to understand measurement of colorimetric parameters (Absorption and Transmission).

6] Student will able to know kinetics of reaction.

Experiments:

1] Semi - micro qualitative analysis using H2S 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, Fe^{-}
(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 ë 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

Reference Books :

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

Course Outcomes :

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

1] Know semi micro qualitative analysis and gravimetric analysis.

2] Know complexometric titration

3] Understand measurement of colorimetric parameters (Absorption and Transmission).

4] Know kinetics of reaction.

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BNTT- 405 : Nanobiology - I
(Lectures : 30, Credits : 02)

Course objective :

1] To study role of microbes in Nanotechnology.
2] To study nanomaterial synthesis by biological methods.
3] To study different concepts of immunology and vaccination.

Unit - I : **[08 Lectures]**

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

Unit - II : **[07 Lectures]**

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 microorganism.

Unit - III : **[08Lectures]**

Concepts of immunology :

Tlymphocytes & 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.

Unit - IV : **[07 Lectures]**

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.

Protocols for nano drug administration for Oral administration, Nasal administration and Ocular administration, Nanomaterial is used in diagnostic and therapeutic application.

References :

1. Immunocytochemical_Methods_and_Protocols 1st_
2. Goldsby RA, Kindt TJ, Osborne BA. . Kuby's Immunology. W.H.Freeman and Company, New York. . 6th edition 2007
3. NANO:The Essentials by T.Pradeep Mc Graw Hill education.
4. Synthesis of Nanoparticales and nanomateriale synthesis by biological approches_Abdullaeva_Springer publication
5. Kuby Immunology,Judith A Owen; Jenni Punt; Sharon A Stranford; Patricia P Jones; Janis Kuby, New York : W.H. Freeman, 7th edition,2013.
6. General Microbiology,Roger Y.Stanier, Edward A. Adelberg, John L Ingraham, Macmillan; 4th edition,1976.

Course Outcomes:

Unit - I : After completion of unit, Students will be able to :

1] Know mechanism of nanoparticle synthesis by bacteria.
2] Know mechanism of nanoparticle synthesis by fungi.
3] Know role of microbes in Nanotechnology.

Unit - II : After completion of unit, Students will be able to :

1] Understand mechanism of nanoparticle synthesis by yeast.
2] Understand mechanism of nanoparticle synthesis by plant.
3] Understand mechanism of formation of antibodies.
4] Understand metal tolerance of micro-organism's.

Unit - III : After completion of unit, Students will be able to :

1] Understand T and B lymphocytes.
2] Understand receptors of lymphocytes.
3] Understand mechanism of Major Histocompatibility complexes.
4] Understand types of various diseases.

Unit - IV : After completion of unit, Students will be able to:

1] Understand mechanism of vaccination.
2] Understand types of different vaccines.
3] Understand different methods of immuno-diagnostics.

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BNTT- 406: Nanobiology II
(Lectures : 30, Credits : 02)

Course objective :

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**.**

Unit - I : [09 Lectures]

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 chip (microfluidic technology) and microelectromechanical systems (MEMS). Nanoprobes for analytical applications.

Unit - II : [07 Lectures]

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.

Unit - III : [06 Lectures]

Nanobiosensor :

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

UNIT -IV : [08 Lectures]

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 theranostics. Introduction to the potentials, applications and challenges of nanomedicine. Nanomedicine and tissue engineering, nanobiomachines and nanorobots.

References:

1. NANO : The Essentials by T.Pradeep Mc Graw Hill education.
2. [Mark_A._Ratner,_Daniel_Ratner]_Nanotechnology_A_(Book4You)

3. [A.K._Bandyopadhyay]_Nano_Materials(Book4You)
4. [Glen_E._Fryxell,_Glen_E._Fryxell]_Environmental_A(BookZZ.org)

Course Outcomes :

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

1] Know concept and applications of Nano.
2] Know mechanism of nanochips for disease diagnostics.
3] Know mechanism of MEMS technology.
4] Know mechanism of nanoprobes for analytical applications.
5] Know concept and applications of Nano.
6] Know mechanism of nanochips for disease diagnostics.
7] Know mechanism of MEMS technology.
8] Know mechanism of nanoprobes for analytical applications.

Unit - II :- After completion of unit, Students will be able to :

1] Disease diagnostic by nanotechnology.
2] Know mechanism of nanoparticles for bioanalytical applications.
3] Know use of nanoparticles for different diagnostics technique.

Unit - III : After completion of unit, Student will be able to :

1] Know mechanism of biosensor.
2] Know mechanism of nanobiosensor.
3] Know mechanism of nanobiosensor for dignostics applications.

Unit - IV : After completion of unit, Student will be able to:

1] Know mechanism and applications of nanomedicine.
2] Know mechanism of nanodrug formation.
3] Know mechanism of nanobiomachines and nanorobots.

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BNTP - 413: Biotechnology Lab
(Credit : 02)

Course Objectives :

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

Experiments :

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.

Reference Books :

1. Immunocyto chemical_Methods_and_Protocols 1st_
2. Immunocyto chemistry: Theory and Practice. Larsson, L. I. CRC, Boca, Raton, FL (1988)

Course outcomes:- After completion of experiment, Students will be able to:

1] Determine the concentration of leucocytes in blood.
2] Know technique of double diffusion.
3] Know technique of antigen capture ELISA.
4] Know synthesis of nano particles using bacteria.
5] Know mechanism of drug diffusion.
6] Know design of Nano diagnostics device.
7] Know synthesis of nano particles using different biological materials.

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BNTT - 407: Statistical Methods for Physical Sciences – III
(Lectures : 30, Credit : 02)

Course 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.

UNIT - I : [06 Lectures]

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.

UNIT - II : [09 Lectures]

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.

UNIT - III : [06 Lectures]

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.

UNIT - IV : [09 Lectures]

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.

Reference Books:

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

Course Outcomes:

UNIT - I : After completion of unit, Students will be able to :

1] Define sample space (Finite and countably infinite), Power set.

2] Identify and explain different types of event.

UNIT - II : After completion of unit, Students will be able to :

1] Explain classical and axiomatic definition of probability.

2] Compute probabilities using different relationship between probabilities.

UNIT - III: After completion of unit, Students will be able to

1] Define Probability Mass Function (pmf),

2] Cumulative Distribution Function(cdf)

UNIT - IV : After completion of unit, Students will be able to

1] Explain different univariate probability distribution.

2] Compute Expectation and variance of univariate distribution.

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BNTT - 408 : Statistical Methods for Physical Sciences – IV
(Lectures : 30, Credit : 02)

Course 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 its Normal approximation

UNIT - 1: [05 Lectures]

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

UNIT - 2 : [10 Lectures]

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.

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 FDistribution.

UNIT - 3 : [07 Lectures]

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) HO: P = PO ii) Ho: P1=P2

b] Tests for means: i) HO: $\mu = \mu O$ ii) Ho: $\mu 1 = \mu 2$

UNIT - 4 : [08 Lectures]

Small sample tests: If X1, X2, ……, X_n is a r. s.from(μ, $\square^2$) then and S^2 are Independently distributed (without proof), construction of test statistic and identification of distribution of teststatistic.

a] T tests for means: i) H0 : $\mu = \mu O$($\square$ unknown)

b] i] Ho: $\mu 1 = \mu 2$ ($\square$ 1= $\square$ 2unknown) unpairedttest.

ii] Ho: $\mu 1 = \mu 2$b (paired t test), iv) H0: p = po

Reference books :

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

Course Outcomes :

UNIT - I : After completion of the unit, Students will be able to

1] Sampling (SRS, SRSWR, SRSWOR, Stratified, Systematic Sampling),
2] Sampling error.

UNIT - II : After completion of the unit, Students will be able to:

1] Exact sampling distributions (Chi-square, Student t, F- distribution)
2] Statement of pdf and Normal approximation.

UNIT - III : After completion of the unit, Students will be able to

1] Explain concepts of Hypothesis, Critical region,
2] Types of errors, size of test.

UNIT - IV : After completion of the unit, Students will be able to

1] Develop test statistic to test hypothesis. Identify which test is appropriate in given situation
2] Develop test statistic to test hypothesis. Identify which test is appropriate in given situation

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BNTP - 414 : Computational MethodsLab 4
(Credit - 02)

Course 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.

Experiments :

1] Sampling for finite population
2] Application of Chi - square Distribution
3] Application of Student –T Distribution
4] Application of F - Distribution
5] Large SampleTest
6] Small SampleTest
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 NormalDistribution

Reference Books :

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

Course outcomes :

After completion of the Experiment, Students will be able to know

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

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BNTT - 409 : Analytical Instrumentation - I
(Lectures : 30, Credits : 02)

Course 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 Lectures]**

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 UV spectrophotometry.

UNIT - 2 **[08 Lectures]**

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 Lectures]**

Fluorescence Spectrophotometry :

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

UNIT - 4 **[07 Lectures]**

Phosphorescence Spectrophotometry :

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

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.
2. Analytical absorption spectrophotometry in the visible and ultra violet the principles. Sommer *Professor of Analytical Chemistry J. E. Purkyne University Brno, Czechoslovakia.* ISBN 0-444-98882-3

3. Fundamentals of UV-visible spectroscopy Hewlett - Packard publication number 12-5965-5123E
4. Ultraviolet and Visible Spectroscopy Edited by. Helmut Giinzler, Alex Williams Copyright OWILEY-VCH Verlag GmbH,2001.
5. An Introduction to Fluorescence Spectroscopy Perkin Elmer 2000.
6. Principles of Fluorescence Spectroscopy Third Edition Joseph R. Lakowicz 2006, 1999, 1983 Springer Science + Business Media, LLC.
7. Fluorescence and phosphorescence spectroscopy Stephen G. Schulman Pergamon Press.

Course Outcomes :

UNIT - I : After completion of this unit, students will be able to :

1] Understand concept of electromagnetic spectrum.
2] Understand Instrumentation of Ultra violet spectrophotometry.

UNIT - II : After completion of this unit, students will be able to :

1] Understand basic principles of visible spectrophotometry
2] Understand working of single beam and double beam spectrophotometer instruments.

UNIT - III : After completion of this unit, students will be able to :

1] Understand mechanism of fluorescence.
2] Understand principle and construction of fluorescence spectrophotometry.

UNIT - IV : After completion of this unit, students will be able to :

1] Understand mechanism of phosphorescence.
2] Understand principle and construction of phosphorescence spectrophotometry.

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BNTT - 410: Analytical Instrumentation-II
(Lectures: 30, Credits: 02)

Course 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 : **[09 Lectures]**

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 : **[06 Lectures]**

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 : **[08 Lectures]**

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 : **[07 Lectures]**

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.

Reference Books:

1. Infrared and Raman spectroscopy : principles and spectral interpretation. Larkin, Peter (Peter J.) ISBN : 978 - 0 - 12 - 386984 - 5.
2. Introductory Raman Spectroscopy, John R. Ferraro, Kazuo Nakamoto and Chris W. Brown ISBN:978-0-12-254105-6, (Second edition) Elsevier, 2003
3. D. Cullity-Elements of X-RAY DIFFRACTION SECOND EDITION. ISBN 0-201- 01174-3. Elsevier 2003.
4. Atomic Force Microscopy/Scanning Tunneling Microscopy 3, Samuel H. Cohenand Marcia L. Light body, Kluwer Academic Publishers.
5. Analytical Atomic Absorption Spectroscopy SELECTED METHODS Jon C.Van
6. Loon 1980 A Subsidiary of Harcourt Brace Jovanovich, Publishers.
7. Atomic Absorption Spectrophotometry *By* W.T. Elwell*And* J. A.F. Gidley Pergamon Press Ltd. 1966
8. Microscopy for Nanotechnology, by Nan Yao. Zhong Lin Wang KluwerAcademic Publishers.
9. 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 ofGermany)

Course Outcomes :

UNIT - I : After completion of the unit, Students will be able to

1] Understand Construction and working of Raman spectrometry.
2] Understand application of IR and Raman spectrometry

UNIT - II : After completion of the unit, Students will be able to

1] Understand the basic principle of X- Ray Diffraction,
2] Understand construction and working of XRD unit.

UNIT - III : After completion of the unit, Students will be able to

1] Understand principle, construction and working of Atomic Absorption Spectrometry
2] Understand principle, construction and working atomic Emission Spectrometry

UNIT - IV : After completion of the unit, Students will be able to

1] Understand construction, working and principle of SEM
2] Understand construction, working and principle of TEM
3] Understand construction, working and principle of AFM

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BNTP – 415: Analytical Instrumentation
(Credits: 02)

Course Objectives :

1] To gain knowledge in characterization techniques

2] To study analysis of the materials by using characterization technique.

Experiments:

1] Data interpretation and plotting

2] Studies on UV - Visible spectrophoto meter

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 in terpretation

9] Atomic Force Microscope image in terpretation

10] Analysis of atomic absorption spectra

Reference Books :

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

Course outcomes: After completion of experiment, Students will be able to :

1] Know principle and working of various characterization techniques. 2] Have an idea about the crystal structure of materials by using XRD.

3] Understanding the atoms stretching in materials by using IR spectrometer.

4] Study about the morphology of materials by using SEM, TEM and AFM images.

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5] Calculate the surface area of colloidal materials by using image of SEM, TEM and AFM.

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	35	05	05	05	130
BNTT-302	Physics-VI	30	5	5						
BNTT-303	Chemistry-V	30	5	5	BNTP 312 LAB 2 Chemistry	35	05	05	05	130
BNTT-304	Chemistry-VI	30	5	5						
BNTT-305	Biotech-V	30	5	5	BNTP 313 LAB 3 Biotechnology	35	05	05	05	130
BNTT-306	Biotech-VI	30	5	5						
BNTT-307	Statistics-I	30	5	5	BNTP 314 LAB 4 Statistics	35	05	05	05	130
BNTT-308	Statistics-II	30	5	5						
BNTT-309	Instrumentation-I	30	5	5	BNTP 315 LAB 5 Instrumentation	35	05	05	05	130
BNTT-310	Instrumentation-II	30	5	5						
BNTT-AECC-2	EVS-I	40	5	5						50
Total of SEM III										**700**

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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	35	05	05	05	130
BNTT-402	Physics-VIII	30	5	5						
BNTT-403	Chemistry-VII	30	5	5	BNTP 412 LAB 2 Chemistry	35	05	05	05	130
BNTT-404	Chemistry-VIII	30	5	5						
BNTT-405	Biotech-VII	30	5	5	BNTP 413 LAB 3 Biotechnology	35	05	05	05	130
BNTT-406	Biotech-VIII	30	5	5						
BNTT-407	Statistics-III	30	5	5	BNTP 414 LAB 4 Statistics	35	05	05	05	130
BNTT-408	Statistics-IV	30	5	5						
BNTT-409	Instrumentation-III	30	5	5	BNTP 415 LAB 5 Instrumentation	35	05	05	05	130
BNTT-410	Instrumentation-IV	30	5	5						
BNTT-AECC-2	EVS-I	40	5	5						50
Total of SEM IV										**700**
Total of SEM III & IV										**1400**

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