Course Outcomes

For B.Sc. (Chemistry)

Programme Outcome:

Students will demonstrate an understanding of major concepts in all disciplines of chemistry. Students will employ critical thinking and the scientific method to design, carry out, record and analyze the results of chemical experiments and get an awareness of the impact of chemistry on the environment, society, and other cultures outside the scientific community. Programme Specific Outcome: The students perusing this course can have ability to explain chemical nomenclature, structure, reactivity, and functions in their specific field of chemistry. The design and execution of the experiments should demonstrate the understanding of good laboratory and the proper handling of chemicals and also explain how the applications of Chemistry related to the real world.

Course Outcomes: F.Y. BSc.

Chemistry Paper-I-

Students will be able to apply thermodynamic principles to physical and chemical process, Knowledge of Chemical equilibrium will make students to understand relation between Free energy and equilibrium and factors affecting on equilibrium constant, Ionic equilibria chapter will lead students to understand concept to ionization process occurred in acids, bases and pH scale, Various theories and principles applied to revel atomic structure, Explain rules for filling electrons in various orbitals- Aufbau's principle, Pauli exclusion principle, Hund's rule of maximum multiplicity, Attainment of stable electronic configurations.

Chemistry Paper-II

The students are expected to understand the fundamentals, principles, and recent developments in the subject area, Analytical Chemistry –branch of chemistry, Calculations of mole, molar concentrations and various units of concentrations which will be helpful for preparation of solution , Basics of type determination, characteristic tests and classifications, reactions of different functional groups, Basics of chromatography and types of chromatography , pH meter and electrodes for pH measurement

Chemistry Paper-III :

students are expected to understand the importance of chemical safety and Lab safety while performing experiments in laboratory, Inorganic Estimations using volumetric analysis.

Course Outcomes: S.Y. BSc.

Chemistry Paper-I-

After studying the Chemical Kinetics student will able to1. Define / Explain concept of kinetics, terms used, rate laws, molecularity, order, Define / explain adsorption, classification of given processes into physical and chemical adsorption, Define, explain and compare meaning of accuracy and precision, After studying the Volumetric Analysis student will able to explain / define different terms

in volumetric analysis such as units of concentration, indicator, equivalence point, end point, standard solutions, primary and secondary standards, complexing agent, precipitating agent, oxidizing agent, reducing agent, redox indicators, acid base indicators, metallochome indicators, etc, Define the terms in phase equilibria such as- system, phase in system, components in system, degree of freedom, one / two component system, phase rule, etc, Define various terms, laws, differentiate ideal and no-ideal solutions, Explain / define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc, Explain / define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc. Explain / define different terms in column chromatography such as stationary phase, mobile phase, elution, adsorption, ion exchange resin, adsorbate.

Chemistry Paper-II :-

After studying the Molecular Orbital Theory student will able to1. Define terms related to molecular orbital theory (AO, MO, sigma bond, pi bond, bond order, magnetic property of molecules, etc, Define different terms related to the coordination chemistry (double salt, coordination compounds, coordinate bond, ligand, central metal ion, complex ion, coordination number, magnetic moment, crystal field stabilization energy, types of ligand, chelate effect, Identify and draw the structures aromatic hydrocarbons from their names or from structure name can be assigned, Identify and draw the structures alkyl / aryl halides from their names or from structure name can be assigned, Identify and draw the structures alcohols / phenols from their names or from structure name can be assigned.

Chemistry Paper-III :

Verify theoretical principles experimentally, Verify theoretical principles experimentally, Verify theoretical principles experimentally, Perform organic and inorganic synthesis and able to follow the progress of the chemical reaction.

Course Outcomes: T.Y. BSc.

Physical Chemistry:

After successfully completion, students will be able to: 1. Know historical of development of quantum mechanics in chemistry, Understand the term additive and constitutive properties, Difference between thermal and photochemical processes, Difference between thermal and photochemical processes, Distinguish between crystalline and amorphous solids / anisotropic and isotropic solids, Types and properties of radiations: alpha, beta and gamma

Analytical Chemistry :-

After completion of the course student should be able to define basic terms in gravimetry, spectrophotometry, qualitative analysis and parameters in instrumental analysis. Such as: Gravimetry, precipitation, solubility product, ionic product, common ion effect, precipitating agent, washing of ppt., drying and ignition of ppt., linearity range, detection limit, precision, accuracy, Sensitivity, Selectivity, Robustness and Ruggedness, electromagnetic radiations, spectrophotometry,

Beers law, absorbance, transmittance, molar absorptivity, monochromator, wavelength of maximum absorbance metal ligand ration, qualitative analysis, group reagent, dry tests, wet test, confirmatory test, precipitation, thermogravimetry, thermogram, percent wt. loss, differential thermal analysis, etc, Define basic terms in solvent extraction, basics of chromatography, HPLC, GC, and AAS and AES. Some important terms are: solvent extraction, aqueous and organic phase, distribution ratio and coefficient, solute remain unextracted, percent extraction, ion association complex, theoretical plate, HETP, retention time, selectivity, resolution, stationary phase, normal and reverse phase, ion exchange, column efficiency, carrier gas, split and spitless injection, packed column, tubular column, atomic absorption and emission spectroscopy, electronic excitation in atoms, nebulization, atomization, reduction of metal ions in flame, absorbance by atoms in flame, flame atomizers, furnace atomizers, interference in AES and FES, HCL, hydride generator.

Inorganic Chemistry:-

A student should know explain electroneutrality principle and different types of pi bonding, To understand about inert and labile complexes and stability of complexes in aqueous solutions, To know position of d-block elements in periodic table, To know position of d-block elements in periodic table, The meaning of metal & semiconductor. Students should be able to understand M-C bond and to define organometallic compounds, Understand the phenomenon of catalysis, its basic principles and terminologies, Identify the biological role of inorganic ions & compounds, know thy types of Inorganic polymers, Understand Preparation of inorganic solids by various methods, Student will learn the concept of acid base and their theories, Know the nature of solids, Different Zeolite Framework Types and their classification, Various methods of nanoparticle synthesis, To know toxic chemical in the environment.

Industrial Chemistry :-

The students are expected to learn importance of chemical industry, Concept of basic chemicals, Importance of sugar industry, Different types of soap products, Dyes: introduction.

Organic Chemistry :-

After studying the polynuclear and heteronuclear aromatic compounds, students will able to define and classify polynuclear and hetreonuclear aromatic hydrocarbons, Meaning of active methylene group, What is rearrangement reaction, 1,1 and 1,2 elimination, They will understand different regions of electromagnetic radiations. They will know different wave parameters, Students will understand the principle of UV spectroscopy and the nature of UV spectrum. They will learn types of electronic excitations.

Polymer Chemistry :-

The students are expected to learn the following aspects of Polymer Chemistry history of polymers, Difference between natural, synthetic, organic and inorganic polymers.

Environmental Chemistry :-

Students should know importance and conservation of environment, Water resources.

Chemistry of Soil and Agrochemicals :- After studying this course, student is expected to understood various components of soil and soil properties and their impact on plant growth, Understood the Reclamation and management of soil physical and chemical constraints, Imparts knowledge on different pesticides, their nature and, mode of action and their fate in soil so as to monitor their effect on the environment

Program Outcomes of F. Y. B. Sc. and S. Y. B. Sc. Botany

1. The scope of plant diversity with respect to environmental relationships.

2. Study of plant classification to understand the taxonomy.

3. The utilization of plants for human beings in terms of its economic importance.

4. Take projects, study case to understand plant biodiversity.

5. Student learns practical work as per the syllabus prescribed by SPPU, field studies for optimizing proficiency the subject.

6. Use of IT tools, communication skills in scientific knowledge1 for specific needs.

7. Career planning.

Course Outcomes of B.Sc. Botany

1. Understanding phylogenetic relationships of plants.

2. Identification of plants becomes easier.

3. Students will apply statistical method to interpret their data collected from various fields.

4. Students will be able to explain plant development at molecular level, development of plant, plant anatomy, photosynthesis and life cycle of plants.

5. Students will be able to develop practical skill in experimental techniques.

Department of Mathematics

Program Outcomes of F. Y. B. Sc. and S. Y. B. Sc. Mathematics ¬

1. Enabling students to develop a positive attitude towards mathematics as an interesting andvaluable subject of study.
2. A student should get a relational understanding of mathematical concepts and concernedstructures, and should be able to follow the patterns involved, mathematical reasoning.
3. Ability to analyze a problem, identify and define the computing requirements, which may beappropriate to its solution.
4. Introduction to various courses like Graph theory, Laplas Transformation
5. Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
6. Ability to pursue advanced studies and research in pure and applied mathematical science.
7. Think in a critical manner.
8. Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.
9. Formulate and develop mathematical arguments in a logical manner.
10. Acquire good knowledge and understanding in advanced areas of mathematicsand statistics, chosen by the student from the given courses.
11. Understand, formulate and use quantitative models arising in social science,Business and other contexts.

Department of Physics
Programme Name - B.Sc. (Physics)
Knowledge Outcomes

After completing B.Sc. (Physics) Programme students will be able to:
1. Apply the basic principles of Physics to the events occurring around us and also in the world.
2. Try to find out or analyze scientific reasoning for various things.

Skill Outcomes
After completing B.Sc. (Physics) Programme students will be able to:
1. use of computers and various software and programming skills
2. apply the knowledge to develop the sustainable and eco-friendly technology for pollution free environment
3. collaborate effectively on team-oriented projects in the field of Physics
4. communicate scientific information in a clear and concise manner both orally and in writing or through audio video presentations

Generic outcomes
Students will
1. develop ability to work in group
2. develop capacity of critical reasoning, judgment and communication skills.
3. Develop abilities for logical thinking

Programme Specific Outcomes
1: Students get acquainted with techniques which are useful in industry.
2: Students get conceptual knowledge of entrepreneurships through the co-curricular activities
3: learn the organizational skills and working in group.
4: Students will be well versed with use of computers

Course Outcomes
In each course students will learn different concepts and theories as mentioned below.

Semester I
Course- PHY 111-
Mechanics and Properties of Matter
1: Application of Newton's laws of motion to solve various problems related to day today life.
2: Concepts like zero work done, conservative forces, mass energy equivalence (E= mc2).
3: Effect of force on various types of materials is described and physical properties like elasticity, different moduli etc. along with their relation.
4: Examples of surface tension in nature and its applications in our day to day life.
5: Concept of viscosity of fluids, Bernoulli's Equation and its applications.

Course- PHY 112-

Physics Principles and Applications

1: Students learn about an atom is made up of protons, neutrons and electron, how they arranged to make up an atom. They learn different atomic models, Atomic spectrum and types of spectrum.

2: Students learn about Different forces which hold atoms together to form a molecule. Different types of chemical and physical bonds like ionic, covalent, Van der Waal's bonds. Energy levels of rotational and vibrational diatomic molecule.

3: Students will identify and compare the characteristics of electromagnetic spectrum including speed, wavelength and frequency.

4: students will learn common uses and applications of electromagnetic waves.

5: students will learn basic principles of Laser, excitation and de-excitation process, pumping scheme, population inversion and metastable state. Characteristics, applications and different types of laser.

Semester II

Course – PHY-121- Heat and Thermodynamics

1: To understand various thermodynamic processes like isothermal, isobaric, isochoric processes and laws of thermodynamics.

2: To understand the concept of entropy. Course outcomes First Year 2019 (CBCS) PATTERN

3:- To understand Carnot's cycle, Heat engines and Refrigerators.

4:- To understand Principle of thermometry and various types of thermometers like Liquid filled thermometers, Gas filled thermometers, Bimetallic thermometers, Platinum resistance thermometer

Course – PHY122

Electricity and Magnetism

1: Students will be able to understand the concept of the electric force, electric field and electric potential for stationary charges. They are able to calculate electric potential and electric field by using Gauss's law.

2: Student will understand the dielectric phenomenon and effect of electric field on dielectric.

3: Study the concept of magnetic field, magnetic field for steady currents using Biot-Savart'sand Ampere's Circuital laws.

4: Student will learn magnetic materials and its properties.

Semester III

Course - PH 231- Mathematical Methods in Physics

1: Study of de moivre's theorem includes understanding of determination of power of given complex number.

2: Many times students come across the terms like divergence, curl and gradient but they don't understand their physical significance. From this course they will learn the concepts to a depth.

3: Students can understand the use of the concept of partial differentiation in solving Physics situations which have more than one variable.

4: Students can also understand the need of complex numbers in solving mathematical equations in different branches of Physics like Electricity and Magnetism, Fluid Dynamics and quantum mechanics.

Course - PH 232 (A) - Electronics

1: Various network theorems which use to solve problems related to complicated circuits by converting them into simpler circuits. This has wide applications in electronic and transmission circuits.

2:- Knowledge about semiconductors since it is a basic materials used in many electronic components like diode, transistors FET, UJT etc. Second Year 2020 (CBCS) PATTERN

3: Characteristics and working of operational amplifiers which are useful in various medicaland scientific investigations to amplify the signals.

4:- Generation of high frequency signals using oscillator circuits and their applications in radio and TV communication

5: Concepts of regulated power supply, rectifiers, filters and regulators. 6: An introduction to digital electronics which is useful in digital computers. Also logic gatesand their applications.

Semester IV

Course- PH241 - Waves, Oscillations and Sound

1: Learn how a body oscillates without damping amplitude and what the necessary conditions are for it.

2: Learn how we can set any object in the forced oscillations that is in continuous motion

3: doppler Effect and its use in in day-to-day life. Using these concept students can get idea of expanding universe.

4: Studying sound concept we can understand why the sound of male and female are differentand the reason behind it.

Course- PH 242- Optics

1: Image formation related to geometrical optics, Deviation, Magnification, Concept for Equivalent lens and Cardinal Points

2: Different types of monochromatic and chromatic aberrations and Achromatism in lenses

3: Construction and working of Simple Microscope, Compound Microscope, Ramsden's Eyepiece and Huygen's Eyepiece

4: Interference and diffraction of light, Formation of fringes, Resolution

5: Concept of Polarization, Double refraction, Construction and working of Nicol Prism

Semester V

Course - PH 351- Mathematical Methods in Physics

1: The three commonly used co-ordinate systems and general curvilinear co-ordinate system.

2: Concept of relativity, length contraction, relativistic mass, time dilation and twin paradox.

3: Various methods to solve different differential equations.

4: Properties of Legendre polynomials, Hermite polynomials and Bessel function. These are useful to solve the problem of linear simple harmonic oscillator in quantum mechanics.

Course - PH 352- Solid State Physics

1: Students will able to study difference between crystalline and amorphous material, crystal structures, miller indices, interplaner distances, interatomic forces and bonds. From this study students get to learn the basics of solid state physics.

2: Students will understand Bragg's diffraction, Bragg's law. X-ray diffraction and characterization techniques. With the help of this knowledge students know the principles of structures determination by X-ray diffraction method. This would be helpful in performing experiments in nanotechnology.

3: Students can understand electrical and thermal conductivity of free electron in metals, Energy levels of free electrons in one and three dimensions. They will learn significance of Pauli's exclusion principle, Bloch theorem, Fermi energy, and Hall effect and energy bands in materials.

4: Students can Describe and explain the behaviour of permanent magnet including induced magnetism, behaviour of paramagnetic, diamagnetic, ferromagnetic materials in terms of magnetic domain.

5: Students can understand superconducting materials, their properties and technological applications of superconductivity.

Course - PH 353- Classical Mechanics

1: Students will be able to define, present and demonstrate basic mechanical concepts and their applications used in daily life.

2: Students can understand the motion of a body, Equations of motions, trajectory of an objects in constant field such as electrical, magnetic field. With the help of this knowledge students can understand process involved in cathode ray Oscilloscope.

3: With the help of this knowledge students will understand how to launch rockets and satellites. Motion of planets and satellites and dynamic molecular collisions. How the mechanicalconcepts used in sports and military.

4: Students will learn Lagrangian and Hamiltonian formulations. Canonical transformation, Passion's Bracket concept. Using the technique of Lagrangian and Hamiltonian formulation students will explain motions of different bodies in simple form such as kinetic and potential energy.

5: Students can learn Newton's laws such as projectile motion and rocket motion. Also Kepler's laws related to motion. Scattering of particles.

6: Mathematical and thinking skills will develop among students by solving problems.

Course - PH 354- Atomic and Molecular Physics

1: There are many atomic models to explain atomic structure. But none of the model explained atomic structure fully. A new model could explain all parameters of atomic structurecalled vector atom model. Studying these model students can draw vector diagrams easily.

2: Students learn how to find out interaction energy from different coupling schemes.

3: Students scientifically understand how the x-rays produced. Also they will understand what precaution should be taken during handling of x- rays.

4: By studying molecular spectroscopy students understand the importance rotational and vibrational energy levels.

Course - PH 355- Computational Physics

1: Learn the Basic Programming Concept.

2: Improve the logical as well as Computational ability.

3: Memory allocation and utilization technique learning.

4: Applicability of computer resources in physics.

5: Learn Graphical technique using some Graphical Commands in C programming.

Course - PH 356 B- Elements of Material Science

1: By studying defects in solid, students can identify the defects existing in a given solid.

2: Students will learn different polymers and the importance of polymerization in making superior quality polymer.

3: Students will understand which type of ceramic material can be used for a particular application.

4: Smart materials are newly discovered materials which are useful to human being in day-to-day life. Students will study such advanced materials.

Semester VI

Course – PH 361 - Electrodynamics

1: Understand the basic mathematical concepts related to electromagnetic vector fields.

2: Understanding of basic principles and concepts of electromagnetism and magnetostatics

3: Learning Maxwell's equations and boundary value problems. Applications of these equations for solving problems.

4: Understanding the basics of electromagnetic waves, wave equations in free space and pointing theorem.

Course - PH 362 –

Quantum Mechanics 1: Introduction to Quantum Mechanics, Historical background, Matter Waves, Wave particle duality, Phase and Group Velocity, Heisenberg's Uncertainty Principle

2: Physical Interpretation of Wave function, Schrödinger's Wave Equation, Eigen Functionand Eigen values

3: Free Particle, One Dimensional and Three Dimensional Rigid Box, Potential Barrier

4: Spherically symmetric potential, Examples of Rigid Rotor and hydrogen atom

5: Hermition and other operators in Quantum Mechanics, Commutator brackets and conceptof parity

Course - PH 363- Thermodynamics and Statistical Physics

1: To study the transport phenomenon such as viscosity, thermal conductivity, diffusion.

2: To learn about thermodynamic functions, variables and their relations.

3: To acquire the skill of solving problems based of particle distribution.

4: To study about types of ensembles viz. Microcanonical, canonical and grand canonical.

5: To get the knowledge about Maxwell Boltzmann statistics, Bose Einstein statistics and Fermi Dirac Statistics

Course - 364- Nuclear Physics

1: Studying Basic properties of nucleus, student got the idea of inner information of the nucleus.

2: From radioactivity chapter student knew that which radiations emit from radioactive material and how they are useful and harmful for the human.

3: From nuclear force student understood that apart from alpha, beta, gamma particle how many other particles are inside the nucleus.

4: Studying molecular spectroscopy students understand the importance rotational and vibrational energy levels.

5: Student learnt by using accelerators we can produce high energy particle which can be used for research purpose

6: Use of nuclear reactors to produce huge amount of heat energy.

Course - 365- Electronics II

Students can learn the design and working of electronics used in different applications.

1: Special Purpose diodes like LED, photodiode, Varactor, Optocoupler

2: Amplifiers, Class A, Class B and Class C , Push Pull emitter follower and differential amplifier

3: Junction Field Effect Transistor and MOS Field Effect Transistor, Working and applications

4: Operational Amplifiers its parameters, characteristics and applications

5: 555 timer, Astable, Monostable and BistableMultivibrator

6: Regulated power supply using IC 723

7: Combinational Circuits like Adder, Subtractor and Multiplexer, Binary to Gray code conversion

8: Sequential Logic Circuits, Flip- Flop, Counters and Shift Register

Course - PH 366 Q- Physics of Nanomaterials

1: To obtain foundational knowledge of the nanomaterials and related fields.

2: To make the students understand the Applications of Nanotechnology.

3: Learn about the background on Nanomaterials

4: Understand the synthesis techniques of nanomaterials and the impact of nanomaterials on environment

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Department of microbiology

Program Outcomes:

At the graduation in science faculty a student should have:

- Acquired the knowledge with facts and figures related to various subjects in pure sciences such as Microbiology, Physics, Chemistry, Botany, Zoology, Mathematics, etc.

- Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.

- Acquired the skills in handling scientific instruments, planning and performing in laboratory experiments.

- The skills of observations and drawing logical inferences from the scientific experiments.Analyzed the given scientific data critically and systematically and the ability to draw the objective conclusions.

- Been able to think creatively (divergently and convergent) to propose novel ideas in explaining facts and figures or providing new solution to the problems.

- Realized how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments.

- Developed scientific outlook not only with respect to science subjects but also in all aspects related to life.

- Realized that knowledge of subjects in other faculties such as humanities, performing arts, social sciences etc. can have greatly and effectively influence which inspires in evolving new scientific theories and inventions.

- Imbibed ethical, moral and social values in personal and social life leading to highly cultured and civilized personality.

- Developed various communication skills such as reading, listening, speaking, etc., which we will help in expressing ideas and views clearly and effectively.Realized that pursuit of knowledge is a lifelong activity and in combination with untiring efforts and positive attitude and other necessary qualities leads towards a successful life.

- Developed flair by participating in various social and cultural activities voluntarily, in order to spread knowledge, creating awareness about the social evils, blind faith, etc.

Program Specific Outcome – Microbiology B.Sc.

Microbiology is a branch of science that studies microscopic life forms such as bacteria, protozoa, algae, fungi, bacteria, viruses, etc. These studies are inclusive of cytology, physiology, ecology, genetics and molecular biology, evolution, taxonomy and systematics with a focus on microorganisms. The relevance and applications of these microorganisms to the surrounding

environment including human life becomes part of this branch. Since inception of this branch of science, microbiology has remained a field of active research and ever expanding in all possible directions; broadly categorized as pure and applied science. Different branches of pure microbiology based on taxonomy are bacteriology, mycology, protozoology and parasitology, phycology and virology; with considerable overlap between these specific branches over each other and also with other disciplines of life sciences, like biochemistry, botany, zoology, cell biology, biotechnology, nanotechnology, bioinformatics, etc. Areas in the applied microbial sciences can be identified as: medical, pharmaceutical, industrial (fermentation, pollution control), air, water, food and dairy, agriculture (plant pathology and soil microbiology), veterinary, environmental (ecology, geomicrobiology); and the technological aspects of these areas. Knowledge of different aspects of microbiology has become crucial and indispensable to everyone in the society. Study of microbes has become an integral part of education and human progress. Building a foundation and a sound knowledge-base of microbiological principles among the future citizens of the country will lead to an educated, intellectual and scientifically advanced society. Microbiological tools have been extensively used to study different life processes and are cutting edge technologies. There is a continual demand for microbiologists in the work force – education, industry and research. Career opportunities for the graduate students are available in manufacturing industry and research institutes at technical level.

M.Sc.

Overall picture of student trends (before undergraduate studies) in selecting courses is very typical; most of the science students aim at professional courses, particularly leading to studies in engineering. Comparatively less number of students opts for degrees in biosciences. For several years now, the first preference of students desiring to enter the field of life sciences has been microbiology, and for last 2 to 3 years it has shifted partly to biotechnology courses. Both these disciplines viz. Microbiology and biotechnology deal with overlapping interests. Microbial sciences focus more on study of the microbial world (this limitation needs to be corrected!) While biotechnology focuses more on application of mammalian systems. The main theme of teaching these courses, however, remains the same i.e. Application of basic principles of life science to develop into technology. Modern biology combines the principles of chemistry and biological sciences (molecular and cellular biology, genetics, and immunology) with technological disciplines (engineering, computer science) to produce goods and services and for environmental management. Tools of molecular biology play an important role in preparation of an engineered clone, a recombinant or a genetically manipulated organism (gmo). The board of studies in microbiology has identified the following thrust areas and prospective plans for syllabi reforms at postgraduate level:

Microbial technology – includes application of bacteria, fungi, protozoa and viruses intraditional (food, dairy, wine, antibiotics, fermentation, etc.) And biotechnological industries.

Human health – includes pathogenic micro-organisms (bacterial, viral, protozoan and Fungal), therapeutics and pharmaceutical approach towards diseases, diagnostics, vaccine developments, epidemiological characterization of diseases, gene therapy, etc.

Agriculture – includes biofertilizers and biocontrol, ecology and geomicrobiology.

Environment – includes cleaner processes that produce less waste and use less energy and water in such industrial sectors as chemicals, pulp and paper, textiles and dyes, food, energy, and metals and minerals, harnessing microbial utilities avoiding the use of caustic chemicals, bioremediation and bioprospecting.

Microbial diversity – includes collecting information of diversity, exploration and utilization of diversity to identify and harvest biomolecules for human health improvisation, microorganisms from extreme environments, archeabacteria, etc.

Research in life-sciences – includes research tools like immunology and molecular biology, developmental biology, evolution, stem cell research, etc.

To enrich students' knowledge and train them in the above mentioned areas; we feel certain topics in the present syllabus need to be supplemented and strengthened by inclusion of few additional topics. Areas that need to be introduced in syllabi have been identified as:

· eukaryotic cellular organization

· eukaryotic gene expression e.g. Yeast genetics

· determinants of microbial pathogenecity

· immunopathology, immunopharmacology and cancer biology

· protein stability, conformation and folding

· over-expression of recombinant proteins

· biocontrol

· bioinformatics

· molecular tools for characterization, identification of bacteria

· possible utilization of microbial population from extreme environments

In addition, we feel that the students should be well acquainted with research methodology which includes different skill developments in scientific writing, data handling and processing, development of research ideas and planning / designing of research projects. The skill sets thus evolved will help the students in academic and applied research.

Course Specific Outcome

F.Y. B.Sc. Microbiology

The course starts with learning the history of microbiology, followed by development of microbiology in 19th and 20th century. Further they study medical microbiology which makes them understand discovery of microbes as pathogens and related topics. Next they learn morphological and differentiating characters of microorganisms (like bacteria, fungi, viruses, etc.) and applications of microbiology in agriculture, pharmaceutical, food etc.

They then study chemistry of biomolecules, their structure &function and bacterial cytology (structure, chemical composition and functions of cell wall, cell membrane, ribosomes etc.) They are introduced to basic techniques in microbiology like microscopy, staining techniques, sterilization and disinfection etc. It also includes cultivation of microorganisms, their growth kinetics and related topics.

S. Y. B.Sc. Microbiology

In the second year they are introduced to BACTERIAL SYSTEMATICS which include Concept of species, Chemotaxonomy, Numerical taxonomy, Genetic basis of taxonomy and BACTERIAL PHYSIOLOGY which comprises Metabolic pathways like EMP, HMP, ED, Phosphoketolase, Glyoxylate, TCA, etc. They also learn Biocatalysts; their structure and function and the effect of environmental factors on their activity. Theyare also made familiar to the molecules of hereditary – DNA & RNA. Under this they study their structure, function and mechanisms. They are also made to understand the experiments that led to all these discoveries.

INDUSTRIAL AND SOIL MICROBIOLOGY –

In industrial microbiology, they study topics related to fermentation like Design of a Fermenter, Strains of industrially important microorganisms, and Media for industrial fermentations etc.

In soil microbiology, they learn Soil microorganisms, Biofertilizers, Biocontrol agents, Role of microorganisms in composting and humus formation etc.

They are also introduced **to AIR AND WATER MICROBIOLOGY** in which theylearn about air flora, air pollution, air sanitation, Air borne infections etc.

In water microbiology, they study water purification methods, water pollution indicators, water borne infections etc.

T. Y. B.Sc. Microbiology

In this year they have six papers of microbiology which make them understand the subject in more detail.

MEDICAL MICROBIOLOGY –

This teaches them, infectious diseases of bacteria their causative agents, Epidemiology, Pathogenicity, Pathogenesis, Symptoms. They also study Chemotherapy, mode of action of antimicrobial agents on bacteria, fungi, viruses etc. and Resistance to antibiotics. They also learn about the Viruses, fungi and parasites; their structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis including serological diagnosis, Epidemiology, Prophylaxis and Chemotherapy.

GENETICS AND MOLECULAR BIOLOGY –

This makes them learn the Mendelian genetics, recombination, crossing-over, chromosome mapping, gene linkage etc. Then they are made to understand the processes of DNA replication, Transcription and Translation. Here they are also briefly introduced to recombinant DNA technology.

They are taught the processes involved in gene manipulations like transformation, conjugation and transduction. They also study DNA damage and repair and recombination in bacteriophages. Then they learn some more of recombinant DNA technology and the tools required for it.

ENZYMOLOGY - This teaches enzymes in detail and includes its Structure, role of cofactors, enzyme assays, its purification methods, enzyme kinetics and regulation. They also learn immobilization of enzymes. They learn Membrane transport mechanisms, Bioenergetics, Biosynthesis and Degradation and bacterial photosynthesis in detail.

IMMUNOLOGY – This stream of microbiology which, the students haven't learnt earlier is introduced to them in the third year. Here they study immunity, formation of blood, organs of immunity, antigen, antibody, innate immunity, acquired immunity, cell mediated immunity etc. They also learn Major Histocompatibility Complex, Antigen- Antibody Interactions, cytokines, Immunohematology, Public health immunology, Hypersensitivity, hybridoma technology etc.

FERMENTATIONTECHNOLOGY –Teaches them everything related to fermentation which includes - Strain Improvement, Media optimization, Sterilization of Media, Scale-up and Scale-down, Principles and methods of downstream processing, Quality assurance (QA) of fermentation product, etc. They will also learn Solid State Fermentation and Submerged Fermentation, Large scale production of Primary Metabolites, Secondary metabolites, Microbial transformation of steroids, Biomass based products, Milk products, Vaccines, Immune sera etc.

FOOD AND DAIRY MICROBIOLOGY – This paper includes Development in India, Milk Chemistry and Constituents, Microbiology of milk, Preservation of Milk by Pasteurization & its storage, Microbial analysis of milk

In **FOOD MICROBIOLOGY**, they learn Classification of Foods based on stability, Food spoilage, Food preservation, Microbial food poisoning and food infection, Fermented foods, Applications of genetically modified microorganisms, Food Sanitation and regulation. They also study Agriculture Technology like Plant growth improvement, Methods of plant disease control by different methods, Biochemistry and production of bio-fertilizers, Bioremediation and Waste Water Treatment; Role of plants& Microbes in Bioremediation, Bioaugmentation: microbial cultures and enzymes for bioaugmentation, Bioleaching, Nanobiotechnology, Microbial Biosensors and Biochips in Environmental Monitoring, Biofuel cells and Biodegradable plastic, Bioterrorism, etc.

Practicals related to these topics are conducted to help the students gain knowledge and hands- on experience of the myriad techniques in microbiology.

M.Sc. Microbiology

M.Sc. – I (Semester I and II):

For each semester this course has three core compulsory theory papers, one core compulsory practical paper and one elective theory paper and its practical paper (three options for elective papers are given out of which any one can be chosen).

MICROBIAL SYSTEMATICS – This paper includes bacterial systematics and classification, taxonomy, various aspects of microbial diversity, concepts of evolution.

QUANTITATIVE BIOLOGY – This includes various concepts of statistics like descriptive statistics, inferential statistics and probability.

BIOCHEMISTRY AND METABOLISM – This includes in depth concepts of protein chemistry, developmental biology, cell biology and biophysical techniques such as chromatography, electrophoresis, PCR and sequencing techniques.

FUNGAL SYSTEMATICS AND EXTREMOPHILES – This includes taxonomy of fungi and studies on extremophiles.

EXPERIMENTAL DESIGN AND QUANTITATIVE APPROACHES FOR BIOLOGIST – This includes research methodology and data analysis techniques for life sciences.

MICROBIAL COMMUNICATION, MEMBRANE TRANSPORT AND SIGNAL TRANSDUCTION – This includes membrane transport and cell signaling in microorganisms.

INSTRUMENTATION AND MOLECULAR BIOPHYSICS – This includes separation techniques for various biomolecules, X-ray crystallography, spectroscopic techniques and radioisotopic techniques.

MOLECULAR BIOLOGY – This includes RNA processing, tools for genetic engineering, genome projects and molecular diagnostics.

ENZYMOLOGY, BIOENERGETICS AND METABOLISM – This includes enzyme kinetics, thermodynamics, carbohydrate and lipid metabolism.

BIOINFORMATICS AND BIONANOTECHNOLOGY – This includes various concepts and techniques in bioinformatics and nanotechnology.

MOLECULAR BIOLOGY TOOLS AND APPLICATIONS – This includes various techniques in molecular biology such as hybridization techniques, DNA footprinting, recombinant DNA technology and its applications.

NITROGEN METABOLISM, RESPIRATION AND PHOTOSYNTHESIS– This includes biochemistry of biological nitrogen fixation, respiration and photosynthesis. Practicals related to these topics are conducted to help the students gain knowledge and hands- on experience of the myriad techniques in microbiology.