B.Sc. (Honours) Biological Science CBCS Structure under the Faculty of APPLIED & ALLIED SCIENCE

	CORE COURSES (14)	ABILITY ENHANCEMENT (2)	SKILL ENHANCEMENT (4)	DISCIPLINE SPECIFIC (4)	GENERIC ELECTIVE (4)
SEMESTER -I	BSHB-CC-101 (Chemistry) BSHB-CC-102 (Cell Biology)	BSHB-AE-101 English	BSHB-SE-101 (Biostatistics)		BSHB-GE-101 Fundamentals of Yoga & Ayurveda Or BSHB-GE-102 Foundation of Physical Education
SEMESTER -II	BSHB-CC-201 (Biodiversity) BSHB-CC-202 (Biophysics)	BSHB-AE-201 Environmental Science	BSHB-SE-201 (Recombinant DNA Technology)		BSHB-GE-201 Indian Culture or BSHB-GE-202 Introduction to Srimad Bhagawad Gita
SEMESTER -III	BSHB-CC-301 (Biochemistry) BSHB-CC-302 (Ecology) BSHB-CC-303 (Microbiology)		BSHB-SE-301 (Computer Programming)	BSHB-DS-301 (Drug Discovery & Development)	
SEMESTER -IV	BSHB-CC-401 (Metabolism) BSHB-CC-402 (Mol Biology) BSHB-CC-403 (Physiology)		BSHB-SE-401 (Analytical Chemistry)	BSHB-DS-401 (Biomaterials)	
SEMESTER -V	BSHB-CC-501 (Genetics) BSHB-CC-502 (Neurobiology)			BSHB-DS-501 (Economic Botany)	BSHB-GE-501 Research Methodology or BSHB-GE-502 Fundamentals of Organic Chemistry
SEMESTER -VI	BSHB-CC-601 (Evolution) BSHB-CC-602 (Endocrinology)			BSHB-DS-601 (Dissertation)	BSHB-GE-601 Biochemical Instrumentation or BSHB-GE-602 Structural Bioinformatics
TOTAL	14 PAPERS THEORY 14X4CREDITS=56 PRACTICAL 14X2CREDITS=28	2 PAPERS 2X4 CREDITS=8	4 PAPERS 4X4 CREDITS=16	4 PAPERS 4X6 CREDITS=24	4 PAPERS 4X4 CREDITS=16
OVERALL CREDITS	148				

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: CHEMISTRY (THEORY)

SUBJECT CODE: - BSHB-CC101

SEMESTER – I

Course Objectives:

The chemistry course objectives are

1) **Helping learners to describe chemical bonding and structural aspect of molecules.**
2) **Basic idea of inorganic, Physical and organic aspectt of the molecules.**
3) **Help to understand the atomic structure, Kinetics, bonding & bio-molecules.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1: Chemical Bonding and Molecular Structure Ionic Bonding [15 hrs]

Ionic Bonding, Lattice energy and solvation energy. Born-Haber cycle and its applications, Covalent Bonding: VB Approach, Lewis theory, VSEPR theory to explain the shapes of molecules, concept of hybridization, MO Approach: limitations of the VB approach, salient features of the MO theory. Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for s-s-, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules and heteronuclear diatomic molecules such as CO, HF.

Unit 2 Chemical Thermodynamics [15 hrs]

First Law of Thermodynamics: Calculation of work (w), heat (q), changes in internal energy (ΔE) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w,q, ΔE, and ΔH for processes involving changes in physical states. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, Variation of enthalpy of a reaction with temperature Kirchhoff's equation. Second law of thermodynamics,

concept of entropy, Gibbs free energy and Helmoltz free energy. Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity, Gibbs Helmholtz equation.

Unit 3 Chemical Kinetics [10 hrs]

The concept of reaction rates, effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, derivation of integrated rate equations for zero, first and second order reactions, half–life of a reaction, general methods for determination of order of a reaction, Concept of activation energy and its calculation from Arrhenius equation.

Unit 4 Atomic Structure [15 hrs]

Review of: Bohr's theory and its limitations, Heisenberg uncertainty principle, Dual behaviour of matter and radiation, De-Broglie's relation, Hydrogen atom spectra, need of a new approach to atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and $\psi 2$, Schrödinger equation for hydrogen atom, radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation), radial and angular nodes and their significance, radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers. Shapes of s, p and d atomic orbitals

Unit 5 Bio-molecules & Medicinal chemistry [5 hrs]

Bio-molecules: Carbohydrates, proteins, medicines and vitamins.

Course Outcomes

Upon completion of the course the student should be able to:

1. Get a knowledge of the theoretical principles of chemistry of molecular structure, bonding and properties of chemical substances and structure and function of bio-inorganic molecules
2. Get an acquaintance with chemical concepts and apply the concepts of thermodynamics like heat, temperature, calorie, degree Celsius, application in photosynthesis and digestion, food industry, role of entropy on global warming, enthalpy of a reaction
3. Apply the concepts related to rate of chemical reaction, role of enzyme catalyst etc

SUGGESTED READINGS

1. J. D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.

2. P.W. Atkins: Physical Chemistry, Oxford University Press

3. R.T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall

4. James E. Huheey *et al*.: Inorganic Chemistry: Principles of Structure and reactivity,

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BSHB-CC101-P CHEMISTRY (PRACTICALS) SEMESTER - I

TOTAL HOURS: 30 CREDIT: 2

1. Simple Acid Base titrations for determining strengths.

2. Estimation of oxalic acid by titrating it with KMnO4.

3. Surface tension measurement (use of organic solvents excluded) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

4. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer

5. Determination of melting and boiling points of organic compounds

6. Separation of mixures by Chromatography; Measure the Rf value in each case (combination of two compounds to be given) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.

7. Determination of Functional groups present in an organic compound.

8. Identification of anions and cations in an inorganic compound

Suggested Reading Materials:

1. A.I. Vogel, Vogel's Qualitative Inorganic Analysis, Prentice Hall, 7th Edition

2. A.I. Vogel, Vogel's Quantitative Chemical Analysis, Prentice Hall, 6th Edition

3. B.D. Khosla, Senior Practical Physical Chemistry, R.Chand & Co.

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: CELL BIOLOGY (THEORY)

SUBJECT CODE: - BSHB-CC102

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The cell biology course objectives are

1. **Helping learners to describe cytological, biochemical, physiological aspect of cell.**
2. **Relate normal cellular structures to their functions.**
3. **Apply modern cellular techniques to solve aspects of scientific problems.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit I: The Cell [10 hrs]

Historical background, significant landmarks, cell theory, structure of prokaryotic and eukaryotic cells, Types of prokaryotic Cells- Domain archaea & domain bacteria, Prokaryotic diversity, mycoplasma, viruses, viroids, prions. Cell Organelles: Structure and functions of various organelles.

The nature of biological molecules, Carbohydrates, Lipids, Proteins, Nucleic acids

Unit III: Cell Fractionation [10 hrs]

Centrifugation: types of centrifuges, principle and different types of centrifugation- differential, density gradient and equilibrium.

Unit IV: Cell Membrane and Transport [15 hrs]

Functions, different models of membrane structure, types of membrane lipids, membrane proteins and carbohydrate.Transport of small molecules: Passive transport (simple diffusion and facilitated diffusion) and active transport and their types (P, V, F and ABC transporter) with

example of Na+ /K+ pump. Transport of macromolecules: Endocytosis (pinocytosis, phagocytosis), exocytosis.

Unit V: Cell Junctions [05 hrs]

Basics concepts of anchoring junctions, tight junctions, communication junctions (gap junction and plasmodesmata).

Unit VI: Cytoskeletal Elements [05 hrs]

Structure assembly and functions of microtubules, Microfilaments and Intermediate filaments.

Unit VII: Cell Cycle [05 hrs]

Different phases of cell cycle and their significance. Checkpoints and regulation of cell cycle.

Unit VIII Principles of Microcopy [10 hrs]

Principles and Applications of Microscopy including Light Microscopy, Phase Contrast Microscopy ,Confocal microscopy and Electron Microscopy.

Course outcomes

1. At the end of the course, the student has a strong foundation on the functions of the cell. Understand the genetic changes that give rise to cancer and the mechanisms by which those changes occur, as well as how genes are abnormally regulated.
2. The student grasps how cellular processes—such as cancer cell metabolism, stress responses, and cell cycle regulation—contribute to cancer development and progression. He/ She knows the biological processes underlying cancer initiation, progression, and metastasis and identify how tumors evolve and respond to/ or resist treatment
3. He masters the basic principles of signal transduction mechanisms, in particular the concepts of response specificity, signal amplitude and duration, signal integration and intracellular location give examples of different types of extracellular signals and receptors, and explain their functional significance describe the mechanisms by which different receptors may be activated by their respective ligands, describe and give examples of the structure and properties of the major components of signal transduction pathways.

SUGGESTED READINGS

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition, John Wiley & Sons. Inc.

2. De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper G. M. Hausman R. E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press and Sunderland, Washington D. C.; Sinnauer Academic Press.

4. Becker W. M., Kleinsmith L.J. and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San fransisco.

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Structure of B.Sc. (Hons) Biological Science under CBCS

BSHB-CC-102-P Cell Biology (PRACTICALS) SEMESTER - I

TOTAL HOURS: 30 CREDIT: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Microscopy- Theoretical knowledge of Light and Electron microscope.

2. To study the following techniques through photomicrographs: fluorescence microscopy, autoradiography, positive staining, negative staining, endocytosis and phagocytosis.

3. To explain mitosis and meiosis using permanent slides.

4. To cytochemically demonstrate the structure of cell using onion peel.

5. To cytochemically demonstrate presence of carbohydrates in cheek cells or onion peel using periodic acid Schiff‟s reagent.

6. To cytochemically demonstrate presence of DNA in cheek cells or onion peel using Feulgen reagent.

7. To study the effect of isotonic, hypotonic and hypertonic solutions on cells.

8. To study and comment upon different organelles of a typical cell using specimens/photographs.

9. To study the process of osmosis using potato osmometer.

SUGGESTED READINGS

1. Cell Biology-Practical Manual- Dr. Renu Gupta, Dr. Seema Makhija and Dr. Ravi Toteja, Prestige Publishers.
2. Cell and Molecular Biology- A Lab Manual-K.V. Chaitanya, PHI Learning Pvt. Limited, New Delhi
3. A Manual of Practical Zoology-Biodiversity, Cell Biology, Genetics & Developmental Biology Part 1- M.M Trigunayat and Kritika Trigunayat, Scientific Publishers, India

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: BIOPHYSICS (THEORY)

SUBJECT CODE: - BSHB-CC-202

SEMESTER – II, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The biophysics course objectives are

1. **It Helps learner to understand the laws of physics to biological problems.**
2. **Biophysics helps to understand the various laws & principles used for biological system.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit1: General Physics: [15 Hrs]

Conservation of momentum and energy, work energy theorem. Conservation of angular momentum, torque, Physiological effects of acceleration and angular motion. Simple harmonic motion, damped and driven harmonic oscillator, Wave equation, superposition principle, pulses, Doppler effect, effects of vibrations in humans,

Unit 2: Protein Structure & Stability [15 Hrs]

Predicting properties of proteins from amino acid composition, Primary structure sequencing of polypeptide, hemoglobin, homologies in proteins, Secondary structure alpha and beta conformation, collagen structure, stability of alpha helix, Ramchandran plot, Tertiary structure, structure of myoglobin and hemoglobin, Quaternary structure, Analysis of subunits and chain arrangement of subunits, stability of globular quaternary structure. Protein folding rules

Unit 3: Biophysics of Various Organs [30 Hrs]

(i) Structure of the eye, Optics of Vision, retinal pigments, rods and cones, Photochemistry of vision, structure of ear, physics of audition (amplitude, frequency, pitch), unit of measurement of sound, intensity, Audiometry, deafness, hearing aids. Taste & Smells: taste receptors & their role,

(ii) Electrocardiogram (ECG) and its characteristics, structure of lungs, diffusion, exchange and transport of gases, Effect of altitude changes on body, high altitude- mountain sickness. Biophysics of nerves, generation and propagation of nerve impulse, synapse, synaptic transmission, Brain Waves (EEG): origin of alpha, beta, delta & theta

Course Outcome

1. Examine biophysical scenarios using a conceptual understanding of the core concepts of biology, chemistry, and physics
2. Effectively communicate biophysics content through both written reports and oral presentation
3. Apply their physics and biophysics experience and knowledge to analyze new biophysical situations and to develop and refine experimental methods

SUGGESTED READINGS

1. Physical Biochemistry, David Freifelder, Applications to Biochemistry and Molecular Biology, 2nd Edition, W.H. freeman and Company, 2005.

2. Hoppe et. al., Biophysics, Translation of 2nd German Edition, Springer Verlag, 1983.

3. Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, 2005

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course BSHB-CC-202-P BIOPHYSICS (PRACTICALS)

SEMESTER - II TOTAL HOURS: 30 CREDIT: 2

1. Determination of the acceleration due to gravity using bar pendulum

2. Determination of the coefficient of Viscosity of water by capillary flow method (Poiseuille's method)

3. Verification of Beer Law

4. Effect of different solvents on UV-Vis absorption spectra of proteins.

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course (C-3)

COURSE DETAILS

SUBJECT TITLE: BIODIVERSITY (THEORY)

SUBJECT CODE: - BSHB-CC201

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Identify and describe the structural features of plants.**
2. **Describe major evolutionary lineages of plants and their defining characterstics.**
3. **Describe the cultural uses of plants for food, fiber, medicine, biotechnology etc.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 Defining Biodiversity [15 hrs]

Components of Biodiversity. Biodiversity crisis and biodiversity loss. Importance of biodiversity in daily life. Biodiversity and climate change. Threats to biodiversity, threatened criteria, Types of Ecosystems: India as mega biodiversity Nation. Hot spots and biodiversity in India. Biodiversity and Ecosystem functioning. Plant and Animal systematic. Species concept in biodiversity studies. Indian Wildlife protection act, 1972

Unit 2 Modern Tools in the study of Biodiversity [15 hrs]

Endemism, endemic plants and animals; Assessment of mapping of biodiversity; GIS/Remote sensing; Biotechnology and Conservation, IUCN; Protected areas networks, reserve forests, biosphere reserve forest, wetlands, Biodiversity park, Germplasm banks, National Parks, Botanical and Zoological Gardens; Wildlife Sanctuaries, Bioresources, rescue centers, captive breeding centres, zoo. Biological diversity act, 2002.

Unit 3 Crop Diversity [15 hrs]

Wild relatives of cultivated plant; BM Crops, Domesticated diversity; Spice diversity; Forest diversity and wild life. Men biosphere program 1988

Unit 4 Bio-prospecting [10 hrs]

Bio-prospecting - Micro organisms as a source of novel enzymes, antibiotics, antiviral agents; Immunosuppressive agents and other therapeutic agents.

Unit5: Different Projects for conserving wild animals [5 hrs]

Project Tiger, Project Asiatic lion and elephant, Project Crocodile, Project Vultures

Learning Outcomes:

1. Students will realize that people are dependent on intact habitats that sustain the various organisms we need to produce food, medicines, clothing, and other materials. Students will learn about certain species' roles in an ecosystem.

2. Students will discover that life can be found almost everywhere on earth.

3. Students will identify floral and faunal species in its surrounding with their status.

4. Inputs of conservation steps according to the status of degradation in surrounding.

5. Actively participate in planned, sustained, and collaborative ecological Projects.

SUGGESTED READINGS

1. Aber, J.D.and Melillo J.M., Terrestrial Ecosystems: 1991, W.B.Saunders

2. Ingrowille, M Diversity and Evolution of land plants 1992 chapman and Hall

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Structure of B.Sc. (Hons) Biological Science under CBCS

BSHB-CC-201-P BIODIVERSITY (PRACTICALS)

SEMESTER - II TOTAL HOURS: 30 CREDIT: 2

1. Study of a few endangered species of amphibians, reptiles, birds and mammals of India

2. Report on visit to National Park/Wild life sanctuary/Botanical garden.

3. Study through specimens/photographs/slides of a. Key stones species (b) Ecads, Ecotypes, Ecophenes (c) Sacred flora (havan materials etc.)

4. Study of the characteristic features of any flower for each family a. Malvaceae/ Fabaceae/Cruciferae/Ranunculaceae (any one family), (b) Compositae b. Euphorbiaceae, (d) Poaceae/Liliaceae (any one family)

SUGGESTED READING

1. A Manual of Practical Zoology-Biodiversity, Cell Biology, Genetics & Developmental Biology Part 1- M.M Trigunayat and Kritika Trigunayat, Scientific Publishers, India
2. Dinesh Biodiversity (Microbes, Algae, Fungi & Archegoniates)-Dr. Anil K. Thakur , Dr. Susheel K. Bassi, Dr. S.K. Sood- Dinesh & Co.

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Core Course

COURSE DETAILS

SUBJECT TITLE: MICROBIOLOGY (THEORY)

SUBJECT CODE: - BSHB-CC303

SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

2. **Describe disease causing microorganisms and microbial agents at organismal, cellular or molecular levels.**
3. **Relate normal cellular and molecular structures their functions.**
4. **Apply modern biological techniques to identify potential pathogens and solve aspects of scientific problems.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 [15Hrs]

Early history of Microbiology and Microbial Diversity constituting structure of bacteria: cocci/bacilli and its organelles, Discovery of microorganisms, contributions of scientists, spontaneous generation v/s Biogenesis, discovery of antibiotics. Physiological diversity, microbial classification (prokaryotes: Bacteria and Archaea, eukaryotes: Fungi, Algae, Protozoa, Helminthes) Binomial nomenclature, General characteristics of viruses, Lytic and lysogenic cycle of T4 and Lambda bacteriophages.

Unit 2 [15Hrs]

Microbial Nutrition, Growth and Control Nutritional requirements (macro and micronutrients), Temperature, pH, osmotic pressure, Types of culture media, uptake of nutrients, Maintenance of pure cultures. Bacterial division, growth curve, generation time, measurement of growth. Asepsis, sterilization with physical and chemical agents.

Unit 3 [15Hrs]

Harmful and beneficial microbes Normal microflora of human body, host-pathogen interaction, bacterial, viral, protozoan and fungal diseases of plants and animals. Phytotoxins, antimicrobial agents, drug resistance, interferons. Microorganisms and fermentation; Bioremediation; Bio-indicators.

Unit 4 [15Hrs]

Microbial Biotechnology Types of restriction enzymes, cloning vectors (plasmids, phage-based etc), selection of recombinants. Application of recombinant DNA technology – Therapeutic proteins (human disease) transgenics-herbicide, resistance, metabolic engineering, production of vaccines

Course Outcomes:

1. Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions
2. Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology.

SUGGESTED READINGS

1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J.(2008). Prescott, Harley and Klein's Microbiology.7th edition. McGraw Hill Higher Education.

2. Tortora, G.J., Funke, B.R. and Case, C.L.(2008) Microbiology: An Introduction. 9th edition. Pearson Education.

3. Primrose and Twymann, Principles of Gene Manipulation and Genomics. 7th edition(2008), Blackwell Publishing.

4.Microbiology, Prescott, Harley and Kleins, McGraw Hill International.

5.Microbiology, Pelczar, Chan and Krieg.McGraw Hill International .

6.Biology of Microorganisms, T. D. Brock and M.T. Madigan, Pearsons, Benjamin Cumming

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Structure of B.Sc. (Hons) Biological Science under CBCS

BSHB-CC-303-P MICROBIOLOGY (PRACTICALS)

SEMESTER – III, TOTAL HOURS: 30 CREDITS : 2

1. To study disinfectants and sterilization techniques.

2. To study types of Media and perform media preparation.

3. To perform subculturing- streaking techniques (T streaking). .

4. To study Growth Curve of bacteria.

5. To study the effect of pH/temperature/UV light on bacterial growth.

6. To perform Gram's staining

7. Milk quality testing by Methylene Blue dye reductase test.

SUGGESTED READINGS

1. **Practical Microbiology Paperback –D.K.** Maheshwari & R.C. Dubey, S. Chand & Company Limited.
2. **Introductory Practical Microbiology**- J. Mudili, Narosa Publishing House
3. **Practical Manual for Undergraduates Microbiology**- Mukesh Kumar 3rd Edition, Jain Brothers

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: BIOCHEMISTRY (THEORY)

SUBJECT CODE: - BSHB-CC301

SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. To give students a solid foundation in biology and chemistry.

2. To develop analytical and critical-thinking skills that allows independent exploration of biological phenomena through the scientific method.

3. To introduce students to modern methods of biochemical experimentation within the disciplines of biology and chemistry.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit - 1: [15 hrs]
Introduction to Bio-chemistry; chief intracellular components; Introduction to chemical receptors/co-receptors, cell to cell communication, channels & transportation; Definition and classification of Vitamins and their Clinical importance; Basics of Molecular mechanism of O2 transport and storage; Fundamentals of Bio-Energetics: Biological Oxidation, General Concept of oxidation, features of cellular Oxidation-respiratory chain oxidative phosphorylations, Structure and analysis of water.

Unit – 2: [15 hrs]
Carbohydrates: Definition, classification with examples and general functions; Concept of isomerism, types & mode of action; Introduction to metabolism, Integration of metabolism and catabolism.

Unit-3: [15 hrs]
lipids and proteins Lipids: definition, classifications and general functions; Introduction to essential fatty acids, cholesterol, Blood lipids, brief review of lipoproteins and fatty liver; Proteins: definition, classification and Biomedical Importance, Plasma Proteins and functions;

Definition, classification and nomenculature of Enzymes, basic introduction to Enzymology and regulation of Enzymatic activity. Structure of DNA, RNA, nuclic acid metabolism and diseases associated with it.

Unit- 4: [15 hrs]
Functional Bio-chemistry Introduction to hormones, molecular basis of hormonal action; Introduction to common metabolic disorders; Basic techniques for estimation of different Bio-chemical markers i.e., diffusion, Osmosis, Electrophoresis

Learning Outcomes:

1. Disciplinary grasp and understanding of biochemistry, structure and function of biological molecules.
2. Explain biological mechanisms, such as the processes and control of bioenergetics and metabolism.
3. Explain the biochemical processes that underlie the relationship between genotype and phenotype.
4. Demonstrate an experiential learning and critical thinking of the structure and function of both prokaryotic and eukaryotic cells (including the molecular basis and role of sub-cellular compartmentalization).
5. Fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms.
6. Understanding of the concepts of mole, mole fraction, molarity, etc. and to apply them in preparations of solutions of desired strengths.
7. Demonstrate an understanding of the principles, and have practical experience of,a wide range of biochemical techniques (e.g. basic molecular biology, cell biology and microbiology methods, spectro-photometry, the use of standards for quantification, enzyme kinetics; macromolecular purification, chromatography, electrophoresis, etc.).
8. Analyse biochemical data (e.g. in enzyme kinetics, molecular structure analysis and biological databases.

SUGGESTED READING

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning

2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,

6. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill 7. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons,

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BSHB-CC-302-P Biochemistry (Practicals)

1. Properties of water, Concept of pH and buffers, preparation of buffers and Numerical problems to explain the concepts

2. Qualitative/Quantitative tests for carbohydrates, reducing sugars, non reducing sugars

3. Qualitative/Quantitative tests for lipids and proteins

4. Study of protein secondary and tertiary structures with the help of models

SUGGESTED READING

1. **Introductory Practical Biochemistry, S.K. Sawhney, Narosa Publishing House**

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: ECOLOGY (THEORY)

SUBJECT CODE: - BSHB-CC 302

SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Describe plant and animal distribution patterns in relation to abiotic and biotic factors.**
2. **Define the essential characteristics underlying natural ecosystems.**
3. **Identify global environmental problems**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 Ecology [15 Hrs]

History, definition, ecological factors (abiotic and biotic factor), ecological range (Eury , Steno) Stress and adaptation (Morphological, physiological, anatomical and biochemical), Biotic interaction, phenotypic and genotypic plasticity, canalization, Ecological Succession, Ecological Services.

Unit 2: Ecosystem [15 Hrs]

Concept, components, (e.g., aquatic, marine, forest, grassland, desert, energy flow, food web, niche , different trophic levels, ecological pyramids, Autecology

Unit 3 Pollution [15 Hrs]

Pollution: Pollution of Soil, water, air (types of pollutants and sources), noise pollution, radiation pollution, eutrophication, remedial measures, biomagnifications, Disaster management : Types of disasters & Management strategy, Environmental Impact Assessment analysis

Unit 4 Behavioral ecology [15 Hrs]

Social, reproductive & territorial behavior, evolution of optimal life history, reproductive structure and mating system, microbial ecology.

Learning Outcomes:

1. Master the concepts and principles of Ecology
2. Master the structural and functional aspects of biodiversity and the need for itsconservation
3. Be aware of the suitable use of field techniques, data collection, mapping, analysis andinterpretation.
4. Be able to take up interdisciplinary research and teaching in Ecology
5. The student should have understanding of the ecology and the role of human beings inshaping the ecosystem.
6. Knowing various components of the ecology and interfaces.
7. Ability to understand the ecosystem and its various component and functions.
8. Knowledge on ecology, and ecological dynamics.
9. Ability to understand the various ecosystem services and their role in sustaining theenvironment.
10. Be familiar with modern tools and techniques and their appropriate use to conduct research.

SUGGESTED READINGS

1. Wilkenson DM - 2007 - Fundamental Processes in Ecology

2. Aber J.D. & Melillo J M 1991- Terrestrial Ecosystems

3. Smith R.L. Elements of ecology

4. Ricklefs Economy of nature

5. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole

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Structure of B.Sc. (Hons) Biological Science under CBCS

BSHB-CC-302-P Ecology Practicals

SEMESTER – III, TOTAL HOURS: 30 CREDITS: 2

1. Study through specimens/photographs/slides Parasitic angiosperms, Saprophytic angiosperms, VAM fungi, Root nodules, Corolloid roots, Mycorrhizal roots, Velamen roots, Lichen as pollution indicators,

2. Principle and function of Sechi disc, Atmometer, Anemometer, Hygrometer, Hair hygrometer, Luxmeter, Rain guage, Soil thermometer, Min-Max thermometer

3. Minimal quadrat method

4. To determine density/frequency/abundance of the vegetation by quadrat method.

5. To determine soil texture

6. To determine soil density, bulk density, particle density and pore space.

7. To determine water holding capacity and percolation rate of soil.

8. To determine pH, Cl, SO4 , NO3 in the soil.

SUGGESTED READINGS

1. Wilkenson DM - 2007 - Fundamental Processes in Ecology

2. Aber J.D. & Melillo J M 1991- Terrestrial Ecosystems

3. Smith R.L. Elements of ecology

4. Ricklefs Economy of nature

5. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole

University of Patanjali, Haridwar

Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: MICROBIOLOGY (THEORY)

SUBJECT CODE: - BSHB-CC303

SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Describe disease causing microorganisms and microbial agents at organismal, cellular or molecular levels.**
2. **Relate normal cellular and molecular structures their functions.**
3. **Apply modern biological techniques to identify potential pathogens and solve aspects of scientific problems.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 [15Hrs]

Early history of Microbiology and Microbial Diversity constituting structure of bacteria: cocci/bacilli and its organelles, Discovery of microorganisms, contributions of scientists, spontaneous generation v/s Biogenesis, discovery of antibiotics. Physiological diversity, microbial classification (prokaryotes: Bacteria and Archaea, eukaryotes: Fungi, Algae, Protozoa, Helminthes) Binomial nomenclature, General characteristics of viruses, Lytic and lysogenic cycle of T4 and Lambda bacteriophages.

Unit 2 [15Hrs]

Microbial Nutrition, Growth and Control Nutritional requirements (macro and micronutrients), Temperature, pH, osmotic pressure, Types of culture media, uptake of nutrients, Maintenance of pure cultures. Bacterial division, growth curve, generation time, measurement of growth. Asepsis, sterilization with physical and chemical agents.

Unit 3 [15Hrs]

Harmful and beneficial microbes Normal microflora of human body, host-pathogen interaction, bacterial, viral, protozoan and fungal diseases of plants and animals. Phytotoxins, antimicrobial agents, drug resistance, interferons. Microorganisms and fermentation; Bioremediation; Bio-indicators.

Unit 4 [15Hrs]

Microbial Biotechnology Types of restriction enzymes, cloning vectors (plasmids, phage-based etc), selection of recombinants. Application of recombinant DNA technology – Therapeutic proteins (human disease) transgenics-herbicide, resistance, metabolic engineering, production of vaccines

Learning Outcomes:

1. Apply the knowledge to understand the microbial physiology and to identify the microorganisms.
2. Define basic concepts and definitions of microbiology
3. Familiarize basic concepts in microscopy and sterilization procedures
4. Explain general characters of different groups of microbes and culturing media.
5. Discuss the ultrastructure of bacterial cell. Differentiate prokaryotic and eukaryotic microbes
6. Explain classification of microbes and Examine different methods for bacterial identification
7. Master the regulation of biochemical pathway and possible processmodifications for improved control over microorganisms for microbialproduct synthesis.

SUGGESTED READINGS

1. Willey, J.M., Sherwood, L.M. and Woolverton, C.J.(2008). Prescott, Harley and Klein's Microbiology.7th edition. McGraw Hill Higher Education.

2. Tortora, G.J., Funke, B.R. and Case, C.L.(2008) Microbiology: An Introduction. 9th edition. Pearson Education.

3. Primrose and Twymann, Principles of Gene Manipulation and Genomics. 7th edition(2008), Blackwell Publishing.

4.Microbiology, Prescott, Harley and Kleins, McGraw Hill International.

5.Microbiology, Pelczar, Chan and Krieg.McGraw Hill International .

6.Biology of Microorganisms, T. D. Brock and M.T. Madigan, Pearsons, Benjamin Cumming

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Structure of B.Sc. (Hons) Biological Science under CBCS

BSHB-CC-303-P MICROBIOLOGY (PRACTICALS)

SEMESTER – III, TOTAL HOURS: 30 CREDITS : 2

1. To study disinfectants and sterilization techniques.

2. To study types of Media and perform media preparation.

3. To perform subculturing- streaking techniques (T streaking). .

4. To study Growth Curve of bacteria.

5. To study the effect of pH/temperature/UV light on bacterial growth.

6. To perform Gram's staining

7. Milk quality testing by Methylene Blue dye reductase test.

SUGGESTED READINGS

4. **Practical Microbiology Paperback –D.K.** Maheshwari & R.C. Dubey, S. Chand & Company Limited.
5. **Introductory Practical Microbiology-** J. Mudili, Narosa Publishing House
6. **Practical Manual for Undergraduates Microbiology-** Mukesh Kumar 3rd Edition, Jain Brothers

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: METABOLISM (THEORY)

SUBJECT CODE: - BSHB-CC401

SEMESTER – IV, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. Knowledge of the historical background for metabolism.

2. Explain the basic elements of the integration of metabolism

3. Compare and contrast the basic differences between carbohydrate, lipid and protein metabolism.

<table>
<tr><td colspan="2">Total Number of Hrs. : 60</td><td>Theory</td><td>Practical</td><td>Tutorial</td></tr>
<tr><td colspan="2">Credits</td><td>4</td><td>2</td><td>-</td></tr>
<tr><td colspan="2">Hrs/Week</td><td>4</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">SCHEME OF EXAMINATION</td></tr>
<tr><td colspan="5">Total marks: 150</td></tr>
<tr><td colspan="2">Theory:100</td><td colspan="3">Practical:50</td></tr>
<tr><td>Final Exam (SEE)</td><td>Internal Assessment (CT+TA)</td><td>Final Exam (SEE)</td><td colspan="2">Internal Assessment (CT+TA/PR)</td></tr>
<tr><td>70</td><td>30</td><td>35</td><td colspan="2">15</td></tr>
</table>

Unit 1 Concept of Metabolism [10HRS]

Experimental approaches to study metabolism; Primary and secondary metabolism

Unit 2 Major metabolic pathways [20HRS]

Basics of Carbohydrate Metabolism (I) - Glycolysis; Aerobic and Anerobic, metabolism of glycogens; glycogenesis, glycogenolysis, glyconeogenesis, Regulation of glycogen metabolism; Basics of Carbohydrate Metabolism (II) - Kreb's Cycle (T.C.A), Regulation of Blood glucose, Hexose Mono Phosphate (HMP Shunt); Basics of Lipid Metabolism - Oxidation of fatty acids, cholesterol synthesis.Correlation between carbohydrate, amino acids and fatty acid degradation.

Unit 3 Special aspects of metabolic regulation, Tissue specialization [15HRS]

Function. Intracellular communications and signal transduction mechanisms; developmental adaptations – eg: rat, C3, C4 plants; Metabolic basis of health and disorders – Jaundice – diabetes mellitus, exercise, alcohol abuse

Unit 4 Use of microbes for specific metabolic tasks [15HRS]

Alternate metabolic cycles, Carbon metabolism of intracellular bacterial pathogens; Environmental cleaning, Metabolic handling of xenobiotics and drug resistance; Photo and lithotrophic metabolic capabilities; myporia

Course Outcome:

1. It helps the students in appreciating the integrated approach of interrelated pathways of catabolism and anabolism.
2. It also emphasizes on metabolic disorders at molecular level.
3. It features the regulatory aspects of metabolism for better understanding of physiology and therapeutic applications.

BSHB CC401-P METABOLISM : INTEGRATION AND ADAPTATION – LABORATORY **Credit:2**

1. Estimation of blood glucose – Glucose Oxidase method

2. Estimation of Cholesterol – Hyper Cholesteremia samples

3. Estimation of SGPT and SGOT 4.

Identification of organelles by marker enzymes – SDH, LDH and acid phosphatase

SUGGESTED READINGS

1. H.G. Sehlegal, General Microbiology 2003, Cambridge University Press Cambridge

2. Sterier, R.Y.et AL, General Microbiology 1986, Macmillan London

3. Thomas M.Devlin, Text Book of Biochemistry with Clinical Correlations, 6th edition, 2006, Wiley-Liss 4. Peter W. Hochachka, George. N. Somero, Biochemical adaptation, Amazon Publishers BISP 302 :

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: MOLECULAR BIOLOGY (THEORY)

SUBJECT CODE: - BSHB-CC402

SEMESTER – IV, TOTAL HOURS: 60 CREDITS: 4

Course Objectives

1. **Outline the structure of the biomolecules found in all living organisms.**
2. **To describe how RNA, DNA and Proteins are synthesized.**
3. **To explain the process of cell division in both somatic and germ cells.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 Molecular Biology [15 Hrs]

General principles - bidirectional replication, Semi-conservative, discontinuous. RNA priming, Various models of DNA replication. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, primase, telomerase and other accessory proteins. Denaturation and renaturation of DNA, Cot curves.

Unit 2 The mutability and Repair of DNA [10 Hrs]

Replication Errors (Transitions, transversion and thymine dimer), DNA Damage (deamination, depurination and dimerization) and their repair: mismatch repair, SOS response (recombination), Excision Repair, Photoreactivation.

Unit 3 Information Transfer –I: Mechanism of Transcription [10Hrs]

Basic transcription apparatus, Initiation, elongation and termination of transcription, Eukaryotic transcription of mRNA, tRNA and rRNA, types of RNA polymerases, transcription factors, Inhibitors of transcription- rifampicin and α-amanitin. Reverse Transcription in virus.

Unit 4 Post-Transcriptional Modifications [10 Hrs]

Split Genes, Concept of introns and exons, RNA splicing, Spliceosomes and Self splicing introns, alternative splicing and exon shuffling, mRNA transport.

Unit 5 Information Transfer-II: Mechanism of Translation [15 Hrs] Features of genetic code and exceptions in some systems, Ribosome structure- rRNA and proteins, Charging of tRNA, aminoacyl tRNA synthetases, Proteins involved in initiation (in prokaryotes and eukaryotes), elongation and termination of polypeptides, Fidelity of translation, Inhibitors of protein synthesis – tetracyclins, aminoglycosides, chloramphenicol and aminoglycosides.

Learning Outcomes:

1. Graduates will gain fundamental knowledge in Molecular Biology.
2. Graduates will be familiarizing with the contemporary research in the field of Molecular Biology.
3. Exhibit an advanced knowledge base in genetics, cell and molecular biology, and anatomy and physiology.
4. Graduates gain the applied knowledge of molecular biology for research and development.
5. Graduates will gain knowledge in molecular biology for academic and Biotech industry placement
6. Graduates will gain basic and applied knowledge to enable them for start-ups/bio entrepreneurship.

SUGGESTED READINGS

1. Molecular Biology of the Gene, 6th edition (2007), Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R; Benjamin Cummings Publishers, ISBN-13: 978-0805395921.

2. Cell and Molecular Biology: Concepts and Experiments, 7th edition (2013), Gerald Karp. ; Wiley Publishers ISBN-13: 978-1118206737.

3. Molecular Cloning: A Laboratory Manual, 4th edition (2012), Michael R. Green and Joseph Sambrook; Cold Spring Harbor Laboratory Press, ISBN-13: 978-1936113422.

4. The World of the Cell, 7th edition (2008), Becker, Kleinsmith, Hardin and Bertoni. Benjamin Cummings, ISBN-13: 978-0805393934.

5. The Cell: A Molecular Approach, 6th edition (2013), Cooper and Hausman; Sinauer Associates, Inc. ISBN-13: 978-1605351551.

6. DNA Replication, 2nd edition (2005), Arthur Kornberg; University Science Books ISBN-13: 978-1891389443.

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Structure of B.Sc. (Hons) Biological Science under CBCS

BSHB-CP-402-P Molecular Biology

TOTAL HOURS: 30 CREDITS: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Preparation of various stock solutions required for Molecular Biology Laboratory.

2. Preparation of culture medium (LB) for E. coli (both solid and liquid) and raise culture of E. coli.

3. Isolation of chromosomal DNA from bacterial cultures and visualization on Agarose Gel Electrophoresis.

4. Quantitative estimation of salmon sperm/ calf thymus DNA using colorimeter (Diphenylamine reagent) and Spectrophotometer (A260 measurement).

5. Isolation of genomic DNA from blood/ tissue.

6. Demonstration of Polymerase Chain Reaction (PCR) technique

7. Demonstration of AMES test or reverse mutation for carcinogenicity

SUGGESTED READINGS

1. Molecular Biology of the Gene, 6th edition (2007), Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R; Benjamin Cummings Publishers, ISBN-13: 978-0805395921.

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: SYSTEMS PHYSIOLOGY (THEORY)

SUBJECT CODE: - BSHB-CC403

SEMESTER – IV, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Describe metabolic reactions which occur in cells.**
2. **Compare the structure and function of organ systems in a variety of animal phyla.**
3. **Outline the steps involved in transmission of nerve impulses.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1: Movements and Bulk Transport [12HRS]

Cellular movements, ciliary and flagellar structure and function; Introduction to musculo skeletal system; Terrestrial, aquatic and aerial locomotion; Locomotory cost; Long distance transport of water and nutrients in plants (xylem and phloem transport) ; General plan and physiology of circulatory system in vertebrates and invertebrates

Unit 2 Gas exchange in organism; Generation and utilization of energy[15HRS]

Exchange in unicellular organisms and plants; Respiratory organs in aquatic and terrestrial systems ; Physiology of aquatic breathing and aerial breathing; Feeding patterns, digestive tract systems; Digestion of food

Unit 3 Regulatory Physiology[15HRS]

Mechanism of opening and closing of stomata. Regulation of water and solutes in aquatic and terrestrial animals; Osmoregulatory organs. Transpiration in plants; Excretion of nitrogenous wastes in animals; Patterns of Thermoregulation : Ectotherms and Endotherms; Structural and functional adaptation to stress

Unit 4 Integrative Physiology[18HRS]

An overview of neuronal structure and function; Sensory physiology -mechano, chemo, thermo, photo and electro receptors; Endocrine systems in animals and their physiological effects; Plant hormones and their physiological effects; Regulation of metabolism and response to environmental cues.

Learning Outcomes:

1. Have an enhanced knowledge and appreciation of human physiology;

2. Grasp the functions of important physiological systems including the cardio-respiratory, renal, reproductive, metabolic systems,endocrine system, skeletal system, nervous system and sense organs etc.

3. Grasp how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail;

4. Be able to perform, analyse and report on experiments and observations in physiology;

5. Be able to recognise and identify principal tissue structures.

6. Describe the structure of major human organs and explain their role in the maintenance of healthy individuals.

7. Explain the interplay between different organ systems and how organs and cells interact to maintain biological equilibria in the face of a variable and changing environment.

SYSTEMS PHYSIOLOGY BSHB CC-403-P (PRACTICALS)

TOTAL HOURS: 30 CREDITS: 2

1. Effect of isotonic, hypotonic and hypertonic salines on erythrocytes

2. Enumeration of RBC using haemocytometer

3. Estimation of total count of WBC using haemocytometer

4. Study of the effect of various environmental factors on transpiration in an excised twig/leaf

5. Calculation of the stomatal index, stomatal frequency and percentage of leaf area open through stomata in a mesophyte and a xerophytes

6. Study of the mechanism of stomatal opening and closing

SUGGESTED READINGS

1. Knut Schmidt-Nielsen , Animal Physiology , Cambridge University Press

2. David Randall, Eckert's Animal Physiology, W.H.Freeman and Co.

3. Philips Withers; Comparative Animal Physiology. Books Cole Publishers

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: METABOLISM (THEORY)

SUBJECT CODE: - BSHB-CC401

SEMESTER – IV, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. Knowledge of the historical background for metabolism.

2. Explain the basic elements of the integration of metabolism

3. Compare and contrast the basic differences between carbohydrate, lipid and protein metabolism.

<table>
<tr><td colspan="2">Total Number of Hrs. : 60</td><td>Theory</td><td>Practical</td><td>Tutorial</td></tr>
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</table>

Unit 1 Concept of Metabolism [10HRS]

Experimental approaches to study metabolism; Primary and secondary metabolism

Unit 2 Major metabolic pathways [20HRS]

Basics of Carbohydrate Metabolism (I) - Glycolysis; Aerobic and Anerobic, metabolism of glycogens; glycogenesis, glycogenolysis, glyconeogenesis, Regulation of glycogen metabolism; Basics of Carbohydrate Metabolism (II) - Kreb's Cycle (T.C.A), Regulation of Blood glucose, Hexose Mono Phosphate (HMP Shunt); Basics of Lipid Metabolism - Oxidation of fatty acids, cholesterol synthesis.Correlation between carbohydrate, amino acids and fatty acid degradation.

Unit 3 Special aspects of metabolic regulation, Tissue specialization [15HRS]

Function. Intracellular communications and signal transduction mechanisms; developmental adaptations – eg: rat, C3, C4 plants; Metabolic basis of health and disorders – Jaundice – diabetes mellitus, exercise, alcohol abuse

Unit 4 Use of microbes for specific metabolic tasks [15HRS]

Alternate metabolic cycles, Carbon metabolism of intracellular bacterial pathogens; Environmental cleaning, Metabolic handling of xenobiotics and drug resistance; Photo and lithotrophic metabolic capabilities; myporia

Course Outcome:

1. Master the concepts of metabolism and Illustrate the metabolism of carbohydrates through various anabolic and catabolic pathways like glycolysis, Kreb's cycle, Glycogen metabolism, glucuronic acid cycle etc.
2.Grasp the regulation of glycolysis and TCA cycle.

SUGGESTED READINGS

1. H.G. Sehlegal, General Microbiology 2003, Cambridge University Press Cambridge

2. Sterier, R.Y.et AL, General Microbiology 1986, Macmillan London

3. Thomas M.Devlin, Text Book of Biochemistry with Clinical Correlations, 6th edition, 2006, Wiley-Liss 4. Peter W. Hochachka, George. N. Somero, Biochemical adaptation, Amazon Publishers BISP 302 :

BSHB CC401-P METABOLISM : INTEGRATION AND ADAPTATION – LABORATORY

1. Estimation of blood glucose – Glucose Oxidase method

2. Estimation of Cholesterol – Hyper Cholesteremia samples

3. Estimation of SGPT and SGOT 4.

Identification of organelles by marker enzymes – SDH, LDH and acid phosphatase

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: GENETICS (THEORY)

SUBJECT CODE: - BSHB-CC501

SEMESTER – V, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Apply Quantitative problem solving Skills to genetics problems and issues.**
2. **Demonstrate their ability to reason both inductively and deductively with experimental information and data.**
3. **Select and apply experimental procedures to solve genetic problems.**
4. **To make the students to understand the gene expression and regulation**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 : Mendelian Genetics and Extensions [10HRS]

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information. Principles of Inheritance, Chromosome theory of inheritance, Laws of probability, Pedigree analysis, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy

Unit 2: Linkage, Crossing over and Chromosomal Mapping [05 HRS]

Linkage and Crossing over, cytological basis of crossing over, Molecular mechanism of crossing over. Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and Coincidence

Unit 3: Mutations[10 HRS]

Chromosomal mutations, Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced v/s Spontaneous, Back v/s Suppressor mutations.

Molecular basis of mutations in relation to UV light and chemical mutagens, Detection of mutations: ClB method, Attached X-method, DNA repair mechanisms

Unit 4: Extra chromosomal Inheritance [05 HRS]

Chloroplast mutation/Variegation in four 'o clock plant and Chlamydomonas, Mitochondrial mutations in Neurospora and yeast, Maternal effects, Infective heredity-Kappa particles in Paramecium

Unit 5: Genome Dynamics-Transposable Genetic Elements[10 HRS]

Prokaryotic transposable elements-IS elements, Composite transpossons, Tn-3 elemenets; Eukaryotic transposable elements- Ac-Ds system in maize and P-elements in drosophila; Uses of transposons

Unit: 6 Genomics, Bioinformatics and Proteomics[10HRS]

Genomes of bacteria, Drosophila and Humans; Human genome project; Introduction to Bioinformatics, Gene and Protein databases, sequence similarity and alignment, Gene feature identification. Gene Annotation and analysis of transcription and translation; Posttranslational analysis-Protein interaction

Unit: 7 Population and Evolutionary Genetics [10HRS]

Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, Genetic drift. Speciation

Course Outcome:

1. Revising the Mendelian Genetics and molecular basis of heredity
2. Applying the gene transformation in recombination
3. Analyzing the types gene mutation and causes on genetic disorders
4. Revising the Mendelian Genetics and molecular basis of heredity

SUGGESTED READINGS

1. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.
2. 2. Genetics - A Conceptual Approach (2012), 4th ed., Pierce, B.A., W.H. Freeman & Co. (New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.
3. 3. An Introduction to Genetic Analysis (2010), 10th ed., Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN:10: 1-4292-2943-8.

BSHB-CC501-P GENETICS (PRACTICALS) Credit:2

1. Study of Linkage, recombination, gene mapping using marker based data from Drosophila.
2. Study of Phlox/ Allium Karyotype (normal and abnormal).
3. PTC testing in a population and calculation of allele and genotype frequencies.
4. Study of abnormal human karyotype and pedigrees (dry lab)
5. Isolation of plasmid DNA from E.coli. and restriction
6. Restriction enzyme digestion plasmid DNA.
7. Estimation of size of a DNA fragment after electrophoresis using DNA markers.
8. Construction of Restriction digestion maps from data provided.
9. Demonstration of DNA fingerprinting.

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COURSE DETAILS

SUBJECT TITLE: FUNDAMENTALS OF NEUROBIOLOGY (THEORY)

SUBJECT CODE: - BSHB-CC502

SEMESTER – V, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Describe the structure and function of cells that comprise the nervous system.**
2. **Outline sensory and motor systems.**
3. **Generate a hypothesis from a set of observations and then suggest experiments to test the hypothesis.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 [12HRS]

Introduction to neurons, glia and muscle, **Membrane Potentials:** Basic concept of resting membrane potential: equilibrium potentials, Nernst equation, Action potential: generation and propagation.

Unit-2 [12HRS]

Ion Channels and Ion Pumps: Ion channels, ion pumps, Ohm's law, sodium channels, potassium channels, calcium channels, acetylcholine receptor channels, NMDA receptor channels, diversity of potassium channels.

Unit -3 [12HRS]

Drugs and toxins as tools in neuroscience research, **Muscle Contraction:** Mechanism of muscle contraction, **Synapse:** Electrical synapses, chemical synapses, molecular and cellular mechanisms of synaptic transmission, neuropharmacology of synaptic transmission, calcium regulation of synaptic transmission.

Unit-4 [12HRS]

Neural System and Behavior: Functional neuroanatomy of human central nervous system. Neurotransmitter systems, G protein-coupled receptors and effectors. Biology of sleep-wakefulness cycle.**Chemical senses**: Vision. Auditory. Sensation of touch. Thermoreception. Pain and the placebo effects.

Unit -5 [12HRS]

Homeostasis in the Nervous System:

Diseases of Nervous System: Neurobiology of affective disorders or mood disorders; dopamine and addiction; current research on Alzheimer's disease, Parkinson's disease, Huntington's disease, autism spectrum disorders (ASD) and Japanese encephalitis,

SUGGESTED READINGS

1. M.Bear, B.Connors, M. Paradiso,Neuroscience :exploring the brain, Lippincott Williams &Wilkins,3rd edition,2006.

BSHB-CC 502-P NEUROBIOLOGY (PRACTICALS)

1. The vertebrate nervous system and its organization chart.
2. Demonstration of tissue sectioning techniques.
3. Introduction to behavioral measurements and statistical analysis

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Structure of B.Sc. (Hons) Biological Science under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: BIOLOGY OF EVOLUTION (THEORY)

SUBJECT CODE: - BSHB-CC601

SEMESTER –VI, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Describe the theory of natural selection.**
2. **Explain how new species arise.**
3. **Construct a phylogenetic tree.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1: Historical Review of Evolutionary Concept [10HRS]

Pre-Darwinian ideas – List of contributors influencing Darwin indicated as a timeline. Lamarckism – Merits and demerits. Darwinism – Merits and demerits, Post-Darwinian era – Modern synthetic theory; biomathematics and the theory of population genetics leading to Neo-Darwinism

Unit 2: Life's Beginnings[15HRS]

Chemogeny – An overview of pre-biotic conditions and events; experimental proofs to abiotic origin of micro- and macro-molecules. Current concept of chemogeny – RNA first hypothesis. Biogeny – Cellular evolution based on proto-cell models (coacervates and proteinoid micro-spheres). Origin of photosynthesis – Evolution of oxygen and ozone buildup. Endosymbiotic theory – Evolution of Eukaryotes from Prokaryotes

Unit 3: Evidences of Evolution [20HRS]

Paleobiological – Concept of Stratigraphy and geological timescale; fossil study (types, formation and dating methods). Anatomical – Vestigial organs; Homologous and Analogous organs (concept of parallelism and convergence in evolution). Taxonomic – Transitional forms/evolutionary intermediates; living fossils. Phylogenetic – a) Fossil based – Phylogeny of horse as a model. b) Molecule based – Protein model (Cytochrome C); gene model (Globin gene family)

Unit 4: Sources of Evolution – Variations as Raw Materials of Change [15HRS]

Types of variations– Continuous and discontinuous; heritable and non-heritable. Causes, classification and contribution to evolution – Gene mutation; chromosomal aberrations; recombination and random assortment (basis of sexual reproduction); gene regulation . Concept of micro- and macro-evolution – A brief comparison

Course Outcome:

1. Gain conceptual understanding of evidences, theories and mechanisms of evolution

2. Explain the evolutionary history of man

3. Obtain comprehensive knowledge of comparative anatomy of chordates and to recognize their evolutionary trends

SUGGESTED READINGS

1. Ridley, M. (2004) Evolution. III Edn. Blackwell

2. Hall, B. K. and Hallgrimson, B. (2008) Strickberger's Evolution. IV Edn. Jones and Barlett

3. Zimmer, C. and Emlen, D. J. (2013) Evolution: Making Sense of Life. Roberts & Co.

4. Futuyma, D. (1998) Evolutionary Biology. III Edn. Sinauer Assoc. Inc.

5. Barton, Briggs, Eisen, Goldstein and Patel. (2007) Evolution. Cold Spring Harbor Laboratory Press

BSHB-CP 601-P BIOLOGY OF EVOLUTION (PRACTICALS) Credit 2

(A) Evidences of fossils (using pictures/slides)

1. Study of types of fossils (e.g. trails, casts and moulds and others) and Index fossils of Palaeozoic era

2. Connecting links/transitional forms - Eg. Euglena, Neopilina, Balanoglossus, Chimaera, Tiktaalik, Archaeopteryx, Ornithorhynchus

3. Living fossils - Eg. Limulus, Peripatus ,Latimeria, Sphaenodon

4. Vestigial, Analogous and Homologous organs using photographs, models or specimen

(B) Variations

1. Sampling of human height, weight and BMI for continuous variation

(C) Selection Exemplifying Adaptive strategies (Colouration, Mimetic form, Co-adaptation and co-evolution; Adaptations to aquatic, fossorial and arboreal modes of life) using Specimens

(D) Phylogeny

1. Digit reduction in horse phylogeny (study from chart),

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Core Course

COURSE DETAILS

SUBJECT TITLE: ENDOCRINOLOGY (THEORY)

SUBJECT CODE: - BSHB-CC-602

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course objectives

1. **To explain the roles of the endocrine system in maintaining homeostasis, integrating growth and development.**
2. **To differentiate among endocrine, paracrine and autocrine systems.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1: Introduction [**3HRS]**

History of endocrinology, characteristic of Hormones, Classification –Local and circulating hormones, chemical classification, Neurosecretions and Neurohormones

Unit 2: Hypothalamic-Pituitary system [**12HRS]**

Hypothalamus; structure of hypothalamus, names and functions of important hypothalamic nuclei, neuroendocrine regulation of endocrine glands and feedback mechanisms. Pituitary Gland, structure of pituitary, its hormones, their secretion, transportation, storage, functions and hypothalamic regulation; disorders of pituitary gland. Pineal gland, secretions and their functions in biological rhythms and reproduction.

Unit 3: Thyroid-Parathyroid system [8HRS]

Thyroid gland; structure of thyroid gland, synthesis and functions of thyroid hormones, regulation of thyroid hormone secretion; thyrocalcitonin. Disorders of thyroid gland. Parathyroid Glands: Secretion Action of parathyroid Hormones, role of parathyroid hormone and calcitonin in calcium metabolism, disorders of parathyroid gland

Unit 4: Adrenal gland and its hormones [12HRS]

Structural of Adrenal Gland – Synthesis and structure of hormones of the adrenal cortex and medulla; Biological Action of glucocorticoids, mineralocorticoids, adrenaline and noradrenaline on carbohydrate and protein metabolism; and cardiovascular system, osmoregulation, Stress and diseases related to adrenal cortex and medulla.

Unit 5: Pancreas and its hormones [10HRS]

Structure of Pancreatic Islets of Langerhans and hormones secreted by it; insulin secretion (proinsulin) its activation, Glucagon secretion, mechanism of action of both hormones in controlling the blood glucose level. Diabetes mellitus.

Unit 6: Reproductive endocrinology [10HRS]

Male Reproductive system; hormonal control of testes; chemistry and biosynthesis of testosterone, functions of testosterone. Female Reproductive system, role of hormones in Female Sexual cycle, placental hormones; parturition and lactation, Reproductive Health

Unit 7: **Gastrointestinal hormones** No. of Hours: 5

Course Outcome:

After the course the student should be able to comprehend:-

1. Biosynthesis & Receptor mechanism of Hormones and its Disorders

2. Reproductive cycle of Vertebrate, Menturation cycle, Lactation, Pregnancy, and mechanism of Parturation.

3. Hormonal regulation of gamrtogenasis

4. Hormone & Behavior

SUGGESTED READINGS

1. J. Larry Jameson, editor. (2010). Harrison's Endocrinology. 2nd Edition. McGraw-Hill Press: New York.

2. Turner, D.C. and Bagnara, J.T. (Editor) (1976). General Endocrinology. W. B. Saunders Company, Philadelphia, Pennsylvania.

3. Hall, J.E. (2011). Guyton and Hall Textbook of Medical Physiology (Guyton Physiology).

BSHB-CC606-P ENDOCRINOLGY (PRACTICALS) Credit:2

TOTAL HOURS: 30 CREDITS: 2

1. Study of the permanent slides of all the endocrine glands

2. Esrous cycle of rat.- Vaginal smear

3. Compensatory ovarian hypertrophy or adrenal hypertrophy

4. Castration/ ovariectomy

Ability Enhancement compulsory Course

University of Patanjali, Haridwar

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COURSE DETAILS

SUBJECT TITLE: Communicative English

CREDITS: 4

SUBJECT CODE: - BSHB-AE101

Course Objectives

1. To improve the fluency and confidence of the student when speaking English
2. To use English effectively for study purpose across the curriculum**.**

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**-**	**-**	

SEMESTER – I, TOTAL HOURS: 30 CREDITS: 2

Unit 1: Reading and communication Skills

An introduction to the International Phonetic Alphabet for English (Phonetic Symbols, Phonemes, Monophthongs, Diphthongs, Accent, Intonation, Sress etc)

Use of punctuations in Reading

Theory of communication

Type and modes of communication

Suggested reading & Resources for practice:

1. Oxford Advanced learner's Dictionary of Current English (Oxford University Press)
2. Oxford English-Hindi Dictionary (Oxford University Press)
3. Some Useful Mobile Dictionaries Application (Can be downloaded from Google Play Store)
4. Communication Skills – Sanjay Kumar & Pushpa Lata (Oxford University Press, new Delhi)

5. High School English Grammer and Composition – P. C. Wren & H. Martin (S. Chand & Company ltd. Ran Nagar, New Delhi- 110055, ISBN: 81-219-0009-3)
6. Useful You Tube Channels and Other Helpful Mobile Applications

Unit 2

Listening Skills:

To listen to the Good Speakers of English language Having Good Contents.

Resources for practices:

Useful You Tube Channels and Other Helpful Mobile Applications-

Sadhguru

BK Shivani

Unit 3

Grammar Skills

Parts of Speech

Article

Vocabulary (Synonyms & Antonyms)

The Sentence – parts, Types, Forms, Question Tag and Sentence part (Based on Structures)

5. Simple Present, past and Future Tenses (Without main Verbs-SHO i.e is, am, are, was, were, will/shall be: has/have /had/will/shall have Type. Sentences imperative Sentences, Simple Translation (Hindi to English and Vice-Versa)

Suggested Reading

AaoSaralAngreziSeekhein Volume-1- Swami PremVivekanand ji. (Seekers Trust, Sadhana Kendra Ashram, Domet, Dehradun, Uttarakhand – 248125)

High School English Grammar and composition – P.C.Wren & H. Martin (S. Chand & Company Ltd. Ram Nagar, new Delhi -110055)

How to write correct English (Anglo-Hindi) – R. P. Sinha (Bharti Bhawan Publication. Ansari Road, Daryaganj, new Delhi 110002)

How to Translate into English –R. P. Sinha (Bharti Bhawan Publication, Ansari Road, Daryaganj, New Delhi 110002 – ISBN: 9788177091083, 8177091085)

Unit 4

Writing Skills

Short and Simple Messages

Suggested Reading

Advance writing Skills – D.S. Paul (Goodwill Publishing House, ISBN: 9788172455385, 8172455380)

Useful You Tube Channels and other Helpful Mobile Applications

Unit 5

Speaking Skills

General Conversation & Expressions used in Day-to-Day Life

Suggested reading

Conversation Skills – S.C. Gupta 9Arihant Publications pvt Ltd, meerut, ISBN:978-81-8348-135-9)

Useful You Tube Channels and Other helpful Mobile Applications.

Course Outcome

It seeks to develop the students' abilities in grammar, oral skills, reading, writing and study skills

- Students will heighten their awareness of correct usage of English grammar in writing and speaking
- Students will improve their speaking ability in English both in terms of fluency and comprehensibility
- Students will give oral presentations and receive feedback on their performance
- Students will increase their reading speed and comprehension of academic articles

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COURSE DETAILS

SUBJECT TITLE: Environmental Science

SUBJECT CODE: - BSHB-AE201

SEMESTER – II, TOTAL HOURS: 30 CREDITS: 4

Course Objectives

1. **To understand how science and the scientific method work to address environmental problems.**
2. **The student will become familiar with environmental pollution such as Air, Water, Noise and soil and understand about global warming etc.**
3. **Students will learn about the environmental assessment, management and legislation.**

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**		**Internal Assessment (CT+TA/PR)**
70	**30**	**-**		**-**

Unit 1 Introduction to Environmental Science (7hrs)

Difinitions, Principles and Scope of Environmental Science, Structure and composition of Atmosphere, Hydrosphere, lithosphere, Biosphere. Energy and environment: Fossil fuels, wind power, geothermal energy, and solar energy(solar collectors, photovoltaic modules, solar ponds). Nuclear energy, bio-energy, environmental implications of energy use: energy use pattern in india and world

Unit 2 Environmental pollution (8hrs)

Air, Water, Noise and soil Pollutants: Causes, Effects and prevention Global Warming: Impact, adaptation, vulnerability and mitigation. Kyoto protocol, World Metereological organizations (UNEP, IPCC and UNFCCC). Solid and Hazardous Waste management: Solid Waste-type and sources, Solid waste characteristics, generation rates, solid waste components, hazardus waste-Types, characteristics and health impacts, hazardous waste management.

Unit 3 Environmental Assessment, management and legislation (8hrs)

Aims and objectives of Environmental impact assessment (EIA), Environment policy (1986), Overview of Environmental laws in India, Environmental protection act (1986), national Forest Policy (1988), The plastic Waste management rule (2016), Biodiversity and climate change, national missions on climate change.

Unit 4 Current Environmental Issues in India (7hrs)

Environmental issues related to water resource project – narmada dam, Tehri dam, Almatti dam, Cauvary and Mahanadi, Carbon sequestration and carbon credits. Waste management-Swachh Bharat Abhiyan, Environmental Disasters: Minamata Disaster, Bhopal Gas Disaster (1984), Chernobyl Disaster (1986), Fukushima Daiichi nuclear disaster (2011).

Learning Outcomes:

After completing the major in Environmental Studies, students will be able to:

- Articulate the interconnected and interdisciplinary nature of environmental studies;
- Demonstrate an integrative approach to environmental issues with a focus on sustainability;
- Use critical thinking, problem-solving, and the methodological approaches of the social sciences, natural sciences, and humanities in environmental problem solving;
- Communicate complex environmental information to both technical and non-technical audiences;
- Understand and evaluate the global scale of environmental issues & problems; and
- Reflect critically on their roles, responsibilities, and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Suggested Reading

1. Textbook of Environmental Studies (Universities Press India Pvt. Ltd.)Erach Bharucha.
2. Environmental Science: A global concern (McGraw-Hill Education) William P Cunninggham, Mary Ann Cunninggham.

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Structure of B.Sc. (Hons) Biological Science under CBCS

SKILL ENHANCEMENT COURSE

COURSE DETAILS

SUBJECT TITLE: Biostatistics

SUBJECT CODE: - BSHB-SE-101

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The Biostatistics course objectives are

1. It helps learners to analyzing data from various biological experimental problems.

2. It helps to determine the appropriate sampling techniques and coordinate data collection procedures.

3. It helps to conduct statistical analyses to answer scientific questions.

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**-**	**-**	

Unit-1 Biostatistics (8hrs)

Definition –statistical methods – basic principles, Variables-measurements, functions, limitations and uses of statistics.

Unit-2 Collection of data primary and secondary (7hrs)

Types and methods of data collection procedures-merits and demerits. Classification-tabulation and presentation of data-sampling methods.

Unit-3 Measures of central tendency (8hrs)

Mean, median, mode, geometric mean – merits & demerits. Measures of dispersion-range, standards deviation, mean deviation, quartile deviation-merits and demerits; Co-efficient of variations.

Unit 4 Correlation (12 hrs)

Correlation: Types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression. Statistical inference: Hypothesis- simple hypothesis – student 't' test –chi square test.

Unit 5 Population and Sample (15 hrs)

Population and sample, Sampling, Type of sampling, Simple Random Sampling and Stratified Random sampling (description without mathematical details). Analysis of Variance, one way and two way classified data, Design of experiment (DOE), principle of DOE, CRD, RBD, LSD (Description without mathematic details)

Unit 6 Vital events (10 hrs)

Vital events, Vital statistics, Rates and Ratios, Measures of fertility and mortality, Gross and Net reproduction rates, Life tables, complete and abridged life tables, description of life table, uses of life tables, population projection, population projection models.

Course Outcome:

1.This course imparts the knowledge of basic statistical methods to solve problems and students are taught to operate various statistical software packages
2. By the end of the course, the students are able to appreciate the importance of statistics in research and prepares them for a career in research

SUGGESTED READINGS

1. Danniel, W.W. (1987), Biostatistics, New York, John Wiley Sons.
2. Banerjee, P. (2001), Introduction to Biostatistics, S. Chand Publication, Delhi.
3. Goon, Gupta & das Gupta: Fundamentals of Statistics Vol II, Calcutta: The world press.

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SKILL ENHANCEMENT COURSE

COURSE DETAILS

SUBJECT TITLE: RECOMBINANT DNA TECHNOLOGY

SUBJECT CODE: - BSHB-SE-201

SEMESTER – II, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. To understand the basic concept of recombinant DNA technology.

2. To understand various aspects of Cloning vectors for prokaryotes and eukaryotes.

3. To understand the applications of recombinant DNA technology in medicine, production of recombinant pharmaceuticals and in agriculture.

<table>
<tr><td colspan="2">Total Number of Hrs. : 30</td><td>Theory</td><td>Practical</td><td>Tutorial</td></tr>
<tr><td colspan="2">Credits</td><td>4</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">Hrs/Week</td><td>4</td><td>-</td><td>-</td></tr>
<tr><td colspan="5">SCHEME OF EXAMINATION</td></tr>
<tr><td colspan="5">Total marks: 100</td></tr>
<tr><td colspan="2">Theory:100</td><td colspan="3">Practical: NA</td></tr>
<tr><td>Final Exam (SEE)</td><td>Internal Assessment (CT+TA)</td><td>Final Exam (SEE)</td><td colspan="2">Internal Assessment (CT+TA/PR)</td></tr>
<tr><td>70</td><td>30</td><td>-</td><td colspan="2">-</td></tr>
</table>

Unit 1 Introduction to recombinant DNA technology (10 hrs)

Overview of recombinant DNA technology. Restriction and modification systems, restriction endonucleases and other enzymes used in manipulating DNA molecules, separation of DNA by gel electrophoresis. Extraction and purification of plasmid DNA.

Unit 2 Cloning vectors for prokaryotes and eukaryotes (10 hrs)

Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on E. coli plasmids, pBR322, pUC8, pGEM3Z. Joining of DNA fragments: ligation of DNA molecules. DNA ligases, sticky ends, blunt ends, linkers and adapters.

Unit 3 Introduction of DNA into cells (20 hrs)

Uptake of DNA by cells, preparation of competent cells. Selection for transformed cells. Identification for recombinants - insertional inactivation, blue-white selection. Introduction of phage DNA into bacterial cells. Identification of recombinant phages. Methods for clone identification: The problem of selection, direct selection, marker rescue. Gene libraries, identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene.

Unit 4 Applications of RDT (20 hrs)

Applications in medicine, production of recombinant pharmaceuticals such as insulin, human growth hormone, factor VIII. Recombinant vaccines. Gene therapy. Applications in agriculture - plant genetic engineering, herbicide resistant crops, problems with genetically modified plants, safety concerns. Introduction to DNA sequencing, polymerase chain reaction, expression vectors.

Course Outcome:

1.This course teaches RDNA techniques and their application in the field of genetic engineering
2.They learn about plasmids,vectors and gain knowledge on the construction of cDNA libraries
3.Student of this course have knowledge on gene manipulation, gene expression, etc which prepares them for further studies in the area of genetic engineering

SUGGESTED READINGS

1.Gene Cloning and DNA Analysis (2010) 6th ed., Brown, T.A., Wiley-Blackwell publishing (Oxford, UK).

2.Principles of Gene Manipulation and Genomics (2006) 7th ed., Primrose, S.B., and Twyman, R. M., Blackwell publishing (Oxford, UK).

3.Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010) 4th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC).

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SKILL ENHANCEMENT COURSE

SUBJECT TITLE: COMPUTER PROGRAMMING

SUBJECT CODE: - BSHB-SE301

SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. To understand the basic concept of Computer Programming.

2. To understand various aspects of Biology and Computer Programming techniques.

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**-**	**-**	

COMPUTER PROGRAMMING FOR BIOLOGISTS

Fundamentals of computers, algorithms, computer basics, Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts.

Simple programming in Python : Getting started with Python program

Variables, keywords and Operators, Control flow statements, Numbers and Functions, Strings, Lists, Tuples, Dictionary and Sets, More of Python functions, Object oriented programming with Python, Exception Handling in Python, File handing, Regular expression, Multithreading, Database, Python Debugging and Automation, Usage of standard module and web-scrapping.

Course Outcome:

1. This is a skill based paper that introduces the students to the basics of computer operations
2. The student is imparted with knowledge on both hardware and software.
3. The student has a better understanding on the use of computers for various applications

Books Recommended:

1.Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996).

2. Let us Python by Kanetkar, BPB Publication, Noida.

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SKILL ENHANCEMENT COURSE

SUBJECT TITLE: ANALYTICAL CHEMISTRY

SUBJECT CODE: - BSHB-SE401

SEMESTER – IV, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. To understand the basic concept of Chemical Analysis.

2. To understand titrations and salt analysis

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**		**Internal Assessment (CT+TA/PR)**
70	**30**	**-**		**-**

ANALYTICAL CHEMISTRY

Acid-base titrations, Simple & Double

Qualitative analysis of cations & anions, Dry and Wet tests, Confirmatory tests

Organic Compounds analysis (C, N, S and halaides), Functional group analysis

Electrochemistry: Faraday's Law of electrolysis and its applications

Course Outcome:

1. Get knowledge about various topics of analytical chemistry such as Volumetric analysis, Gravimetric analysis and Separation techniques of various cations and anions in a mixture

2. Grasp about the Farady's laws of electrolysis and its application

Books recommended:

1. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
2. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
3. Khopkar, S.M. Basic Concepts of Analytic al Chemistry. New Age, International Publisher, 2009.

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DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: BIOMATERIALS (THEORY)

SUBJECT CODE: - BSHB-DS 401

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course objectives:

1. **To understand the basics of nanoscience and technology.**
2. **To understand the various process techniques available for bio- materials.**
3. **The application of nanotechnology in various fields such as biomedicine, Tissue Replacement Implants and Acute Wound Healing etc.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1: Introduction to biomaterials [**20HRS]**

Classification, Chemistry and characterization of biomaterials. The state of the art of biomaterials and the challenges. Disciplines involved in biomaterials science and the path from a need to a manufactured medical device. Material selection requirements for biomaterials – metals, composites, ceramics and polymers. Tissue environment of the implanted biomaterial: unit cell processes. Tissue responses to implants. Nanomaterials: fullerenes, carbon nanotubes, nanomembranes. Synthesis of bio-materials, Characterization of chemical, physical, mechanical properties, visco elasticity, end group analysis, determination of molecular weight of a polymer.

Unit 2: Biocompatibility [10HRS]

Biocompatibility of Bio-materials, wound-healing process, body response to implants, blood compatibility. Tests to assess biocompatibility of a polymer, modifications to improve biocompatibility. Reactions of biomaterials with cellular and extra cellular components

Unit 3: Modified biomaterials [10HRS]

Biodegradative biomaterials, Bioactive polymers and biosynthetic polymers, inert biomaterials, genetically engineered biomaterials

Unit 4: Applications of Biomaterials [20HRS]

Tissue Replacement Implants, Acute Wound Healing, Blood Clotting, Chronic Wound Healing and Foreign Body Response. Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal Fractures fixation devices, joint replacements. Artificial Organs Artificial Heart, Prosthetic cardiac Valves, Limb prosthesis, Externally Powered limb, prosthesis, Dental Implants, Other applications. Liposomes, hydrogels and Nanomaterials in drug delivery. Biomaterials in diagnostics and bioanalytical techniques.

SUGGESTED READINGS

1. Sujata V. Bhat, Biomaterials , 2nd edition, Narosa Publishing House, New Delhi, 2006.

2. Buddy D. Ratner, B. D. Ratner,Allan S. Hoffman, Biomaterials Science: An Introduction To Materials In Medicine, 2nd Edition(2004) Publisher: Academic Press.

3. Fred W.Billmeyer, Text book of Polymer Science. 3 rd edition John Wiley and sons publications. 4. Basic & Clinical Pharmacology, 10th ed B.G. Kat sung, McGraw-Hill 2007

BSHB-DS-401-P BIOMATERIALS (PRACTICALS)

TOTAL HOURS: 30 CREDITS: 2

1. Understand and follow guidelines regarding biological safety and maintain a laboratory notebook that follows the guidelines given in class. Prepare a laboratory report

2. Demonstrate aseptic cell culture techniques

3. Perform transformation into a bacterial cell

4. Describe and demonstrate basic concepts and examples of biomedical signal and image processing, biomaterials, biomechanics, and cellular and molecular biotechnology

5. Perform literature search

6. Prepare a scientific poster

7. Collect, analyze, and interpret physiological measurements

8. Visit to a R&D section of a leading Pharmaceutical company/ surgical theatre of Hospital. Prepare a laboratory report

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Structure of B.Sc. (Hons) Biological Science under CBCS

DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: DRUG DISCOVERY & DEVELOPMENT (THEORY)

SUBJECT CODE: - BSHB-DS-301

SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. To make the students understand about the basic concept of drug and its targets.

2. To understand the **Fundamentals of Physicochemical principles of drug action.**

3. To understand the **role of pharma-informatics in drug discovery.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 General Introduction [**20HRS]**

Definition and scope of drug design; **Drug target classification:** Proteins as drug targets: Receptors - receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverse agonist, desensitization and sensitization of receptors, affinity, efficacy and potency. Enzymes - Enzyme inhibitors (competitive, noncompetitive, suicide inhibitors), medicinal use of enzyme inhibitors. Nucleic acids as drug targets: Classes of drugs that interact with DNA: DNA intercalators and DNA alkylators.

Unit-2 Physicochemical principles of drug action [05HRS]

Partition coefficient, drug dissolution, acid-base properties, surface activity, bioavailablity, stereochemical aspects of drug action.

Unit-3 Drug receptor interactions [05HRS]

Kinetic analysis of ligand receptor interactions using scatchard plot, double reciprocal plot, Hill plot, forces involved, relationship between dose and effect (graded and quantal response).

Unit-4 Principles of drug design [10HRS]

Introduction to SAR, strategies in the search for new lead compounds, analogue synthesis versus rational drug design, concept of prodrugs.

Unit-5 Drug discovery and pharmainformatics [20HRS]

Drug discovery pipeline, drug target identification and validation for microbial pathogen, selection of gene unique to the pathogen, screening for its presence in other microbes and human host, Drug Databases, PubChem, Calculating drug-like properties, introduction to rational drug design methods, optimization of lead compounds.

Course Outcome:

1. Critically evaluate the drug discovery process.

2. Master the role of bioinformatics and genomics in the drug discovery process.

3. Discuss and place into context the use of high-throughput-screening in the drug discovery process.

4. Appreciate the importance of pharmacology in the drug discovery process.

BSHB-DS-301-P PRACTICALS

TOTAL HOURS: 30 CREDITS: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Preparation of Benzocaine,
2. Preparation of Aspirin and determination of partition coefficient in octanol-water system,
3. Preparation of Paracetamol, Preparation of Phenacetin,

SUGGESTED READINGS

1. Introduction to Medicinal Chemistry, 4th edition (2009), Graham l. Patrick, Oxford University Press. ISBN-13: 978-0199234479.

2. The Organic Chemistry of Drug Design and Drug Action, 2 nd edition (2004), Richard B. Silvermann, Elsevier, Academic Press. ISBN-13: 978-0126437324.

3. Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd edition (2005), Thomas Nogrady and Donal F. Weaver, Oxford University Press. ISBN-13: 978-0195104561.

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Structure of B.Sc. (Hons) Biological Science under CBCS

DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: Economic Botany

SUBJECT CODE: - BSHB-DS-501

SEMESTER – V, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

• To learn the diverse human uses of plants and plant products.

• To learn the taxonomic diversity of useful plants.

• To learn the biological reasons why certain plant resources are important.

• To acquire an increased awareness and appreciation of plants and plant products encountered in everyday life.

• To recognize geographic, historical, & cultural differences in the uses and importance of plants.

• To relate diverse aspects of human cultural endeavors to plant resources, and to gain a better understanding and perspective of the origins, histories, and roles of important plants and plant products to the development of human culture.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Economic Botany (Credits: Theory-4, Practical-2) THEORY

Unit 1: Origin of Cultivated Plants (6 lectures) Concept of Centres of Origin, their importance with reference to Vavilov's work.examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversty.

Unit 2: Cereals (6 lectures) Wheat and Rice (origin, morphology, processing & uses), brief account of millets.

Unit 3: Legumes (4 lectures) General account, importance to man and ecosystem.

Unit 4: Sugars & Starches (4 lectures) Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

Unit 5: Spices (6 lectures) Listing of important spices, their family and part used, economic importance with specialreference to fennel, saffron, clove and black pepper

Unit 6: Beverages (4 lectures) Tea, Coffee (morphology, processing & uses)

Unit 7: Oils & Fats (8 lectures) General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and Brassica andCoconut (Botanical name, family & uses)

Unit 8: Essential Oils (4 lectures) General account, extraction methods, comparison with fatty oils & their uses.

Unit 09: Drug-yielding plants (4 lectures) Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis.

Unit 10: Fibres (4 lectures) Classification based on the origin of fibres, Cotton and Jute (morphology, extraction and uses).

Course Outcomes

1. After learning the subject the student will develop an understanding of plants as a source of food with emphasis on major food crops and requirements for human nutrition, the origin of agriculture, legumes, and starchy staples

2. They will get a knowledge commercial products derived from plants that provide us with consumable products such as beverages, herbs and spices, and materials such as cloth, paper, and wood.

3. They will make an understanding of plants and the environment with emphasis on the principles of ecology: the major biomes of the world, economic value of certain plants, and the strategy of extractive reserves in the rain forest.

Suggested Readings 1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India. 2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands. 3. Chrispeels, M.J. and Sadava, D.E. (2003). Plants, Genes and Agriculture. Jones & Bartlett Publishers

SUBJECT CODE: - BSHB-DS-501-P

Economic Botany (Practical)

1. Cereals: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests)Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests). 2. Legumes: Soya bean, Groundnut, (habit, fruit, seed structure, micro-chemical tests). 3. Sugars & Starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato(habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests). 4. Spices: Black pepper, Fennel and Clove (habit and sections). 5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans). 6. Oils & Fats: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushedseeds. 7. Essential oil-yielding plants: Habit sketch of Rosa, Vetiveria, Santalum and Eucalyptus (specimens/photographs) 8. Drug-yielding plants: Specimens of Digitalis, Papaver and Cannabis. 10. Fibre-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fibre).

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Structure of B.Sc. (Hons) Biological Science under CBCS

DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: Dissertation

SUBJECT CODE: - BSHB-DS-601

SEMESTER – VI, CREDITS: 6

Course Objective:

This course is focused to facilitate student to carry out basic research and development project through problem and gap identification, development of methodology for problem solving, interpretation of findings, presentation of results and discussion of findings. The overall goal of the dissertation is for the student to display the knowledge and capability required for independent work.

Credits	**6**		
SCHEME OF EXAMINATION			
Total marks: 150			

Dissertation

Course Outcome:

The student will be able to
• gain in-depth knowledge and use adequate methods in the major subject/field of study.
• create, analyze and critically evaluate different research solutions
• clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings
• identify the issues that must be addressed within the framework of the specific dissertation in order to take into consideration

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Structure of B.Sc. (Hons) Biological Science under CBCS

GENERIC ELECTIVE COURSE

COURSE DETAILS

SUBJECT TITLE: Fundamentals of Yoga and Ayurveda

SUBJECT CODE: - BSHB-GE-101

SEMESTER – V, TOTAL HOURS: 30 CREDITS: 4

Course Objectives

Objectives

1. Give an introduction of Yoga and its important streams.
2. Give a brief history and the basis different types of Yoga.
3. Understand the concept and principle underlying the Ayurveda medicinal system
4. Have knowledge & skills of therapeutics related to Tridosha system of disease and its treatment.
5. Dietary recommendation of Ayurveda with respect to seasons, behavior and others.
6. Acqu

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**		**Internal Assessment (CT+TA/PR)**
70	**30**	**-**		**-**

Unit 1 General Introduction to Yoga [7Hrs.]

Brief introduction to origin of Yog**a** Psychological aspects leading to origin of Yoga, History and Development of Yoga; Etymology and Definitions of Yoga, Aim and Objectives of Yoga, Misconceptions about Yoga, True Nature of Yoga; General Introduction to Schools (Streams) of Yoga, Principles of Yoga and Yogic practices for healthy living, Patanjali Yoga.

Unit 2 Foundations of Yoga and Yoga Traditions [8Hrs.]

General introduction to Vedas and Upanishads, Yoga in Pre-vedic period, Yoga in Vedic period, Yoga in Ayurveda, Yoga in Principle Upanishads, Yoga in Yogopanishad; General introduction to Bhagavadgita, Yoga in Bhagavadgita; Introduction to Smritis and Yoga in Smritis, Introduction to Puranas, Nature of Yoga in BhagavatPurana ; Yoga in Yoga Vasishtha, Yoga in

Narada Bhakti Sutra, Yoga in Medival Literature, Bhakti Yoga of Medival Saints, Yoga by Ramdev Ji and Parmahansa Yogananda Ji.

Unit 3 Fundamentals of Ayurveda [8 Hrs.]

Introduction of Ayurveda: Ayurveda and its Diversified Areas, AṣṭāngaĀyurveda: The Eight Branches of Āyurveda, Basic principal: Pañcamahābhūta (The Five Basic Elements), The Principle of Triḍoṣa: The Three Biological Humors, Traiyopastambha: Three Supporting Pillars of the Body, Saptadhātu: The Seven Fundamental Tissues, Ojas: The Vital Essence, Upadhātus: Sub-Tissues, Tridaṇḍa: The Three Dimensions of Life - Body, Mind (Psyche) and Soul, PañcaPañcaka: The Five Pentads, Mala: Digestion and Metabolism, Prakṛti, Srotas: Body Channels, Acharya Balkrishna and Ayurveda.

Unit 4 Anatomy & physiology and DravyagunaVigyan [7 hours]

Basic introduction to Anatomy (Sareer Rachana) and Physiology (Sareer Kriya), *Rasa*: Taste: *Rasa (*taste) and the five elements, *Rasa* and *Doṣa, Rasa* and *Dhātu, Rasa* and *Mala,* Identifying *rasa* and their *guṇa-karma* (qualities and actions), *Guṇa*: Attributes, *Vīrya*: Potency, *Vipāka*: Post-Digestive Effect, *Prabhāva*: Specific Action

Course Outcome:

1. Students of the UG course will have an understanding about origin, history and development of Yoga.
2. They will have an idea about the insights of Indian philosophy
3. Introduction about Yoga according to various yogic texts.
4. Explain prevention of diseases through preventive health practices like daily and seasonal regimen.
5. Apply the principles of Swasthavritta and Yoga for improving quality of life.

Suggested Reading

1. Acharya, B. (2004). AusadhDarshan. Haridwar, India: DivyaPrakashan.
2. Acharya, B. (2005). Ayurveda Jadi-butiRahasya. Haridwar, India: DivyaPrakashan.
3. Dasgupta S. N: History of Indian Philosophy, MotilalBanarsidas, Delhi, 2012.
4. Sharma, Chandradhar: A Critical Survey of Indian Philosophy. MotilalBanarasidas, Delhi, 2013.
5. Swami SatyanandaSaraswati: Gheranda Samhita, Pub: BSY Mungher.
6. Swami Kulvyananda: Hath Pradipika, Pub: Kaivalyadhama, Lonawala.
7. Yoga Darshan: Swami Ramdeva, Pub: DivyaPrakashan, Haridwar.
8. Patanjal Yoga Darshan: Geeta Press.
9. Swami Ramdev: Shrimad Bhagavadgita: Geetamrit, Pub: DivyaPrakashan.
10. Shrimad Bhagvadgita: Geeta Press.

Foundation of Physical Education

SUBJECT CODE: - BSHB-GE-102 **Credit 4**

Course Objective:

1. The main aim of physical education is to spread awareness about the physical body. It enhances the knowledge of a student regarding physical safety.

2. It also aims to develop motor abilities like strength, speed, endurance, coordination, flexibility, agility and balance, as they are important aspects for good performance in different games and sports.

3. It gives a brief idea of history of physical education

4. It teaches group solidarity and leadership qualities

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**		**Internal Assessment (CT+TA/PR)**
70	**30**	**-**		**-**

Unit-I Introduction to Physical Education

1.1 Meaning, Definition and Scope of Physical Education

1.2 Aims and Objective of Physical Education

1.3 Importance of Physical Education in present era.

1.4 Misconceptions about Physical Education.

1.5 Relationship of Physical Education with General Education.

1.6 Physical Education as an Art and Science.

Unit-II Historical Development of Physical Education in India

2.1 Vedic Period (2500 BC – 600 BC), Early Hindu Period (600 BC – 320 AD) and Later Hindu Period (320 AD – 1000 AD), Medieval period

2.2 Post Mughal British Period (Before 1947)

2.3 Physical Education in India (After 1947)

2.4 The early history and significant stages in the revival and development of the modern Olympic movement

2.5 Educational and cultural values of Olympic movement

Unit-III Training Components

3.1 Strength: its type and means methods employed for developing them

3.2 Speed: its type and means methods employed for developing them

3.3 Endurance: its type and means methods employed for developing them

3.4 Flexibility: its type and means methods employed for developing them

3.5 Coordinative abilities: means methods employed for developing those

3.6 Principles of load and its components, Determination of Optimum load,

3.7 overload its causes and identification, Tackling over Load, Training programming and planning

3.8 Periodization and its types of Periodization.

3.9 Aim and Content of Periods–Preparatory, Competition, Transitional period, Planning: Meaning and types, Principles of Planning.

Unit-IV Foundation of Physical Education

4.1 Biological

4.1.1 Growth and development

4.1.2 Age and gender characteristics

4.1.3 Body Types

4.2 Psychological

4.2.1 Attitude, interest.

4.2.2 Cognition, emotions and sentiments.

4.2.3 Practical suggestion from psychology.

4.3 Sociological

4.3.1 Society and culture

4.3.2 Social acceptance and recognition

4.3.3 Leadership in physical education

Assignments, And Presentations

Learning Outcomes

1. After studying the subject the student would be able to compare the relationship between general education and physical education.

2. He/ She should be able to identify and relate with the History of physical education

3. He would be able to comprehend the relationship between philosophy, education and physical education.

4. He/ She would know recent development and academic foundation of physical education.

References:

1. Bucher, C. A. (n.d.) - Foundation of physical education. St. Louis: The C.V. Mosby Co.

2. Deshpande, S. H. (2014) - Physical Education in Ancient India. Amravati: Degree college of Physical education.

3. Dash, B.N. (2003.) –Principles of Education, Neelkamal publication, Hyderabad, 32

4. Kamlesh, M.L. (2002) –Sociological Foundation of Physical Education, Metropolitan Book co. Pvt. Ltd., Delhi,

5. Pandey, R.S.(1991) Philosophical & Sociological Foundation of Education, Vinod PustakMandir, Agra,.

INDIAN CULTURE 4 CREDITS

COURSE DETAILS

SUBJECT TITLE: Indian Culture

SUBJECT CODE: - BSHB-GE-201

SEMESTER – II, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

This course introduces to the students the basic ideas and features of ancient Indian religions as manifested through Vedas, Buddhism and Jainism and Puranas. Beginning with the primitive religious beliefs, the Vedic pantheon and sacrifices are focussed in first unit. Next introduces to the students the basic features of the Sraman a traditions which include within its fold Buddhism and Jainism. Life and teaching of Mahāvīra, basic philosophical ideas of Jainism and its spread are discussed. Teachings of Bhagavadgītā are pronounced in detail whereas the core of Purānic religions is sought to be established through Avatāravāda and Pañacadevopāsanā. Various cults like Vaisnavism, Śaivism and Śāktism have played a prominent role in popularizing the basic tenets of Purānic religion.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**-**	**-**	

Unit I : 12 Hours

Indus period, Early Vedic period, Later Vedic period Science & Technology, Culture & Civilization, Literature and texts, Society and position of women

Unit II : 12 Hours

Tirthankar: Rishabhdev, Parshwanath and Mahaveer. Jainism: Life and teachings of Mahavira, Svetambara and Digambara, Anekantavada and Syadvad Buddhism: Life and teachings of Gautama Buddha, Buddhist Councils, Hinayana and Mahayana. Bhagavatism

Unit III : 14 Hours

Teachings of Bhagavadgita, Gyanayoga, Bhaktiyoga and Karmayoga Puranic Religions: Shaivism, Vaishnavism and Shaktism.

Unit IV: 11 Hours

Adi Shankaracharya, Bhakti movement, Ramanujacharya, Kabirdas, Tulsidas, Surdas, Nanak Dev, Chaitanya, etc

Unit V: **11 Hours**

Indian culture in medieval and modern times. Cultural diversity, Uniqueness of Indian Culture, Science & Technology in modern India and cultural change.

Course outcome:

Students will able to:

1. Identify Approaches towards the sources and the study of ancient Indian history.

2. Evolution of social and cultural institutions in the Vedic society, Religious dissent and the rise of Jainism and Buddhism

3. Understand Asoka's Dhamma and his inscriptions.

4. To Know Science and Technology in Ancient Text.

5. To Know Science and Technology in Modern Text.

6. To Know our great Yoga Guru.

Recommended Readings :

Agrawala, V.S., Prachina Bharatiya Lokadharma (Hindi and English), Varanasi, 1964.

Banerjee, J.N., Development of Hindu Iconography, New Delhi, 1985.

Barth, A., The Religions of India, Varanasi, 1985. 19

Bevarkara, S.K. and R.D. Ranade, History of Indian Philosophy, Vol. II, Poona, 1927.

Bhandarkar, R.G., Vaishnavism, Saivism and Minor Religious Systems (Also in Hindi), Varanasi, 1965. Bhattacharya, N.N., History of Sakta Religion, New Delhi, 1974

Chaturvedi, P., Vaishnava Dharma, Varanasi, 1977.

Hiriyanna, M..H., Outlines of Indian Philosophy, London, 1932.

Jaiswal, Suvira, Origin and Development of Vais n avism (also in Hindi), Delhi, 1996 (IInd ed.).

Keith, A.B., The Religion and Philosophy of Veda and Upanis ads (also in Hindi), Cambridge, 1925

Upadhyaya, B. Bharatiya Darshana, Varanasi, 1971.

Bapat, P.V. (ed.), 2500 Years of Buddhism (Also in Hindi), New Delhi, 1987.

Jain, Hiralal, Bharatiya Samskriti me Jaina Dharma ka Yogadana (Hindi). Bhopal, 1962.

Jaini, J.L., An outline of Jainism, Cambridge, 1916.

Jain, Jyoti Prasad, Religion and Culture of the Jains, Delhi, 1995.

Majumdar, R.C. and A. D. Pusalker (eds.), The History and Culture of the Indian People, Vols. I –V (relevant chapters), Bombay, 1951-1957.

Introduction to Srimad Bhagavad Gita

SUBJECT CODE: - BSHB-GE-202 4 CREDITS

Course Objectives:

1. Introducing learners towards various aspects of the Bhagavadgeeta.
2. Familiarize the learners with the contributions of the Bhagavadgeeta in the areas of religion, Yoga, science & Technology, education, languages and literature.
3. Enable learners to appreciate the composite nature of Bhagavadgeeta.
4. Develop among learners a feeling of love and a sense of belonging towards the nation by Bhagavadgeeta.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**-**	**-**	

Unit 1: Shrimad Bhagwadgita Introduction (12 Hours)

General Introduction Of The Bhagavad Gita, The Great Significance Of The Bhagavad Gita And Various Scholars' Views In Relation To It, Synthesis Of Yoga In The Bhagavad Gita, The Major Definitions Of Yoga, The Nature Of Yoga, Yoga Sadhana In The Bhagavad Gita, Relevance Of The Bhagavad Gita In The Current Era.

Unit-2: Gyan Yoga –Atman, Prakriti & Parmatman (12 Hours)

Sankhya Yoga Or Jnana Yoga (Chapter-2, 3, 4, 5, 6, 13),

The Form Of The Soul (Chapter-2),

The Form Of The Supreme Soul (Purushottama), (Chapter4, 8,10,11,13,15),

Form Of Prakriti (Chapter-9, 13, 14).

Unit-3: Karma Yoga and Meditation Yoga (12 Hours)

Concepts Of Karmayoga (Chapter-2-6), Form Of Yajna , Yajnartha Karma, Nishkam Karma (Chapter-3,4), Lok Sangrah (Chapter-3), Jnana-Karma Coordination (Chapter-5), Forms Of Dhyana Yoga (Chapter-6).

Unit 4: Bhakti Yoga (12 Hours)

Concepts Of Bhakti And Mahatmya (Chapters-7, 8, 9,11, 12), The Necessity Of Devotion In Divine Realization (Chapters-11, Verse-52-55), Types Of Bhakti (Chapters-7,12) Characteristics Of The Devotee (Chapter-12, Verse-13-20)

Unit 5: Personality, Diet And Trigun Concept (12 Hours)

Role Of Diet In Yoga Practice (Chapter-6), Introduction To Trigunas (Chapter-14), Concept Of Trigun-Based Personality (Chapter-17), Elements Of Personality Development, Ideal Personality- Daivee Sampda (Chapter-16).

Course Outcome:

Students will able to:

1. get knowledge about Karma, Gyan and Bhakti Yoga.
2. understand how Humans can achieve a better goal in their life.
3. know the true meaning of life.

Prescribed Text Book - 1.श्रीमद्भगवद्गीता- गीतामृत- योग ऋषि स्वामी रामदेव जी, पतजंलि योगपीठ

Supporting text book 1. गीता रहस्य लोक मान्द्य नतलक (चयनित पाठ यांश)

2. Shrimadbhagvadgeeta- Tattvavivechini-Jaidayal Goyandaka, Geeta Press Gorakhpur.

SUBJECT CODE: - BSHB-GE-501 4 CREDITS

RESEARCH METHODOLOGY (Credits: Theory-04, Tutorials-02)

Course Objective:

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**		**Internal Assessment (CT+TA/PR)**
70	**30**	**-**		**-**

Literature Survey: Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.

Digital: Web resources, E-journals, Journal access, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, ChemIndustry, Wiki- Databases, ChemSpider, Science Direct, SciFinder, Scopus.

Information Technology and Library Resources: The Internet and World Wide Web. Finding and citing published information.

Methods of Scientific Research and Writing Scientific Papers: Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation. Writing scientific papers – justification for scientific contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism.

Data Analysis The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments. Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiple linear regression analysis.

Course Outcome:

At the end of the course students will be able to...

CO1: Develop the ability to apply the methods while working on a research project work

CO2: Describe the appropriate statistical methods required for a particular research design

CO3: Choose the appropriate research design and develop appropriate research hypothesis for a research project

CO4: Develop a appropriate framework for research studies

Reference Books:

1. Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. & Jones, A. (2011) Practical skills in chemistry. 2nd Ed. Prentice-Hall, Harlow.
2. Hibbert, D. B. & Gooding, J. J. (2006) Data analysis for chemistry. Oxford University Press.
3. Topping, J. (1984) Errors of observation and their treatment. Fourth Ed., Chapman Hall, London.

Fundamentals of Organic Chemistry

SUBJECT CODE: - BSHB-GE-502 **Credit 4**

Course Objective:

1. To understand the core concepts of organic chemistry i.e. resonance, hyperconjugation, inductive effect etc. and their application.
2. To study about the Biodegradable and non-biodegradable polymers.
3. To understand chemistry in everyday life.
4. To acquire basic knowledge of reactive intermediates and mechanism of organic reactions

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**-**	**-**	

1. Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Reaction intermediates: Carbocations, Carbanions and free radicals. Electrophiles and nucleophiles Aromaticity: Hückel's rule, Stereochemistry
2. Aliphatic Hydrocarbons, Aromatic hydrocarbons, Alkyl Halides, Alcohols, Phenols, Esters, Aldehydes and ketones, Carboxylic acids, Amines (preparations, physical properties & chemical reactions)
3. Polymers: Natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers: natural and synthetic like polythene, nylon, polyesters, bakelite, rubber. Biodegradable and non-biodegradable polymers.
4. Chemistry in everyday life: Chemicals in Medicine, Cleansing agents

Course Outcome:

1.. Know the fundamental principles of organic chemistry and predict outcomes and derive mechanism of various types of organic reactions.
2. Understand various types of reactive intermediates and factors affecting their stability.
3. Understand the synthesis, isomerism and physical properties of alkanes, cycloalkanes, alcohols, esters, amines, aldehydes, ketones etc

Books recommended:

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
5. Berg, J. M., Tymoczko, J. L. & Stryer, L. Biochemistry 7th Ed., W. H. Freeman

SUBJECT CODE: - BSHB-GE-601 **Credit: 4**

BIOCHEMICAL INSTRUMENTATION

Course Objective:

1. **The course will help students to acquaint with basic instrumentation, principle and procedure of various sophisticated instruments**

2. This will enable the students to implement the use of these techniques in biological research and in discovering new products/compounds.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**-**	**-**	

1. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given) (a)Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography (b)Identify and separate the sugars present in the given mixture by paper chromatography.
2. Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers.
3. Infrared spectroscopy: Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR).
4. NMR spectroscopy: Principle, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications.
5. Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio
6. Electrophoresis: Basic Principle of electrophoresis, Paper electrophoresis, Gel electrophoresis, discontinuous gel electrophoresis, PAGE, SDS-PAGE, Native and denaturing gels. Agarose gel electrophoresis, buffer systems in electrophoresis. Electrophoresis of proteins and nucleic acids, protein and nucleic acid blotting, detection and identification. Molecular weight determination
7. Centrifugation
   Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient,

various types of centrifuges, different types of rotors, differential centrifugation, density gradient centrifugation

Course Outcome:

1. This paper is crucial for implementation of research ideas at molecular level.
2. It trains the students in adopting various techniques in biological research.
3. This significantly enhances the employability of the candidates in Biotechnological, Pharmaceutical Industries and Analytical Laboratories and research institutes
4. The course will help students to acquaint with basic instrumentation, principle and procedure of various sophisticated instruments
5. The students will be able to implement the use of instruments like chromatography, UV-VIS spectroscopy, NMR, electrophoresis, etc in biological research

Books recommended:

1. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and Stanley Crouch (ISBN 0-495-01201-7).
2. Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.
3. P.W. Atkins: Physical Chemistry.
4. G.W. Castellan: Physical Chemistry.
5. C.N. Banwell: Fundamentals of Molecular Spectroscopy.

SUBJECT CODE: - BSHB-GE-602 **Credit: 4**

STRUCTURAL BIOINFORMATICS

Course Objective:

The objective of the course is learning and understanding the detailed developments and applications of the field of Bioinformatics in varied area of biological research. The course generally focuses on genomics, proteomics and computational biology studies and their relevance on research platform.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**-**	**-**
Hrs/Week		**4**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**-**	**-**	

Unit I What is Bioinformatics and its relation with molecular biology Examples of related tools (FASTA, BLAST, BLAT, RASMOL), databases (GENBANK, Pubmed, PDB) and software (RASMOL,Ligand Explorer), Data generation; Generation of large scale molecular biology data. (Through Genome sequencing, Protein sequencing, Gel electrophoresis, NMR Spectroscopy, X-Ray Diffraction, and microarray).

Unit II Sequence Alignments and Visualization, Introduction to Sequences, alignments and Dynamic Programming,Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm).Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.

Unit III Fundamentals of X-ray diffraction, NMR spectroscopy of macromolecules, Protein Structure: Primary, Secondary, Super Secondary, Domains, Tertiary, Quaternary, Ramachandran plot.

Unit IV Protein secondary structure classification databases: HSSP, FSSP, CATH, SCOP, Protein secondary structure prediction methods: GOR, Chou-Fasman, PHD, PSI- PRED, J-Pred.

Unit V Protein Tertiary structure prediction methods: Homology Modeling, Fold Recognition, Ab-intio Method, Protein folding, Molecular Dynamics of Protein, Molecular Docking of Protein, Small molecule and Nucleotide, Concepts of Force Field

Unit VI Motif and Domain: Motif databases and analysis tools, Domain databases (CDD, SMART, ProDom) and Analysis tools. HMM (Hidden Markov Model): Introduction to HMM, its application in Sequence alignment and Structure prediction, HMM based Softwares (HMMER and HMMSTR)

Course Outcome:

1. The student will be able to apply basic principles of biology, computer science and mathematics to address complex biological problems.
2. The student will learn about the Computer basics like Operating systems, Programming in Visual Basic, Data Access, Internet and Nucleic acid Sequence and protein Data Banks
3. The course will help to understand the Database Similarity Searches like BLAST, FASTA etc.,multiple sequence alignments, Primer Designing, Homology Modeling, phylogenetic analysis & Drug Designing, and Determination of Secondary & Tertiary of proteins.

Books recommended:

1. Baxevanis & Ouellette 2001. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins 2nd Edition. John Wiley Publishing.
2. Gibas & Jambeck 2001. Developing Bioinformatics Computer Skills. O'Reilly.
3. Bioinformatics: Genome Sequence Analysis Mount 2001
4. Bioinformatics For Dummies – Claverie & Notredame 2003
5. Introduction to Bioinformatics – Lesk 2002
7. Fundamental Concepts of Bioinformatics Krane & Raymer 2003

B.Sc. (Microbiology) Structure under the Faculty of APPLIED & ALLIED SCIENCE

SEMESTER	CORE COURSES (12)	ABILITY ENHANCEMENT (3)	SKILL ENHANCEMENT (2)	DISCIPLINE SPECIFIC (5)
I	BSCM-CC-101 (Chemistry) BSCM-CC-102 (Cell Biology) BSCM-CC-103(Virology)	BSCM-AE-101 Communicative English		
II	BSCM-CC-201 (Introduction to Microbiology & Microbial Diversity) BSCM-CC-202 (Environmental Microbiology) BSCM-CC-203 (Bacteriology)	BSCM-AE-201 Environmental Science		
III	BSCM-CC-301 (Biochemistry) BSCM-CC-302 (Ecology) BSCM-CC-303 (Medical Microbiology)			BSCM-DS-301 (Drug Discovery & Development)
IV	BSCM-CC-401 (Metabolism) BSCM-CC-402 (Mol Biology) BSCM-CC-403 (Systems Physiology)	BSCM-AE-401 (Fundamentals of Yoga & Ayurveda)		
V			BSCM-SE-501 (Instrumentation and Biotechniques)	BSCM-DS-501 (Microbial Genetics) BSHB-DS-502 (Microbial Biotechnology)
VI			BSCM-SE-601 (Bioinformatics)	BSCM-DS-601 (Microbes in Sustainable Agriculture) BSCM-DS-602 (Dissertation)
TOTAL	12 PAPERS THEORY 12X4CREDITS=48 PRACTICAL 12X2CREDITS=24	3 PAPERS 3x2 CREDITS=6	2 PAPERS 2x6 CREDITS=12 Theory & Practical included	5 PAPERS 5x6 CREDITS=30 Theory & Practical included
OVERALL CREDITS	120			

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Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: CHEMISTRY (THEORY)

SUBJECT CODE: - BSCM-CC101

SEMESTER – I

Course Objectives:

The chemistry course objectives are

1) **Helping learners to describe chemical bonding and structural aspect of molecules.**
2) **Basic idea of inorganic, Physical and organic aspect of the molecules.**
3) **Help to understand the atomic structure, Kinetics, bonding & bio-molecules.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1: Chemical Bonding and Molecular Structure Ionic Bonding [15 hrs]

Ionic Bonding, Lattice energy and solvation energy. Born-Haber cycle and its applications, Covalent Bonding: VB Approach, Lewis theory, VSEPR theory to explain the shapes of molecules, concept of hybridization, MO Approach: limitations of the VB approach, salient features of the MO theory. Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for s-s-, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules and heteronuclear diatomic molecules such as CO, HF.

Unit 2 Chemical Thermodynamics [15 hrs]

First Law of Thermodynamics: Calculation of work (w), heat (q), changes in internal energy (ΔE) and enthalpy (ΔH) for expansion or compression of ideal gases under isothermal and adiabatic conditions for both reversible and irreversible processes. Calculation of w,q, ΔE, and ΔH for processes involving changes in physical states. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formation, Variation of enthalpy of a reaction with temperature Kirchhoff's equation. Second law of thermodynamics, concept of entropy, Gibbs free energy and Helmoltz free energy. Calculations of entropy change and free energy change for reversible and irreversible processes under isothermal and adiabatic conditions. Criteria of spontaneity, Gibbs Helmholtz equation.

Unit 3 Chemical Kinetics [10 hrs]

The concept of reaction rates, effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, derivation of integrated rate equations for zero, first and second order

reactions, half–life of a reaction, general methods for determination of order of a reaction, Concept of activation energy and its calculation from Arrhenius equation.

Unit 4 Atomic Structure [15 hrs]

Review of: Bohr's theory and its limitations, Heisenberg uncertainty principle, Dual behaviour of matter and radiation, De-Broglie's relation, Hydrogen atom spectra, need of a new approach to atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ2, Schrödinger equation for hydrogen atom, radial and angular parts of the hydrogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation), radial and angular nodes and their significance, radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers. Shapes of s, p and d atomic orbitals

Unit 5 Biomolecules & Medicinal chemistry[5 hrs]

Biomolecules: Carbohydrates, proteins, medicines and vitamins.

Course Outcomes

Upon completion of the course the student should be able to:

1. Get an Knowledge of the theoretical principles of chemistry of molecular structure, bonding and properties of chemical substances and structure and function of bio inorganic molecules
2. Get knowledge and apply the concepts of thermodynamics like heat, temperature, calorie, degree Celsius, application in photosynthesis and digestion, food industry, role of entropy on global warming, enthalpy of a reaction
3. Apply the concepts related to rate of chemical reaction, role of enzyme catalyst etc

SUGGESTED READINGS

1. J.D.Lee: A New Concise Inorganic Chemistry, E.L.B.S.

2. P.W. Atkins: Physical Chemistry, Oxford University Press

3. R.T. Morrison & R.N.Boyd: Organic Chemistry, Prentice Hall

4. James E.Huheey etal. : Inorganic Chemistry: Principles of Structure and reactivity,

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BSCM-CC101-P CHEMISTRY (PRACTICALS) SEMESTER - I

TOTAL HOURS: 30 CREDIT: 2

1. Simple Acid Base titrations for determining strengths.

2. Estimation of oxalic acid by titrating it with KMnO4.

3. Surface tension measurement (use of organic solvents excluded) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.

4. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer

5. Determination of melting and boiling points of organic compounds

6. Separation of mixures by Chromatography; Measure the Rf value in each case (combination of two compounds to be given) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.

7. Determination of Functional groups present in an organic compound.

8. Identification of anions and cations in an inorganic compound

Suggested Reading Materials:

1. A.I. Vogel, Vogel's Qualitative Inorganic Analysis, Prentice Hall, 7th Edition

2. A.I. Vogel, Vogel's Quantitative Chemical Analysis, Prentice Hall, 6th Edition

3. B.D. Khosla, Senior Practical Physical Chemistry, R.Chand & Co.

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Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: CELL BIOLOGY (THEORY)

SUBJECT CODE: - BSCM-CC102

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The cell biology course objectives are

1. Students will grasp the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles

2. Students will master how these cellular components are used to generate and utilize energy in cells

3. Students will grasp the cellular components underlying mitotic cell division.

4. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 Cell organelles:10 Hrs.

Ultrastructure and function of different cell organelles (cell wall, plasma membrane, nucleus, mitochondria, chloroplast, ribosomes, peroxisomes, lysosomes, Golgi bodies and endoplasmic reticulum).

Unit-2 nuclear material: 10Hrs.

Chromatin structure and chromosomes organization: prokaryotic and eukaryotic cell. Chromosome morphology, specialized types of chromosomes (sex chromosomes, lampbrush chromosomes, polytene chromosomes, transposons.

Unit-3- Cell Division: 15 Hrs.

Cell cycle, mitosis: stages, structure and function of spindle apparatus, anaphasic chromosome movement, meiosis, its different stages- meiosis I, Meiosis II, Synaptonemal complex, chiasmata formation and crossing over.

Unit-4 -Basics of genetic material: 10Hrs.

Griffith's transformation experiment and Hershey and Chase blender experiment to demonstrate DNA as the genetic material Concept of gene, gene operon concept.Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extra chromosomal replicons

Unit-5 -Cell signaling: 10Hrs.

Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signalling pathways, bacterial and plant two component systems, light signalling in plants, bacterial chemotaxis.

Unit-6 –Cancer: 5Hrs

Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

SUGGESTED READINGS

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition, John Wiley & Sons. Inc.

2. De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper G. M. Hausman R. E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press and Sunderland, Washington D. C.; Sinnauer Academic Press.

4. Becker W. M., Kleinsmith L.J. and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San fransisco.

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BSCM-CC-102-P Cell Biology (PRACTICALS) SEMESTER - I

TOTAL HOURS: 30 CREDIT: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Principle and working of basic instruments:-
    a. Laminar Air Flow.
    b. pH meter.
    c. Spectrophotometer.
    d. Autoclave.
    e. Incubator
    f. Water bath
2. Identification and study of types of cancer, cancer cells by permanent slides/ photographs.
3. Study of ultrastructure of cell (Cell wall, Primary and secondary pits, Plasodesmata, Gap junctions, Tight junctions, Plasma membrane, Nucleus, Nuclear Pore Complex, Chloroplast, Mitochondrion, Golgi bodies, Lysosomes, SER and RER), Prokaryotic and Eukaryotic cell, Plant and Animal Cell, through electron micrographs/photographs.
4. Preparation of temporary slides of the following (Onion epidermal peel/ root tips or any other suitable available material like Crinum, Wheat caryopsis etc.).
5. Basic sterilization techniques required for Media preparation & Cytological techniques.
6. Staining technique of Bacteria:-
    g. Preparation of bacterial smear.
    h. Gram staining.
    i. Simple staining.
    j. Acid fast staining.
7. Study through permanent slides:-Cell division (mitotic and meiosis).
8. Section cutting of following plant materials:-
    a. monocot
    b. dicot
9. Separation of nucleic acid bases by paper chromatography.
10. Study of different stages of meiosis by temporary preparation/ permanent slides of onion flower buds.

References books

1. Celis JE (ed) (1998) Cell Biology: A Laboratory Handbook, 2nd edn. San Diego: Academic Press.
2. Lacey AJ (ed) (1999) Light Microscopy in Biology: A Practical Approach, 2nd edn. Oxford: Oxford University Press.
3. Paddock SW (ed) (1999) Methods in Molecular Biology, vol 122: Confocal Microscopy Methods and Protocols. Totowa, NJ: Humana Press.
4. Watt IM (1997) The Principles and Practice of Electron Microscopy, 2nd edn, Cambridge: Cambridge University Press.
5. 1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition,
6. De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.

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Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: Virology (THEORY)

SUBJECT CODE: - BSCM-CC103

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The Virology course objectives are

- Contrast differences in virus architecture and classification
- Diagram transmission and replication for medically important viruses
- Distinguish characteristics of normal cells and virus-infected cells
- Explain and apply methods used in research and diagnosis of viral diseases
- Describe cellular and therapeutic antiviral strategies
- Explore social stigmas against infected individuals

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit I: Introduction of virology [15 hrs]

History: History, origin and evolution of viruses, pioneers of Virology and properties of viruses. Nomenclature and classification of viruses: Criteria used for naming and classification, Morphology and properties of viruses: Physical- morphology and structure, sedimentation, electrophoretic mobility, buoyant density; Biochemical- chemical composition, nucleic acids, proteins, enzymes, lipids, carbohydrates, polyamines, captions, virus stability; Biological- Host range, inclusion bodies and transmission.

Unit II: Maintenance of viruses: [15 hrs]

Laboratory Bio-safety: Principles of bio-safety, biosafety levels, containment facilities, maintenance and handling of laboratory animals and requirements of virology laboratory. Isolation, cultivation and maintenance of viruses: Isolation and cultivation of plant and animal viruses (experimental plants and tissue culture, experimental animals Purification of viruses: Extraction of viruses from tissues, clarification, and concentration of viruses in clarified extracts by physical and chemical methods.

Unit III: Assay of viruses [15 hrs]

Assay of viruses: Infectivity assay methods (plaque, pock, end point, local / systemic assay of plant viruses), physical (EM), serological (HA, HI, immunofluorescence, ELISA) and molecular (viral protein and nucleic acid based) approaches. Replication: Introduction to virus replication, steps involved in virus replication and general strategies. Management of viruses: Cultural practices, Sanitation, control of vectors, vaccines, antiviral drugs and chemotherapy.

Unit IV: Bacteriophages[15 hrs]

Bacteriophages: Biology of major RNA (MS2, Qβ) and DNA (T4, lambda, Øx174, M13) bacteriophages, replication of M13, T4 and lambda phages; biology of cyanophages. Algal and fungal viruses: Biology of viruses of Phycodnaviridae, Partitiviridae andTotiviridae. Biology of sub-viral agents: Satellite viruses, sat-RNAs, DI particles, viroids, virusoids and prions.

Course outcomes

- CO1: Learn the discovery, nature, origin and evolution of viruses and the physical, biochemical, and biological properties of viruses, criteria used for nomenclature and classification of bacteria, plant and animal viruses.
- CO2: Describe the methods used for isolation, cultivation, and purification of viruses and criteria of purity.
- CO3: Define biological, physical, biochemical, and serological methods used for quantitation of viruses, major characteristics of important plant and animal virus families and biology and applications of major RNA and DNA viruses of insects.
- CO4: Master the biology of major bacteriophages, algal and fungal viruses, sub viral agents and importance of viruses in human welfare with suitable examples.

SUGGESTED READINGS

1. Evidence-Based Diagnosis: An Introduction to Clinical Epidemiology 2nd Edition, by Thomas B. Newman, Michael A. Kohn (2020).2 edition, Publisher: Cambridge University Press.
2. Virusphere: From Common Colds to Ebola Epidemics--Why We Need the Viruses That Plague Us (2020). 1st edition, Frank Ryan (Author), Publisher: Prometheus.
3. Guide to Clinical and Diagnostic Virology (2019), (ASM Books) 1st Edition, by ReetiKhare, Publisher: ASM Press.
4. Virology (2019), P. Saravanan. 5. Recent Advances in Animal Virology (2019) 1st Edition, Kindle Edition, by Yashpal Singh Malik, Raj Kumar Singh, Mahendra Pal Yadav, 471 pages, Publisher: Springer.

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Structure of B.Sc. Microbiology under CBCS

BSCM-CC-102-P Virology (PRACTICALS) SEMESTER - I

TOTAL HOURS: 30 CREDIT: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1) Study of the structure of important animal viruses (rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs.
2) Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs.
3) Study of the structure of important bacterial viruses (ϕX 174, T4, ℨ) using electron micrograph.
4) Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique.
5) Studying isolation and propagation of animal viruses by chick embryo technique.
6) Study of cytopathic effects of viruses using photographs.
7) Perform local lesion technique for assaying plant viruses.

Suggested Readings

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.

2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.

3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular Biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.

4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.

5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.

6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.

7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.

8. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.

9. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

University of Patanjali, Haridwar

Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: Introduction to Microbiology & Microbial Diversity (THEORY)

SUBJECT CODE: - BSCM-CC-201

SEMESTER – II, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The course objectives are

1. Apply the knowledge to understand the microbial physiology and to identify the microorganisms.

2. Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit1: 1 History of Microbiology[15 Hrs]

History and mile stones in microbiology. Contributions of Anton von Leeuwenhoek, Edward Jenner, LouisPasteur, Robert Koch, Ivanowsky. Importance and applications of microbiology. Classification of microorganisms. Whittaker's five kingdom concept, Bergey's Manual of Systematic Bacteriology. General characteristics and outline classification of Bacteria, Archaea, Mycoplasmas, Cyanobacteria, Fungi, Algae, Protozoa and viruses.

Unit 2: Methods of sterilization [10 Hrs]

Methods of sterilization: Physical methods–Dry heat, moist heat, radiation methods, filtration methods, Chemical methods and their application. Microbial cultures: Concept of pure culture, Methods of pure culture isolation, Enrichment culturing techniques, single cell isolation, and pure culture development. Preservation of microbial cultures: sub culturing, overlaying cultures with mineral oils, lyophilization, and cultures, storage at low temperature.

Unit 3: Staining methods [10 Hrs]

Staining Techniques- Simple and Differential staining techniques. Principles of microscopy- Bright field and Electronmicroscopy (SEM and TEM).Nutritional types of bacteria. Microbiological media-Natural and synthetic-basal, defined, complex, enrichment, selective, differential, maintenance and transport media.

Unit-4 Microbial growth [15Hrs.]

Microbial growth: Principles of growth, Kinetics of growth, Methods of measuring growth: Direct methods: viable plate counts, membrane filtration. Indirect methods: Metabolicactivity–measurements of DNA, Protein, Microscopiccounts, electroniccounters, mostprobable number; Batch and continuous growth, Synchronous culture, Diauxic growth, Types of cultures stock, batch, continuous and synchronous cultures. Cultivation of aerobes and anaerobes. Reproduction in bacteria and spore formation.

Unit-5 Ultra-structure of Prokaryotic cell [10 Hrs.]

Ultra structure of Prokaryotic cell- Variant components and invariant components. Cell wall of bacteria and fungi, Gram positive cell wall, Gram negative cell wall, Cell wall of fungi and yeasts.Morphology,Ultrastructure and chemical composition of bacteria, Actinomycetes Spirochetes, Rickettsiae, Mycoplasma, Chlamydiae. Economic importance of algae and fungi.SCP.

Course Outcome:

Students will be acquainted with the basic concept of prokaryotes, their taxonomy, and their differentiation from eukaryotes and how Microbiology developed and what is the scope of the various branches of the subject.

SUGGESTED READING

- Pelczar,M.J.,Chan,E.C.S.andKreig,N.R.(1993).Microbiology.5thEdition,TataMc Graw HillPublishingCo.,Ltd.,NewDelhi.
- Dube,R.C.andMaheswari,D.K.(2000)GeneralMicrobiology.SChand,NewDelhi. Edition),Himalaya PublishingHouse,Mumbai.
- Power,C.B.and Daginawala,H.F.(1986).GeneralMicrobiologyVolI&II
- Prescott,M.J.,Harley,J.P.andKlein,D.A.(2010).Microbiology.5thEdition,WCBMc GrawHill,NewYork.

Structure of B.Sc. Microbiology under CBCS

BSCM-CC-201-P Introduction to Microbiology & Microbial Diversity (PRACTICALS)

TOTAL HOURS: 30 CREDIT: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Microbiology Good Laboratory Practices and Biosafety.

2. Preparation of culture media for cultivation of bacteria

3. Preparation of culture media for cultivation of fungi

4. Sterilization of medium using Autoclave

5. Sterilization of glassware using Hot Air Oven

6. Light compound microscope and its handling

7. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram - ve bacilli), Cyanobacteria, Algae and Fungi.

8. Simple staining

9. Gram's staining

10. Hanging-drop method.

11. Isolation of pure cultures of bacteria by streaking method.

12. Preservation of bacterial cultures by various techniques.

SUGGESTED READING

- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi.
- Dube, R.C. and Maheswari, D.K. (2000) General Microbiology. S Chand, New Delhi. Edition), Himalaya Publishing House, Mumbai. • Power, C.B. and Daginawala, H.F. (1986). General Microbiology Vol I & II
- Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). Microbiology. 5th Edition, WCB Mc GrawHill, New York.
- Reddy, S.M. and Reddy, S.R. (1998). Microbiology Practical Manual, 3 rd Edition, Sri Padmavathi Publications, Hyderabad. • Singh, R.P. (2007). General Microbiology. Kalyani Publishers, New Delhi.
- Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi. • Microbiology Edited by Prescott
- Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
- Gopal Reddy et al., Laboratory Experiments in Microbiology.

University of Patanjali, Haridwar

Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: Environmental Microbiology (THEORY)

SUBJECT CODE: - BSCM-CC-202

TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The course objectives are

1. Students will learn the major principles of environmental microbiology and the relationship of microbes to environmental processes and other living organisms. Assessment will be based upon performance on exam questions. Assessment can also be based on research papers/projects.
2. Students will demonstrate proper scientific procedure to identify various type of environmental microbes. Students will be evaluated by observation in the laboratory and analysis of unknown bacteria and projects. Assessment will also be based upon performance on exam question and laboratory projects.
3. Students will be able to explain the scientific basis for each technique used. Students will be required to answer exam questions designed to allow them to demonstrate their acquisition and retention of this knowledge.
4. Students will demonstrate proper scientific laboratory record keeping. Students will be evaluated by periodic notebook collection.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit1: 1 History of Microbiology [15 Hrs]

Introduction to microbiology: Scope of microbiology, Structure and classification of microbes, Role of microbes in human life and environment, Prokaryotic cell, Cytoplasm of Eukaryotes, Basic methods in microbiology: Microscopic methods, Techniques of sterilization, Media preparation, Isolation and inoculation, direct observation and staining techniques, Maintenance and preservation of cultures.

Unit 2: Prokaryotes and Viruses: [15 Hrs]

Prokaryotes and Viruses: Brief description about Bacteria and Viruses and their role and importance in Environment 04 5 Eukaryotes: Brief description about protozoa, algae and fungi and their role and importance in Environment**,** Microorganisms and Human diseases: Diseases caused by bacteria, fungi and protozoa, Role of Microorganisms in Environment, Industry and Food: Soil microorganisms, microorganisms in aquatic habitats, microorganisms and pollution, Bio-fertilizers

Unit 3: Staining methods [10 Hrs]

StainingTechniques-Simple and Differential staining techniques. Principles of microscopy- Brightfield and Electronmicroscopy (SEM and TEM).Nutritional types of bacteria. Microbiological media-Natural and synthetic basal,defined,complex,enrichment,selective,differential,maintenance and transport media.

Unit-4 Microbialgrowth [15Hrs.]

Microbial growth: Principles of growth, Kinetics of growth, Methods of measuring growth: Direct methods: viable plate counts, membrane filtration. Indirect methods: Metabolic activity–measurements of DNA, Protein, Microscopic counts,electronic counters, most probable number; Batch and continuous growth, Synchronous culture, Diauxic growth, Types of cultures-stock, batch, continuous and synchronoerobes and anaerobes. Reproductionin bacteria and spore formation.

Unit-5 Ultra structure of Prokaryotic cell [10 Hrs.]

Ultra structure of Prokaryotic cell- Variant components and invariant components. Cell wall of bacteria and fungi, Gram positive cell wall, Gram negative cell wall, Cell wall of fungi and yeasts.Morphology, Ultrastructure and chemical composition of bacteria, Actinomycetes Spirochetes, Rickettsiae, Mycoplasma, Chlamydiae. Economic importance of algae and fungi.SCP.

Course Outcome:

This is a specific paper which will train students for sustainable development by maintaining soil health. Besides this, they will be acquainted with the bio-fertilizer production technology and the bottlenecks in the technology

SUGGESTED READING

- Pelczar,M.J.,Chan,E.C.S.andKreig,N.R.(1993).Microbiology.5thEdition,TataMcGraw HillPublishingCo.,Ltd.,NewDelhi.
- Dube,R.C.andMaheswari,D.K.(2000)GeneralMicrobiology.SChand,NewDelhi.Edition),Himalaya PublishingHouse,Mumbai.
- Power,C.B.and Daginawala,H.F.(1986).GeneralMicrobiologyVolI&II
- Prescott,M.J.,Harley,J.P.andKlein,D.A.(2010).Microbiology.5thEdition,WCBMcGrawHill,NewYork.

Structure of B.Sc. Microbiology under CBCS

BSCM-CC-202-P Environmental Microbiology (PRACTICALS) SEMESTER - II

TOTAL HOURS: 30 CREDIT: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Bacteriological Test for Water Pollution Analysis.
2. Membrane-Filter Technique for Bacteriological Examination of Water.
3. Multiple Tube Method for Enumeration of Bacteria.
4. Preparation of culture media for cultivation of Bacteria.
5. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram - ve bacilli), Cyanobacteria, Algae and Fungi.
6. Preservation of bacterial cultures by various techniques.

SUGGESTED READING

- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi.
- Dube, R.C. and Maheswari, D.K. (2000) General Microbiology. S Chand, New Delhi. Edition), Himalaya Publishing House, Mumbai. • Power, C.B. and Daginawala, H.F. (1986). General Microbiology Vol I & II
- Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). Microbiology. 5th Edition, WCB Mc GrawHill, New York.
- Reddy, S.M. and Reddy, S.R. (1998). Microbiology Practical Manual, 3 rd Edition, Sri Padmavathi Publications, Hyderabad. • Singh, R.P. (2007). General Microbiology. Kalyani Publishers, New Delhi.
- Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi. • Microbiology Edited by Prescott
- Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
- Gopal Reddy et al., Laboratory Experiments in Microbiology.

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Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: Bacteriology (THEORY)

SUBJECT CODE: - BSCM-CC-203

SEMESTER – II, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The course objectives are

- Report for the structure, morphology and life cycle of medically relevant bacteria and eukaryotic microorganisms.
- Account for microbiological techniques including substrate production, sterilisation, disinfection, isolation methods and isolation mediums.
- Account for systematics of bacteria and classification of bacteria, especially the methods that are used for classification.
- Account for the growth, physiology and metabolism of bacteria, especially the processes that are of significance for the aetiological ability of bacteria.
- Account for the genetic mechanisms (conjugation, transduction and transformation) and gene regulation mechanisms that are of significance for the virulence and antibiotic resistance development of bacteria.
- Account for mechanisms of transmission, virulence, pathogenicity of pathogenic microorganisms and methods for treatment and prevention of medical important microorganisms.
- Account for the mechanisms of action of antibiotics and the genetic and evolutionary mechanisms behind bacterial development of resistance to antibiotics.
- Account for the factors that influence the virulence of pathogenic microorganisms and how virulence evolves.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit1: 1 History of Bacteriology [15 Hrs]

Early history of Microbiology and Microbial Diversity constituting structure of bacteria: cocci/bacilli and its organelles, Discovery of microorganisms, contributions of scientists, spontaneous generation v/s Biogenesis, discovery of antibiotics. Physiological diversity, microbial classification (prokaryotes: Bacteria and Archaea, eukaryotes: Fungi, Algae, Protozoa, and Helminthes)

Unit 2: Microbial nutrition [20 Hrs]

Microbial Nutrition, Growth and Control Nutritional requirements (macro and micronutrients), Temperature, pH, osmotic pressure, Types of culture media, uptake of nutrients, Maintenance of pure cultures. Bacterial division, growth curve, generation time, measurement of growth. Asepsis, sterilization with physical and chemical agents. Brief description about Bacteria and their role and importance in Environment. Microorganisms and Human diseases: Diseases caused by bacteria, fungi and protozoa, Role of Microorganisms in Environment, Industry and Food: Soil microorganisms, microorganisms in aquatic habitats, microorganisms and pollution.

Unit 3: Harmful and beneficial microbe's [10 Hrs]

Harmful and beneficial microbe's Normal microflora of human body, host-pathogen interaction, bacterial, viral, protozoan and fungal diseases of plants and animals. Phytotoxins, antimicrobial agents, drug resistance, interferon. Microorganisms and fermentation; Bioremediation; Bio-indicators.

Unit-4 Microbialgrowth [15Hrs.]

Microbialgrowth:Principlesofgrowth,Kineticsofgrowth,Methodsofmeasuringgrowth: Direct methods: viable plate counts, membrane filtration. Indirect methods: Metabolicactivity–measurementsofDNA,Protein,Microscopiccounts,electroniccounters,mostprobable number;Batch and continuous growth, Synchronous culture, Diauxic growth, Typesofcultures-stock,batch,continuousandsynchronouscultures.Cultivationofaerobesandanaerobes.Reproductioninbacteriaandsporeformation.

Unit-5 Microbial Biotechnology [15 Hrs.]

Microbial Biotechnology Types of restriction enzymes, cloning vectors (plasmids, phagebased etc), selection of recombinants. Application of recombinant DNA technology – Therapeutic proteins (human disease) transgenics-herbicide, resistance, metabolic engineering, production of vaccines

SUGGESTED READING

- Pelczar,M.J.,Chan,E.C.S.andKreig,N.R.(1993).Microbiology.5thEdition,TataMcGraw HillPublishingCo.,Ltd.,NewDelhi.
- Dube,R.C.andMaheswari,D.K.(2000)GeneralMicrobiology.SChand,NewDelhi.Edition),Himalaya PublishingHouse,Mumbai.
- Power,C.B.and Daginawala,H.F.(1986).GeneralMicrobiologyVolI&II
- Prescott,M.J.,Harley,J.P.andKlein,D.A.(2010).Microbiology.5thEdition,WCBMcGrawHill,NewYork.

Structure of B.Sc. Microbiology under CBCS

BSCM-CC-203-P Bacteriology (PRACTICALS) SEMESTER - II

TOTAL HOURS: 30 CREDIT: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Microbiology Good Laboratory Practices and Biosafety.

2. Preparation of culture media for cultivation of bacteria

3. Preparation of culture media for cultivation of fungi

4. Sterilization of medium using Autoclave

5. Sterilization of glassware using Hot Air Oven

6. Light compound microscope and its handling

7. Microscopic observation of bacteria (Gram +ve bacilli and cocci, Gram - ve bacilli), Cyanobacteria, Algae and Fungi.

8. Simple staining

9. Gram's staining

10. Hanging-drop method.

11. Isolation of pure cultures of bacteria by streaking method.

12. Preservation of bacterial cultures by various techniques.

SUGGESTED READING

- Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi.
- Dube, R.C. and Maheswari, D.K. (2000) General Microbiology. S Chand, New Delhi. Edition), Himalaya Publishing House, Mumbai. • Power, C.B. and Daginawala, H.F. (1986). General Microbiology Vol I & II
- Prescott, M.J., Harley, J.P. and Klein, D.A. (2010). Microbiology. 5th Edition, WCB Mc GrawHill, New York.
- Reddy, S.M. and Reddy, S.R. (1998). Microbiology Practical Manual, 3 rd Edition, Sri Padmavathi Publications, Hyderabad. • Singh, R.P. (2007). General Microbiology. Kalyani Publishers, New Delhi.
- Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi. • Microbiology Edited by Prescott
- Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
- Gopal Reddy et al., Laboratory Experiments in Microbiology.

University of patanjali, Haridwar

Structure of B.Sc. Biochemistry under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: BIOCHEMISTRY (THEORY)

SUBJECT CODE: - BSCM-CC301

SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. To give students a solid foundation in biology and chemistry.

2. To develop analytical and critical-thinking skills that allows independent exploration of biological phenomena through the scientific method.

3. To introduce students to modern methods of biochemical experimentation within the disciplines of biology and chemistry.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit - 1:[15 hrs]
Introduction to Bio-chemistry; chief intracellular components; Introduction to chemical receptors/co-receptors, cell to cell communication, channels & transportation; Definition and classification of Vitamins and their Clinical importance; Basics of Molecular mechanism of O2 transport and storage; Fundamentals of Bio-Energetics: Biological Oxidation, General Concept of oxidation, features of cellular Oxidation-respiratory chain oxidative phosphorylations, Structure and analysis of water.

Unit – 2:[15 hrs]
Carbohydrates: Definition, classification with examples and general functions; Concept of isomerism, types & mode of action; Introduction to metabolism, Integration of metabolism and catabolism.

Unit-3:[15 hrs]
lipids and proteins Lipids: definition, classifications and general functions; Introduction to essential fatty acids, cholesterol, Blood lipids, brief review of lipoproteins and fatty liver; Proteins: definition, classification and Biomedical Importance, Plasma Proteins and functions; Definition, classification and nomenculature of Enzymes, basic introduction to Enzymology and regulation of Enzymatic activity. Structure of DNA, RNA, nuclic acid metabolism and diseases associated with it.

Unit- 4:[15 hrs]
Functional Bio-chemistry Introduction to hormones, molecular basis of hormonal action; Introduction to common metabolic disorders; Basic techniques for estimation of different Bio-chemical markers i.e., diffusion, Osmosis, Electrophoresis

Learning Outcomes:

1. Disciplinary knowledge and understanding of biochemistry, structure and function of biological molecules.
2. Explain biological mechanisms, such as the processes and control of bioenergetics and metabolism, as chemical reactions.
3. Explain the biochemical processes that underlie the relationship between genotype and phenotype.
4. Demonstrate an experiential learning and critical thinking of the structure andfunction of both prokaryotic and eukaryotic cells (including the molecular basisand role of sub-cellular compartmentalization).
5. Fundamental properties of elements, their role in formation of biomolecules and inchemical reactions within living organisms.
6. Acquainted with the concepts of mole, mole fraction, molarity, etc. and to applythem in preparations of solutions of desired strengths.
7. Demonstrate an understanding of the principles, and have practical experience of,a wide range of biochemical techniques (e.g. basic molecular biology, cell biologyand microbiology methods, spectrophotometry, the use of standards forquantification, enzyme kinetics; macromolecular purification, chromatographyelectrophoresis, etc.).
8. Analyse biochemical data (e.g. in enzyme kinetics, molecular structure analysisand biological databases.

SUGGESTED READING

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning

2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman

4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,

6. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill 7. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons,

University of patanjali, Haridwar

Structure of B.Sc. (Hons) Biological Science under CBCS

BSCM-CC-301-P Biochemistry (Practical)

1. Properties of water, Concept of pH and buffers, preparation of buffers and Numerical problems to explain the concepts

2. Qualitative/Quantitative tests for carbohydrates, reducing sugars, non reducing sugars

3. Qualitative/Quantitative tests for lipids and proteins

4. Study of protein secondary and tertiary structures with the help of models

SUGGESTED READING

1. **Introductory Practical Biochemistry, S.K. Sawhney, Narosa Publishing House**

University of Patanjali, Haridwar

Structure of B.Sc. Microbiology CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: ECOLOGY (THEORY)

SUBJECT CODE: - BSCM-CC 302

TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Describe plant and animal distribution patterns in relation to abiotic and biotic factors.**
2. **Define the essential characteristics underlying natural ecosystems.**
3. **Identify global environmental problems**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 Ecology[15 Hrs]

History, definition, ecological factors (abiotic and biotic factor), ecological range (Eury , Steno) Stress and adaptation (Morphological, physiological, anatomical and biochemical), Biotic interaction, phenotypic and genotypic plasticity, canalization, Ecological Succession, Ecological Services.

Unit 2: Ecosystem [15 Hrs]

Concept, components, (e.g., aquatic, marine, forest, grassland, desert, energy flow, food web, niche , different trophic levels, ecological pyramids, Autecology

Unit 3 Pollution[15 Hrs]

Pollution: Pollution of Soil, water, air (types of pollutants and sources), noise pollution, radiation pollution, eutrophication, remedial measures, biomagnifications, Disaster management : Types of disasters & Management strategy, Environmental Impact Assessment analysis

Unit 4Behavioral ecology[15 Hrs]

Social, reproductive & territorial behavior, evolution of optimal life history, reproductive structure and mating system, microbial ecology.

Learning Outcomes:

1. Master the concepts and principles of Ecology
2. Master the structural and functional aspects of biodiversity and the need for itsconservation

3. Be aware of the suitable use of field techniques, data collection, mapping, analysis and interpretation.
4. Be able to take up interdisciplinary research and teaching in Ecology
5. The student should have understanding of the ecology and the role of human beings inshaping the ecosystem.
6. Grasp the various components of the ecology and interfaces.
7. Ability to understand the ecosystem and its various component and functions.
8. Knowledge on ecology, and ecological dynamics.
9. Ability to understand the various ecosystem services and their role in sustaining theenvironment.
10. Be familiar with modern tools and techniques and their appropriate use to conduct research.

SUGGESTED READINGS

1. Wilkenson DM - 2007 - Fundamental Processes in Ecology

2. Aber J.D. & Melillo J M 1991- Terrestrial Ecosystems

3. Smith R.L. Elements of ecology

4. Ricklefs Economy of nature

5. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole

University of Patanjali, Haridwar

Structure of B.Sc. Microbiology under CBCS

BSHB-CC-302-P Ecology Practicals

TOTAL HOURS: 30 CREDITS: 2

1. Study through specimens/photographs/slides Parasitic angiosperms, Saprophytic angiosperms, VAM fungi, Root nodules, Corolloid roots, Mycorrhizal roots, Velamen roots, Lichen as pollution indicators,

2. Principle and function of Sechi disc, Atmometer, Anemometer, Hygrometer, Hair hygrometer, Luxmeter, Rain guage, Soil thermometer, Min-Max thermometer

3. Minimal quadrat method

4. To determine density/frequency/abundance of the vegetation by quadrat method.

5. To determine soil texture

6. To determine soil density, bulk density, particle density and pore space.

7. To determine water holding capacity and percolation rate of soil.

8. To determine pH, Cl, SO4 , NO3 in the soil.

SUGGESTED READINGS

1. Wilkenson DM - 2007 - Fundamental Processes in Ecology

2. Aber J.D. & Melillo J M 1991- Terrestrial Ecosystems

3. Smith R.L. Elements of ecology

4. Ricklefs Economy of nature

5. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole

University of Patanjali, Haridwar

Structure of B.Sc. Microbiology CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: Medical Microbiology (THEORY)

SUBJECT CODE: - BSCM-CC 303

SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

- To offer globally-relevant, industry-linked, research-focused, technology- enabled seamless education at the graduate, postgraduate and research levels in various areas of engineering & technology and applied sciences keeping in mind that the manpower so spawned is excellent in quality, is relevant to the global technological needs, is motivated to give its best and is committed to the growth of the Nation;
- To foster the creation of new and relevant technologies and to transfer them to industry for effective utilization;
- To participate in the planning and solving of engineering and managerial problems of relevance to global industry and to society at large by conducting basic and applied research in the areas of technologies. To develop and conduct continuing education programmes for practicing engineers and managers with a view to update their fundamental knowledge base and problem-solving capabilities in the various areas of core competence of the University
- To develop strong collaborative and cooperative links with private and public sector industries and government user departments through various avenues such as undertaking

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 INTODUCTION TO HUMAN ANATOMY AND PHYSIOLOGY [15 Hrs]

INTODUCTION TO HUMAN ANATOMY AND PHYSIOLOGY Structural organization of human body, homeostasis, directional and regional terms of human anatomy and physiology, body planes, cavities and regions. DIGESTIVE SYSTEM Structure and functions of the organs of digestive system, gastrointestinal glands, enzymes of digestive system, mechanism of digestion in gastrointestinal/digestive system RESPIRATORY SYSTEM Structure and functions of respiratory organs, respiratory volumes and capacities, mechanism of breathing and exchange of gases**.**

Unit 2: CARDIOVASCULAR SYSTEM [15 Hrs]

CARDIOVASCULAR SYSTEM Blood composition, structure and function of heart and major blood vessels of human body, blood circulation pathway, pulmonary circulation, general and systematic circulation, conductive system of heart, cardiac cycle, ECG ENDOCRINE SYSTEM Location of pituitary gland, thyroid gland, parathyroid gland, adrenal gland,

hypothalamus, pancreatic iselets, pineal and thymus gland, structure and function of all human glands.

Unit 3 MUSCULAR SYSTEM [15 Hrs]

MUSCULAR SYSTEM Structure of different types of muscles in human body, mechanism of muscle contraction, neuromuscular transmission SKELETAL SYSTEM Classification, structure and function of human skeletal system, micro anatomical and gross structure of a bone, tapes and developments of bones, movement and types of bone joints in human body

Unit 4 NERVOUS SYSTEM [15 Hrs]

NERVOUS SYSTEM Location of brain and spinal cord, structure and function of brain and spinal cord, details of central nervous system, peripheral nervous system and autonomous nervous system, structure of neuron, synapse, transmission and conduction of nerve impulse URINOGENITAL SYSTEM Structure and functions of organs of urinary system, structure and function of nephron, mechanism of urine formation, micturition, structure and function of male and female reproductive system, menstrual cycle, infertility and menopause, fertulisation and embryogenesis**.**

Course Outcome:

Upon successful completion of this course the student will be able to

- Identify microorganisms of relevance to healthcare and the pharmaceutical industry and their sources.
  Discuss Microbial contamination/product spoilage and antimicrobial preservation of pharmaceutical formulations during production and in products.
- Master various disinfection and sterilization techniques ,evaluate the sterility testing, microbial assays, pharmacopoeial standards of sterilization process
- Discuss Microbial contamination, product spoilage and antimicrobial preservation of Cosmetic products
- Grasp the mechanism of action of Non-therapeutic antimicrobial and therapeutic antimicrobial agents.
- Recognize the biochemical and genetic basis for antibiotic resistance and ways of controlling spread of antibiotic resistance.
- Demonstrate a knowledge and understanding of microbiological assays of growth promoting and growth inhibiting substances

SUGGESTED READINGS

1. S.No. Author(s) Title of the Book Publisher/Year Ross & Wilson Anatomy Anne Waugh, Allison Grant Churchill Livingstone and Physiology.
2. Principles of Anatomy & Tortora & Bryan WILEY.
3. Kathleen J.W. Wilson Anatomy and Physiology in Churchill Livingstone,
   Health and Illness New York.
4. Arthur C,Guyton and Text book of Medical Hall. Miamisburg, OH, John.E Physiology U.S.A.

University of Patanjali, Haridwar

Structure of B.Sc. Microbiology under CBCS

BSHB-CC-303-P Medical Microbiology Practical

SEMESTER – III, TOTAL HOURS: 30 CREDITS: 2

1. Demonstrate proper procedures for the collection, safe handling, and analysis of biological specimens to the satisfaction of the clinical instructor.
2. Utilize scientific principles, methods for identifying, and clinical decision making for the identification of clinically significant microorganisms.
3. Evaluate correctly laboratory test results to determine disease diagnosis.
4. Evaluate correctly acceptability of quality control and test result data
5. . Demonstrate ethical behavior and professionalism, including maintaining the confidentiality of patient information to the satisfaction of the instructor.

SUGGESTED READINGS

1. Ciulla AP, Lehman DL. Success! In Clinical Laboratory Sciences. 4th ed. Upper Saddle River, NJ: Pearson Education, Inc.; 2010. ISBN: 978-0-13-512648-6 Tanabe, Patricia A.

2. Holladay, E. Blair., eds. BOC Study Guide: Clinical Laboratory Certification Examinations. 5th ed. Chicago.

3. American Society for Clinical Pathology, 2014, c2009. Print. ISBN: 978-089189-5879

University of Patanjali, Haridwar

Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: METABOLISM (THEORY)

SUBJECT CODE: - BSCM-CC401

TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. Knowledge of the historical background for metabolism.

2. Explain the basic elements of the integration of metabolism

3. Compare and contrast the basic differences between carbohydrate, lipid and protein metabolism.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1 Concept of Metabolism [10HRS]

Experimental approaches to study metabolism; Primary and secondary metabolism

Unit 2 Major metabolic pathways [20HRS]

Basics of Carbohydrate Metabolism (I) - Glycolysis; Aerobic and Anerobic, metabolism of glycogens; glycogenesis, glycogenolysis, glyconeogenesis, Regulation of glycogen metabolism; Basics of Carbohydrate Metabolism (II) - Kreb's Cycle (T.C.A), Regulation of Blood glucose, Hexose Mono Phosphate (HMP Shunt); Basics of Lipid Metabolism - Oxidation of fatty acids, cholesterol synthesis.Correlation between carbohydrate, amino acids and fatty acid degradation.

Unit 3 Special aspects of metabolic regulation, Tissue specialization [15HRS]

Function. Intracellular communications and signal transduction mechanisms; developmental adaptations – eg: rat, C3, C4 plants; Metabolic basis of health and disorders – Jaundice – diabetes mellitus, exercise, alcohol abuse

Unit 4 Use of microbes for specific metabolic tasks [15HRS]

Alternate metabolic cycles, Carbon metabolism of intracellular bacterial pathogens; Environmental cleaning, Metabolic handling of xenobiotics and drug resistance; Photo and lithotrophic metabolic capabilities; myporia.

Course Outcome:

- The student in the course learn the biochemical aspects of metabolic pathways of microorganisms

- They also learn the application of microbial cells in bioremediation and mineral recovery

- At the end of the course, the students will be able to appreciate the aspects of microbial metabolism and their application in industries

SUGGESTED READINGS

1. H.G. Sehlegal, General Microbiology 2003, Cambridge University Press Cambridge

2. Sterier, R.Y.et AL, General Microbiology 1986, Macmillan London

3. Thomas M.Devlin, Text Book of Biochemistry with Clinical Correlations, 6th edition, 2006, Wiley-Liss 4. Peter W. Hochachka, George. N. Somero, Biochemical adaptation, Amazon Publishers BISP 302 :

BSCM CC401-P METABOLISM: INTEGRATION AND ADAPTATION – LABORATORY

1. Estimation of blood glucose – Glucose Oxidase method

2. Estimation of Cholesterol – Hyper Cholesteremia samples

3. Estimation of SGPT and SGOT 4.

Identification of organelles by marker enzymes – SDH, LDH and acid phosphatase

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Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: MOLECULAR BIOLOGY (THEORY)

SUBJECT CODE: - BSCM-CC402

TOTAL HOURS: 60 CREDITS: 4

Course Objectives

1. **Outline the structure of the biomolecules found in all living organisms.**
2. **To describe how RNA, DNA and Proteins are synthesized.**
3. **To explain the process of cell division in both somatic and germ cells.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**		**Internal Assessment (CT+TA/PR)**
70	**30**	**35**		**15**

Unit 1 Molecular Biology [15 Hrs]

General principles - bidirectional replication, Semi-conservative, discontinuous. RNA priming, various models of DNA replication. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, primase, telomerase and other accessory proteins. Denaturation and renaturation of DNA, Cot curves.

Unit 2 The mutability and Repair of DNA [10 Hrs]

Replication Errors (Transitions, transversion and thymine dimer), DNA Damage (deamination, depurination and dimerization) and their repair: mismatch repair, SOS response (recombination), Excision Repair, Photoreactivation.

Unit 3 Information Transfer –I: Mechanism of Transcription [10Hrs]

Basic transcription apparatus, Initiation, elongation and termination of transcription, Eukaryotic transcription of mRNA, tRNA and rRNA, types of RNA polymerases, transcription factors, Inhibitors of transcription- rifampicin and α-amanitin. Reverse Transcription in virus.

Unit 4 Post-Transcriptional Modifications [10 Hrs]

Split Genes, Concept of introns and exons, RNA splicing, Spliceosomes and Self splicing introns, alternative splicing and exon shuffling, mRNA transport.

Unit 5 Information Transfer-II: Mechanism of Translation[15 Hrs] Features of genetic code and exceptions in some systems, Ribosome structure- rRNA and proteins, Charging of tRNA, aminoacyl tRNA synthetases, Proteins involved in initiation (in prokaryotes and eukaryotes), elongation and termination of polypeptides, Fidelity of translation, Inhibitors of protein synthesis – tetracyclins, aminoglycosides, chloramphenicol and aminoglycosides.

Learning Outcomes:

1. Graduates will gain fundamental knowledge in Molecular Biology.
2. Graduates will be familiarizing with the contemporary research in the field of Molecular Biology.
3. Exhibit an advanced knowledge base in genetics, cell and molecular biology, and anatomy and physiology.
4. Graduates gain the applied knowledge of molecular biology for research and development.
5. Graduates will gain knowledge in molecular biology for academic and Biotech industry placement
6. Graduates will gain basic and applied knowledge to enable them for start-ups/bio entrepreneurship.

SUGGESTED READINGS

1. Molecular Biology of the Gene, 6th edition (2007), Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R; Benjamin Cummings Publishers, ISBN-13: 978- 0805395921.

2. Cell and Molecular Biology: Concepts and Experiments, 7th edition (2013), Gerald Karp. ; Wiley Publishers ISBN-13: 978-1118206737.

3. Molecular Cloning: A Laboratory Manual, 4th edition (2012), Michael R. Green and Joseph Sambrook; Cold Spring Harbor Laboratory Press, ISBN-13: 978-1936113422.

4. The World of the Cell, 7th edition (2008), Becker, Kleinsmith, Hardin and Bertoni. Benjamin Cummings, ISBN-13: 978-0805393934.

5. The Cell: A Molecular Approach, 6th edition (2013), Cooper and Hausman; Sinauer Associates, Inc. ISBN-13: 978-1605351551.

6. DNA Replication, 2nd edition (2005), Arthur Kornberg; University Science Books ISBN-13: 978-1891389443.

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Structure of B.Sc. Microbiology under CBCS

BSCM-CP-402-P Molecular Biology

TOTAL HOURS: 30 CREDITS: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Preparation of various stock solutions required for Molecular Biology Laboratory.

2. Preparation of culture medium (LB) for E. coli (both solid and liquid) and raise culture of E. coli.

3. Isolation of chromosomal DNA from bacterial cultures and visualization on Agarose Gel Electrophoresis.

4. Quantitative estimation of salmon sperm/ calf thymus DNA using colorimeter (Diphenylamine reagent) and Spectrophotometer (A260 measurement).

5. Isolation of genomic DNA from blood/ tissue.

6. Demonstration of Polymerase Chain Reaction (PCR) technique

7. Demonstration of AMES test or reverse mutation for carcinogenicity

SUGGESTED READINGS

1. Molecular Biology of the Gene, 6th edition (2007), Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R; Benjamin Cummings Publishers, ISBN-13: 978- 0805395921.

2. Cell and Molecular Biology: Concepts and Experiments, 7th edition (2013), Gerald Karp. ; Wiley Publishers ISBN-13: 978-1118206737.

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Structure of B.Sc. Microbiology under CBCS

Core Course

COURSE DETAILS

SUBJECT TITLE: SYSTEMS PHYSIOLOGY (THEORY)

SUBJECT CODE: - BSCM-CC403

SEMESTER – IV, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. **Describe metabolic reactions which occur in cells.**
2. **Compare the structure and function of organ systems in a variety of animal phyla.**
3. **Outline the steps involved in transmission of nerve impulses.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit 1: Movements and Bulk Transport [12HRS]

Cellular movements, ciliary and flagellar structure and function; Introduction to musculo skeletal system; Terrestrial, aquatic and aerial locomotion; Locomotory cost; Long distance transport of water and nutrients in plants (xylem and phloem transport) ; General plan and physiology of circulatory system in vertebrates and invertebrates

Unit 2 Gas exchange in organism; Generation and utilization of energy [15HRS]

Exchange in unicellular organisms and plants; Respiratory organs in aquatic and terrestrial systems ; Physiology of aquatic breathing and aerial breathing; Feeding patterns, digestive tract systems; Digestion of food

Unit 3 Regulatory Physiology [15HRS]

Mechanism of opening and closing of stomata. Regulation of water and solutes in aquatic and terrestrial animals; Osmo-regulatory organs. Transpiration in plants; Excretion of nitrogenous wastes in animals; Patterns of Thermoregulation: Ectotherms and Endotherms; Structural and functional adaptation to stress

Unit 4 Integrative Physiology [18HRS]

An overview of neuronal structure and function; Sensory physiology -mechano, chemo, thermo, photo and electro receptors; Endocrine systems in animals and their physiological effects; Plant hormones and their physiological effects; Regulation of metabolism and response to environmental cues.

Learning Outcomes:

1. Have an enhanced knowledge and appreciation of human physiology;

2. Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive, metabolic systems, endocrine system, skeletal system, nervous system and sense organs etc.

3. Understand how these separate systems interact to yield integrated physiological responses to challenges such as exercise, fasting and ascent to high altitude, and how they can sometimes fail;

4. Be able to perform, analyse and report on experiments and observations in physiology;

5. Be able to recognise and identify principal tissue structures.

6. Describe the structure of major human organs and explain their role in the maintenance of healthy individuals.

7. Explain the interplay between different organ systems and how organs and cells interact to maintain biological equilibria in the face of a variable and changing environment.

SYSTEMS PHYSIOLOGY BSCM CC-403-P (PRACTICALS)

TOTAL HOURS: 30 CREDITS: 2

1. Effect of isotonic, hypotonic and hypertonic salines on erythrocytes

2. Enumeration of RBC using haemocytometer

3. Estimation of total count of WBC using haemocytometer

4. Study of the effect of various environmental factors on transpiration in an excised twig/leaf

5. Calculation of the stomata index, stomatal frequency and percentage of leaf area open through stomata in a meophyte and a xerophytes

6. Study of the mechanism of stomata opening and closing

SUGGESTED READINGS

1. Knut Schmidt-Nielsen , Animal Physiology , Cambridge University Press

2. David Randall, Eckert's Animal Physiology, W.H.Freeman and Co.

3. Philips Withers; Comparative Animal Physiology. Books Cole Publishers

COURSE DETAILS

SUBJECT TITLE: Instrumentation & bio-techniques

SUBJECT CODE: - BSCM-SE-501

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The course objectives are

Students should be able to –

CO1: Discuss the applications of biophysics and principle involved in bio instruments

CO2: Describe the methodology involved in bio techniques

CO3: Describe the applications of bio instruments

CO4: Demonstrate knowledge and practical skills of using instruments in biology and medical field

CO5: Perform techniques involved in molecular biology and diagnosis of diseases

CO6: Update current knowledge regarding biomedical engineering involving new methods and the instrumentation.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 Microscopy (15hrs)

Bright field and dark field microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

Unit-2 Electrophoresis (15hrs)

Electrophoresis Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Principles and applications of paper chromatography (including Descending and 2-D), thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion-exchange chromatography and affinity chromatography, GLC, HPLC.

Unit-3 Spectrophotometry and Centrifugation (15hrs)

Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV, visible and IR range. NMR Spectroscopy, Colorimetry and turbidometry. Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

Unit 4 Contamination, preservation and spoilage (15hrs)

Contamination, preservation and spoilage of meat and meat products, eggs and poultry, fish and other sea foods: preservation by use of heat, low temperature, irradiation, drying and preservatives. Contamination, preservation and spoilage of milk and milk products, spoilage of heated canned foods: causes of spoilage, appearance of the unopened container types of biological spoilage of canned foods, miscellaneous foods: Fatty foods, essentials oils, Spices and other condiments, salt, nutmeats, other foods.

Course Outcome:

1. This skill based course will teach the students the various instrumentations that are used in the analytical laboratories.
2. This course covers both fundamental and applications of the instruments that are routinely used for the characterization of bio-molecules
3. At the end of the course, the student has the basic knowledge on the theory, operation and function of analytical instruments.

SUGGESTED READINGS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.

2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5 th Ed., W.H. Freeman and Company. 3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. λthEd., McGraw Hill.

4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.

Instrumentation & bio techniques BSCM-SE-501-P (PRACTICALS)

TOTAL HOURS: 30 CREDITS: 2

1. Study of fluorescent micrographs to visualize bacterial cells.

2. Ray diagrams of phase contrast microscopy and Electron microscopy.

3. Separation of mixtures by paper / thin layer chromatography.

4. Demonstration of column packing in any form of column chromatography.

5. Separation of protein mixtures by any form of chromatography.

6. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).

7. Determination of λmax for an unknown sample and calculation of extinction coefficient.

8. Separation of components of a given mixture using a laboratory scale centrifuge.

9. Understanding density gradient centrifugation with the help of pictures.

Reference Books:

1. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc. 5. De Robertis EDP and De Robertis EMF. (2006).
2. Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
3. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
4. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw.

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COURSE DETAILS

SUBJECT TITLE: Bioinformatics

SUBJECT CODE: - BSCM-SE-601

SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

The Biostatistics course objectives are

1. It helps learners to analyzing data from various biological experimental problems.

2. It helps to determine the appropriate sampling techniques and coordinate data collection procedures.

3. It helps to conduct statistical analyses to answer scientific questions.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 Introduction to Computer Fundamentals and Bioinformatics (20hrs)

Introduction to Computer Fundamentals and Bioinformatics and Biological Databases (20 Periods) RDBMS - Definition of relational database Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.

Unit-2 Sequence Alignments, Phylogeny and Phylogenetic trees (20 hrs)

Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices Types of phylogenetic trees, Different approaches of phylogenetic tree construction - UPGMA, Neighbour joining, Maximum Parsomony, Maximum likelihood.

Unit-3 Genome organization and analysis (10hrs)

Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes Genome, transcriptome, proteome, 2-D gel electrophoresis, Maldi Toff spectroscopy Major features of completed genomes: E.coli, S.cerevisiae, Arabidopsis, and Human.

Unit 4 C Protein Structure Predictions (10 hrs)

Hierarchy of protein structure - primary, secondary and tertiary structures, modeling Structural Classes, Motifs, Folds and Domains Protein structure prediction in presence and absence of structure template Energy minimizations and evaluation by Ramachandran plot Protein structure and rational drug design.

Course Outcome:

1. This allied paper introduces the students to concepts in bioinformatics
2. The student will be able to apply basic principles of biology, computer science and mathematics to address complex biological problems

SUGGESTED READINGS

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House.
2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications
3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition.

Bioinformatics BSCM SE-601-P (PRACTICALS)

TOTAL HOURS: 30 CREDITS: 2

1. Introduction to different operating systems - UNIX, LINUX and Windows.
2. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB.
3. Sequence retrieval using BLAST.
4. Sequence alignment & phylogenetic analysis using clustalW & phylip.
5. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, GENSCAN), Primer designing, Genscan/Genetool.
6. Protein structure prediction: primary structure analysis, secondary structure prediction using psipred,homology modeling using Swissmodel. Molecular visualization using jmol, Protein structure modelevaluation (PROCHECK).
7. Prediction of different features of a functional gene.

Suggested Readings

1. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House

2. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications

3. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition

4. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication

5. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell.

Ability Enhancement compulsory Course

University of Patanjali, Haridwar

Structure of B.Sc. Microbiology under CBCS

COURSE DETAILS

SUBJECT TITLE: Communicative English

CREDITS: 2

SUBJECT CODE: - BSCM-AE101

Course Objectives

1. To improve the fluency and confidence of the student when speaking English
2. To use English effectively for study purpose across the curriculum.

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**2**	**-**	**-**
Hrs/Week		**2**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 50				
Theory:50		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
30	**20**	**-**	**-**	

SEMESTER – I, TOTAL HOURS: 30 CREDITS: 2

Unit 1: Reading and communication Skills

An introduction to the International Phonetic Alphabet for English (Phonetic Symbols, Phonemes, Monophthongs, Diphthongs, Accent, Intonation, Sress etc)

Use of punctuations in Reading

Theory of communication

Type and modes of communication

Suggested reading & Resources for practice:

1. Oxford Advanced learner's Dictionary of Current English (Oxford University Press)
2. Oxford English-Hindi Dictionary (Oxford University Press)
3. Some Useful Mobile Dictionaries Application (Can be downloaded from Google Play Store)
4. Communication Skills – Sanjay Kumar & PushpaLata (Oxford University Press, new Delhi)
5. High School English Grammer and Composition – P. C. Wren & H. Martin (S. Chand & Company ltd. Ran Nagar, New Delhi- 110055, ISBN: 81-219-0009-3)
6. Useful You Tube Channels and Other Helpful Mobile Applications

Unit 2

Listening Skills:

To listen to the Good Speakers of English language Having Good Contents.

Resources for practices:

Useful You Tube Channels and Other Helpful Mobile Applications-

Sadhguru

BK Shivani

Unit 3

Grammar Skills

Parts of Speech

Article

Vocabulary (Synonyms & Antonyms)

The Sentence – parts, Types, Forms, Question Tag and Sentence part (Based on Structures)

5. Simple Present, past and Future Tenses (Without main Verbs-SHO i.e is, am, are, was, were, will/shall be: has/have /had/will/shall have Type. Sentences imperative Sentences, Simple Translation (Hindi to English and Vice-Versa)

Suggested Reading

Aao Saral Angrezi Seekhein Volume-1- Swami PremVivekanand ji. (Seekers Trust, Sadhana Kendra Ashram, Domet, Dehradun, Uttarakhand – 248125)

High School English Grammar and composition – P.C.Wren & H. Martin (S. Chand & Company Ltd. Ram Nagar, New Delhi -110055)

How to write correct English (Anglo-Hindi) – R. P. Sinha (Bharti Bhawan Publication. Ansari Road, Daryaganj, New Delhi 110002)

How to Translate into English –R. P. Sinha (Bharti Bhawan Publication, Ansari Road, Daryaganj, New Delhi 110002 – ISBN: 9788177091083, 8177091085)

Unit 4

Writing Skills

Short and Simple Messages

Suggested Reading

Advance writing Skills – D.S. Paul (Goodwill Publishing House, ISBN: 9788172455385, 8172455380)

Useful You Tube Channels and other Helpful Mobile Applications

Unit 5

Speaking Skills

General Conversation & Expressions used in Day-to-Day Life

Suggested reading

Conversation Skills – S.C. Gupta 9Arihant Publications pvt Ltd, meerut, ISBN: 978-81-8348-135-9)

Useful You Tube Channels and Other helpful Mobile Applications.

Course Outcome

It seeks to develop the students' abilities in grammar, oral skills, reading, writing and study skills

- Students will heighten their awareness of correct usage of English grammar in writing and speaking
- Students will improve their speaking ability in English both in terms of fluency and comprehensibility
- Students will give oral presentations and receive feedback on their performance
- Students will increase their reading speed and comprehension of academic articles

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COURSE DETAILS

SUBJECT TITLE: Environmental Science

SUBJECT CODE: - BSCM-AE-201

TOTAL HOURS: 30 CREDITS: 2

Course Objectives

1. **To understand how science and the scientific method work to address environmental problems.**
2. **The student will become familiar with environmental pollution such as Air, Water, Noise and soil and understand about global warming etc.**
3. **Students will learn about the environmental assessment, management and legislation.**

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**2**	**-**	**-**
Hrs/Week		**2**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 50				
Theory:50		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
30	**20**	**-**	**-**	

Unit 1 Introduction to Environmental Science (7hrs)

Difinitions, Principles and Scope of Environmental Science, Structure and composition of Atmosphere, Hydrosphere, lithosphere, Biosphere. Energy and environment: Fossil fuels, wind power, geothermal energy, and solar energy (solar collectors, photovoltaic modules, solar ponds). Nuclear energy, bio-energy, environmental implications of energy use: energy use pattern in india and world

Unit 2 Environmental pollution (8hrs)

Air, Water, Noise and soil Pollutants: Causes, Effects and prevention Global Warming: Impact, adaptation, vulnerability and mitigation. Kyoto protocol, World Metereological organizations (UNEP, IPCC and UNFCCC). Solid and Hazardous Waste management: Solid Waste-type and sources, Solid waste characteristics, generation rates, solid waste components, hazardus waste- Types, characteristics and health impacts, hazardous waste management.

Unit 3 Environmental Assessment, management and legislation (8hrs)

Aims and objectives of Environmental impact assessment (EIA), Environment policy (1986), Overview of Environmental laws in India, Environmental protection act (1986), national Forest Policy (1988), the plastic Waste management rule (2016), Biodiversity and climate change, national missions on climate change.

Unit 4 Current Environmental Issues in India (7hrs)

Environmental issues related to water resource project – narmada dam, Tehri dam, Almatti dam, Cauvary and Mahanadi, Carbon sequestration and carbon credits. Waste management-Swachh Bharat Abhiyan, Environmental Disasters: Minamata Disaster, Bhopal Gas Disaster (1984), Chernobyl Disaster (1986), Fukushima Daiichi nuclear disaster (2011).

Learning Outcomes:

After completing the major in Environmental Studies, students will be able to:

- Articulate the interconnected and interdisciplinary nature of environmental studies;
- Demonstrate an integrative approach to environmental issues with a focus on sustainability;
- Use critical thinking, problem-solving, and the methodological approaches of the social sciences, natural sciences, and humanities in environmental problem solving;
- Communicate complex environmental information to both technical and non-technical audiences;
- Understand and evaluate the global scale of environmental issues & problems; and
- Reflect critically on their roles, responsibilities, and identities as citizens, consumers and environmental actors in a complex, interconnected world.

Suggested Reading

1. Textbook of Environmental Studies (Universities Press India Pvt. Ltd.)Erach Bharucha.
2. Environmental Science: A global concern (McGraw-Hill Education) William P Cunninggham, Mary Ann Cunninggham.

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GENERIC ELECTIVE COURSE

COURSE DETAILS

SUBJECT TITLE: Fundamentals of Yoga and Ayurveda

SUBJECT CODE: - BSCM-GE-501

SEMESTER – IV, TOTAL HOURS: 30 CREDITS: 2

Course Objectives

Objectives

1. Give an introduction of Yoga and its important streams.
2. Give a brief history and the basis different types of Yoga.
3. Understand the concept and principle underlying the Ayurveda medicinal system
4. Have knowledge & skills of therapeutics related to Tridosha system of disease and its treatment.
5. Dietary recommendation of Ayurveda with respect to seasons, behavior and others.

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**2**	**-**	**-**
Hrs/Week		**2**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 50				
Theory:50		**Practical: NA**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
30	**20**	**-**	**-**	

Unit 1 General Introduction to Yoga [7Hrs.]

Brief introduction to origin of Yog**a** Psychological aspects leading to origin of Yoga, History and Development of Yoga; Etymology and Definitions of Yoga, Aim and Objectives of Yoga, Misconceptions about Yoga, True Nature of Yoga; General Introduction to Schools (Streams) of Yoga, Principles of Yoga and Yogic practices for healthy living, Patanjali Yoga.

Unit 2 Foundations of Yoga and Yoga Traditions [8Hrs.]

General introduction to Vedas and Upanishads, Yoga in Pre-vedic period, Yoga in Vedic period, Yoga in Ayurveda, Yoga in Principle Upanishads, Yoga in Yogopanishad; General introduction to Bhagavadgita, Yoga in Bhagavadgita; Introduction to Smritis and Yoga in Smritis, Introduction to Puranas, Nature of Yoga in BhagavatPurana ; Yoga in Yoga Vasishtha, Yoga in Narada Bhakti Sutra, Yoga in Medival Literature, Bhakti Yoga of Medival Saints, Yoga by Ramdev Ji and Parmahansa Yogananda Ji.

Unit 3 Fundamentals of Ayurveda [8 Hrs.]

Introduction of Ayurveda: Ayurveda and its Diversified Areas, AṣṭāngaĀyurveda: The Eight Branches of Āyurveda, Basic principal: Pañcamahābhūta (The Five Basic Elements), The Principle of Triḍoṣa: The Three Biological Humors, Traiyopastambha: Three Supporting Pillars of the Body, Saptadhātu: The Seven Fundamental Tissues, Ojas: The Vital Essence, Upadhātus: Sub-Tissues, Tridaṇḍa: The Three Dimensions of Life - Body, Mind (Psyche) and Soul, PañcaPañcaka: The Five Pentads, Mala: Digestion and Metabolism, Prakṛti, Srotas: Body Channels, Acharya Balkrishna and Ayurveda.

Unit 4 Anatomy & physiology and DravyagunaVigyan [7 hours]

Basic introduction to Anatomy (Sareer Rachana) and Physiology (Sareer Kriya), *Rasa*: Taste: *Rasa (*taste) and the five elements, *Rasa* and *Doṣa, Rasa* and *Dhātu, Rasa* and *Mala,* Identifying *rasa* and their *guṇa-karma* (qualities and actions), *Guṇa*: Attributes, *Vīrya*: Potency, *Vipāka*: Post-Digestive Effect, *Prabhāva*: Specific Action

Course Outcome:

1. The course will provide deeper insight into the curriculum of Yogic Sciences along with the therapeutic applications of Yoga and alternative therapies.

2. Promoting Positive Health in the Student through Yoga and enabling and imparting skill in them to practice and apply Yogic practices for Health to general public and teach Yoga for Total personality development and spiritual evolution.

Suggested Reading

1. Acharya, B. (2004). AusadhDarshan. Haridwar, India: DivyaPrakashan.
2. Acharya, B. (2005). Ayurveda Jadi-butiRahasya. Haridwar, India: DivyaPrakashan.
3. Dasgupta S. N: History of Indian Philosophy, MotilalBanarsidas, Delhi, 2012.
4. Sharma, Chandradhar: A Critical Survey of Indian Philosophy. MotilalBanarasidas, Delhi, 2013.
5. Swami SatyanandaSaraswati: Gheranda Samhita, Pub: BSY Mungher.
6. Swami Kulvyananda: Hath Pradipika, Pub: Kaivalyadhama, Lonawala.
7. Yoga Darshan: Swami Ramdeva, Pub: DivyaPrakashan, Haridwar.
8. Patanjal Yoga Darshan: Geeta Press.
9. Swami Ramdev: Shrimad Bhagavadgita: Geetamrit, Pub: DivyaPrakashan.
10. Shrimad Bhagvadgita: Geeta Press.

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DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: DRUG DISCOVERY & DEVELOPMENT (THEORY)

SUBJECT CODE: - BSCM-DS-301

TOTAL HOURS: 60 CREDITS: 6

Course Objectives:

1. To make the students understand about the basic concept of drug and its targets.

2. To understand the **Fundamentals of Physicochemical principles of drug action.**

3. To understand the **role of pharm informatics in drug discovery.**

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hrs/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 General Introduction [**20HRS]**

Definition and scope of drug design; **Drug target classification:** Proteins as drug targets: Receptors - receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverse agonist, desensitization and sensitization of receptors, affinity, efficacy and potency. Enzymes - Enzyme inhibitors (competitive, noncompetitive, suicide inhibitors), medicinal use of enzyme inhibitors. Nucleic acids as drug targets: Classes of drugs that interact with DNA: DNA intercalators and DNA alkylators.

Unit-2 Physicochemical **principles of drug action [05HRS]**

Partition coefficient, drug dissolution, acid-base properties, surface activity, bioavailablity, stereochemical aspects of drug action.

Unit-3 Drug receptor interactions [05HRS]

Kinetic analysis of ligand receptor interactions using scatchard plot, double reciprocal plot, Hill plot, forces involved, relationship between dose and effect (graded and quantal response).

Unit-4 Principles of drug design [10HRS]

Introduction to SAR, strategies in the search for new lead compounds, analogue synthesis versus rational drug design, concept of prodrugs.

Unit-5 Drug **discovery and pharma-informatics [20HRS]**

Drug discovery pipeline, drug target identification and validation for microbial pathogen, selection of gene unique to the pathogen, screening for its presence in other microbes and human host, Drug Databases, PubChem, Calculating drug-like properties, introduction to rational drug design methods, optimization of lead compounds.

Course Outcome:

1. This interdisciplinary course introduces the students with molecular dynamics, simulation, and modeling for drug discovery.
2. The outcome of the course is to train the students in use of computer aided technology to fasten the drug discovery through simulation and modeling.

SUGGESTED READINGS

1. Introduction to Medicinal Chemistry, 4th edition (2009), Graham l. Patrick, Oxford University Press. ISBN-13: 978-0199234479.

2. The Organic Chemistry of Drug Design and Drug Action, 2 nd edition (2004), Richard B. Silvermann, Elsevier, Academic Press. ISBN-13: 978-0126437324.

3. Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd edition (2005), Thomas Nogrady and Donal F. Weaver, Oxford University Press. ISBN-13: 978-0195104561.

BSHB-DS-301-P PRACTICALS

TOTAL HOURS: 30 CREDITS: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Preparation of Benzocaine,
2. Preparation of Aspirin and determination of partition coefficient in octanol-water system,
3. Preparation of Paracetamol, Preparation of Phenacetin,

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DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: Microbial Genetics (THEORY)

SUBJECT CODE: - BSCM-DS-501

TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. Apply the knowledge to understand the microbial physiology and to identify the microorganisms.

2. Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 Genome Organization and Mutations [20HRS]

Genome organization: E. coli, Saccharomyces, Tetrahymena Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes.

Unit-2 Plasmids and Phage Genetics [15 HRS]

Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 ɜ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids Features of T4 genetics , Genetic basis of lytic versus lysogenic switch of phage lambda .

Unit-3 Mechanisms of Genetic Exchange [15 HRS]

Transformation - Discovery, mechanism of natural competence Conjugation - Discovery, mechanism, Hfr and F' strains, Interrupted mating technique and time of entry mapping Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates, Mapping by recombination and co-transduction of markers.

Unit-4 Transposable elements [10HRS]

Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon Eukaryotic transposable elements - Yeast (Ty retro transposon), Drosophila (P elements), Maize (Ac/Ds) Uses of transposons and transposition .

Course Outcome:

1. Students will be taught cell division, genetic materials, their structure and types, mechanism of replication of DNA.
2. Students gain knowledge in gene concepts and genetic code, gene expression, gene regulation and also learn about mutation.
3. By the end of study in this course, the student will be able to identify and distinguish genetic regulatory mechanism at different levels

SUGGESTED READINGS

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011).
2. Concepts of Genetics, 10th Ed., Benjamin Cummings 2. Krebs J, Goldstein E, Kilpatrick S (2013).
3. Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning 3. Pierce BA (2011)
4. Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning

BSCM-DS-501-P PRACTICALS

TOTAL HOURS: 30 CREDITS: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Preparation of Master and Replica Plates
2. Study the effect of chemical (HNO2) and physical (UV) mutagens on bacterial cells
3. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
4. Isolation of Plasmid DNA from E.coli.
5. Study different conformations of plasmid DNA through Agaraose gel electrophoresis.
6. Demonstration of Bacterial Conjugation.
7. Demonstration of bacterial transformation and transduction 8. Demonstration of AMES test

SUGGESTED READINGS

1. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., and Macmillan Higher Education Learning.

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DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: Microbial Biotechnology (THEORY)

SUBJECT CODE: - BSCM-DS-502

TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. Highlight the roles and characteristics of microorganisms in field of Biotechnology
2. To impart knowledge on the basic concept of multiplication in microorganism
3. To study in detail the growth, genetic organization of microorganisms and impact of environment on their growth
4. To evaluate explicitly, the metabolic pathways, role of microbes in public health; insight into the physical and chemical control of microorganisms.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 Introduction and Historical development [15 HRS]

Introduction and Historical developments in industrial microbiology; industrially important microbes and metabolic pathways; Various Microbial metabolites and their Overproduction; Isolation and selection of industrially important microorganisms; Preservation and maintenance of microbial cultures.

Unit-2 Microbial substrates and Media formulation [15 HRS]

Microbial substrates and Media formulation; Components of microbial fermentation process; Types of fermentation processes- Solid state, Static and submerged fermentations; Design of laboratory bioreactor; Types of Bioreactor: Stirred tank reactor, bubble column etc.; Downstream processing

Unit-3 Production of Microbial Biomass [15 HRS]

Production of Microbial Biomass - Baker's Yeast, Mushroom; Production of fermented foods; Alcoholic beverages- wine, beer, etc.; Production of Ethanol, Citric acid; Amino acids and vitamins; Microbial enzymes for food, detergent and pharma industry; Biopesticides and biofertilizers

Unit-4 [15 HRS]

Production of Antibiotics; penicillin and other antibiotics; Bioweapons and Bioshields; Pigments, Microbial transformation, Production of Insulin, Interluekin, growth hormones, etc using rDNA technology.

Course Outcome:

Upon successful completion of this course students will be able to:

- Demonstrate how microbiology is applied to manufacturing in the pharmaceutical industry.
- Explain the importance of patents for commercial development of a microbial bioprocess; the impact of GMO versus non-GMO organism in processes, the pathway of biologics development.
- Explain the advantages and disadvantages of production of peptides, proteins, glycoproteins, in Gram negative, Gram positive, yeast expression systems.
- Know the production methods for pharmaceuticals of microbial origin such as Antibiotics and vaccines.
- Know microbe DNA structurally and genetically.
- Understanding of mutagenesis and gene expression in microbes.

SUGGESTED READINGS

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011).
2. Concepts of Genetics, 10th Ed., Benjamin Cummings 2. Krebs J, Goldstein E, Kilpatrick S (2013).
3. Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning 3. Pierce BA (2011)
4. Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning

BSCM-DS-502-P PRACTICALS

TOTAL HOURS: 30 CREDITS: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1.Preparation of Master and Replica Plates
2.Study the effect of chemical (HNO2) and physical (UV) mutagens on bacterial cells
3.Study survival curve of bacteria after exposure to ultraviolet (UV) light.
4.Isolation of Plasmid DNA from *E.coli*.
5.Study different conformations of plasmid DNA through Agaraose gel electrophoresis.
6.Demonstration of Bacterial Conjugation.
7.Demonstration of bacterial transformation and transduction 8. Demonstration of AMES test

SUGGESTED READINGS

1.Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., and Macmillan Higher Education Learning.

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DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: Microbes in Sustainable Agriculture (THEORY)

SUBJECT CODE: - BSCM-DS-601

TOTAL HOURS: 30 CREDITS: 6

Course Objectives:

By the end of this course, students should successfully be able to:

1. Understand what is meant by "sustainable" agriculture and apply this description to crop and livestock production systems.

2. Identify appropriate cultural practices to enhance biodiversity on the farm, increase soil organic matter, and limit negative environmental impacts from crop and livestock production.

3. Incorporate and quantify ecosystem services at work in production systems.

4. Describe resources for and constraints on contemporary farm production systems (ecological, social, and economic)

5. Outline the social, economic and political forces that have shaped and can shape sustainable agriculture and food systems

6. Describe the ethical constraints on food system development and sociocultural wellbeing.

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**4**	**2**	**-**
Hts/Week		**4**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
70	**30**	**35**	**15**	

Unit-1 Concept of organic farming[15 HRS]

1. Introduction: Farming, organic farming, concept and development of organic farming. 2. Principles of organic farming 3. Types of organic farming 4. Biodynamic farming 5. Benefits of organic farming. 6. Need for organic farming Page 4 of 8 7. Conventional farming v/s organic farming 8. Scope of organic farming; Kerala, national and international status 9. Agencies and institutions related to organic agriculture 10. Requirements for organic farming 11. Farm components for an organic farming.

Unit-2 Organic plant nutrient management [15 HRS]

1. Organic farming systems 2. Soil tillage 3. Land preparation and mulching 4. Choice of varieties 5. Propagation-seed, planting materials and seed treatments. 6. Water management 7. Green manuring 8.

Composting- principles, stages, types and factors 9. Composting methods 10. Vermicomposting 11. Bulky organic manures 12. Concentrated organic manures 13. Organic preparations 14. Organic amendments and sludges, biogas 15. Bio-fertilizers- 21 types 16. Bio-fertilizers-methods of application, advantages and disadvantages 17. Standards for organic inputs- fertilizers

Unit-3 Organic plant protection [15 HRS]

1. Plant protection- cultural 2. Plant protection - mechanical 3. Plant protection- botanical pesticides I 4. Plant protection- botanical pesticides II 5. Plant protection- botanical pesticides III 6. Plant protection- bio pesticide 7. Plant protection- bio control agents 8. Plant protection bio control agents 9. Weed management 10. Weed management 11. Standards for organic inputs- plant protection.

Unit-4 Organic Certification [15HRS]

Farm economy: Basic concept of economics- Demand, supply 2. Economic Viability of a farm. 3. Basic production principles 4. Reducing expenses, ways to increase returns, 5. Cost of production system. Benefit/ cost ratio. 6. Marketing, Imports and exports 7. Policies and incentives of organic production. 8. Farm inspection and certification: I 9. Farm inspection and certification: II 10. Conversion to organic farming, Process 11. Income generation activities: Apiculture, Mushroom production, Terrace farming

SUGGESTED READINGS

1. Lampkin, N (1990) Organic Farming. Farming Press, Ipswich (ISBN 0 85236 191 2)

2. Lampkin, N & Measures, M (2004) 2004 Organic Farm Management Handbook. Organic Farming Research Unit, Aberystwyth (ISSN 1354 3768) & Organic Advisory Service, Berkshire (ISBN 1 872 064 388) Y

3. Younie, D & Wilkinson, J. M (eds) (2001) Organic Livestock Farming. Chalcombe Publications, Lincoln (ISBN 0 948617 45 4)

4. Younie, D., Taylor, B. R., Welsh, J. P & Wilkinson, J. M (eds) (2002) Organic Cereals and Pulses. Chalcombe Publications, Lincoln

5. Bavec, F. and Bavec, M. (2007). Organic Production and Use of Alternative Crops.CRC Press, Boca Raton, FL.

BSCM-DS-601-P PRACTICALS

TOTAL HOURS: 30 CREDITS: 2

(Wherever wet lab experiments are not possible the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

List of practical's:

1. Preparation of enrich compost

2. Vermicomposting Preparation

3. Bio-fertilizers/bio-inoculants and their quality analysis

4. Indigenous technology knowledge (ITK) for nutrient

5. Insect, pest disease and weed management

6. Cost of organic production system

7. Post-harvest management

8. Quality aspect, grading, packaging and handling.

9. Visit to organic farms to study the various components and their utilization

10. Laboratory Note Book

11. Internal Assessment

SUGGESTED READINGS

1. Bavec, F. and Bavec, M. (2007). Organic Production and Use of Alternative Crops.CRC Press, Boca Raton, FL. 2. Kristensen, P., Taji, A. and Reganold, J. (2006). Organic Agriculture: A Global Perspective.CSIRO Press, Victoria, Australia.

3. Organic Farming Web Sites Organisation IRL address Scottish Agricultural College (SAC) http://www.sac.ac.uk/organic-farming Scottish Organic Producers Association

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DISCIPLINE SPECIFIC SUBJECT

COURSE DETAILS

SUBJECT TITLE: Dissertation

SUBJECT CODE: - BSCM-DS-602

TOTAL HOURS: 60 CREDITS: 6

Dissertation.

Course Objective:

This course is focused to facilitate student to carry out basic research and development project through problem and gap identification, development of methodology for problem solving, interpretation of findings, presentation of results and discussion of findings. The overall goal of the dissertation is for the student to display the knowledge and capability required for independent research work.

Credits	**6**		
SCHEME OF EXAMINATION			
Total marks: 150			

Course Outcome:

The student will be able to

• gain in-depth knowledge and use adequate methods in the major subject/field of study.

• create, analyze and critically evaluate different research solutions

• clearly present and discuss the conclusions as well as the knowledge and arguments that form the basis for these findings

• identify the issues that must be addressed within the framework of the specific dissertation in order to take into consideration