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

**University of Patanjali, Haridwar**

**University of Patanjali, Haridwar**

**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 prospect of the molecules.**
3) **Help to understand the biomolecules and their role in human life.**
4) **To understand the basic concept of medicinal chemistry and drug targets.**

| **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]**

Lattice energy and solvation energy. Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, Covalent Bonding: VB Approach,Lewis theory, VSEPR theory to explain the shapes of molecules, salient features of the Valence bond (VB) theory and the 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, nonbonding combinations of orbitals MO treatment of homonuclear diatomic molecules of 1st period and heteronuclear diatomic molecules such as CO, HF.

**Unit 2 Chemical Thermodynamics [15 hrs]**

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

**Unit 3 Fundamentals of Organic Chemistry [10 hrs]**

Hybridization in organic compounds, cleavage of covalent bond, hemolysis, and heterolysis, Electronic effects: Electronic effects and their applications – inductive, resonance and hyperconjugation effects. Structure and relative stability of reactive carbon species – carbocations, carbanions, free radicals and carbenes, Molecular Force: types of intermolecular and intra-molecular forces and their characteristic : dipole-dipole, dipole induced dipole and dispersion (London) forces. Hydrogen bond (both intramolecular and intermolecular), Effect of inter/intramolecular forces on physical properties such as solubility, vapour pressure, melting and boiling points of different compounds, Aromaticity.

**Unit 4 Stereochemistry [10 hrs]**

Stereochemistry and its importance. Geometrical isomerism, cis-trans and E/Z nomenclature Optical isomerism – optical activity, plane polarized light, enantiomerism, chirality, specific molar rotation, Stereoisomerism with two chiral centers: Diastereomers, mesoisomers, Resolution of racemic modification. Projection diagrams of stereoisomers: Fischer, Newman and Sawhorse projections.

**Unit 5 Biomolecules & Medicinal chemistry [10 hrs]**

Biomolecules: Definition and classification and function of lipids, Carbohydrates, proteins and vitamin. Nucleic acids: Role of nucleic acids in living system. Composition of nucleic acids- the purine and pyrimidine bases. Structure of nucleosides and nucleotide, deoxynucleotides, cyclic nucleotides and polynucleotides.

Introduction to Medicinal Chemistry. Basic idea of drug targets like protein and nucleic acids.

**Course Outcomes**

Upon completion of the course the student should develop the understandings of:

**CO1.** Get an understanding of the theoretical principles of chemistry of molecular structure, bonding and properties of chemical substances and structure and function of bio- inorganic molecules

**CO2.** Get understand 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

**CO3.** 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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**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** | **-** |
| **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: The Cell [10 hrs]**

Historical background, significant landmarks, cell theory, structure of prokaryotic and eukaryotic cells, mycoplasma, viruses, viroids, prions. Cell Organelles: Structure and functions of various organelles.

**Unit II: Cell Fractionation [10 hrs]**

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

**Unit III: 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 VII: Cytoskeletal Elements [05 hrs]**

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

**Unit VIII: 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

**CO1.** At the end of the course, the student has a strong found at 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.

**CO2.** The student understands 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

**CO**3. He understands 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.

**Ability Enhancement compulsory Course**

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**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: Communicative English**

**SUBJECT CODE: - BSHB-AE103**

**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** | | **-** | **-** | **-** |
| **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)** | |
| **35** | **15** | **-** | **-** | |

**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

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

**CO1**. Students will heighten their awareness of correct usage of English grammar in writing and speaking

**CO2**. Students will improve their speaking ability in English both in terms of fluency and comprehensibility

**CO3.** Students will give oral presentations and receive feedback on their performance

**CO4.** Students will increase their reading speed and comprehension of academic articles

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**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: Biostatistics**

**SUBJECT CODE: - BSHB-SE104**

**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.**

<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>-</td><td>-</td></tr>
<tr><td colspan="2">Hts/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 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:

**CO1**.This course imparts the knowledge of basic statistical methods to solve problems and students are taught to operate various statistical software packages

**CO2**. 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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**BSHB-CP105 CHEMISTRY (PRACTICALS) SEMESTER - I**

**TOTAL HOURS: 30 CREDIT: 2**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture

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

3. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator

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

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

6. Determination of melting and boiling points of organic compounds

7. Separation of mixures 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.

## 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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**BSHB-CP106 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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**Core Course**

**COURSE DETAILS, SEMESTER – II,**

**SUBJECT TITLE: BIOPHYSICS (THEORY)**

**SUBJECT CODE: - BSHB-CC201**

**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. **It gives the ideas of instrumentation to understand living things.**
3. **Biophysics helps to understand the various laws & principles used for biological system.**

<table>
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<tr><td colspan="2">Credits</td><td>4</td><td>2</td><td>-</td></tr>
<tr><td colspan="2">Hts/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: Mechanics [14 Hrs]**

Conservation of momentum and energy, work energy theorem. Conservation of angular momentum, torque, Motion of a particle in central force field. Kepler's Laws, Physiological effects of acceleration and angular motion.

**Unit 2: Waves and Oscillations [12 Hrs]**

Simple harmonic motion, damped and driven harmonic oscillator, coupled oscillator, energy relation and energy transfer, normal modes, Wave equation, Travelling waves, superposition principle, pulses, Doppler effect, effects of vibrations in humans, physics of hearing, heartbeat.

**Unit: 3 Biological membranes [16 Hrs]**

Colloidal solution, Micelles, reverse micelles, bilayers, liposomes, phase transitions of lipids, active, passive and facilitated transport of solutes and ions, Fick's Laws, Nernst Planck Equations, Diffusion, Osmosis,

**Unit 4: Spectroscopic techniques [18 Hrs]**

Basic principles of absorption and emission spectra. Beer-Lambert law, light absorption and its transmittance. UV and visible spectrophotometry-principles, instrumentation and applications of fluorescence spectroscopy.

## Course Outcome

**CO1.** Examine biophysical scenarios using a conceptual understanding of the core concepts of biology, chemistry, and physics

**CO2.** Effectively communicate biophysics content through both written reports and oral presentation

**CO3.** 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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**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: BIODIVERSITY (THEORY)**

**SUBJECT CODE: - BSHB-CC202**

**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** | **-** |
| **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 Defining Biodiversity [15 hrs]**

Components of Biodiversity. Biodiversity crisis and biodiversity loss. Importance of biodiversity in daily life. Biodiversity and climate change. 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.

**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; Germplasm banks, National Parks, Botanical Gardens; Wildlife Sanctuaries, Bioresources.

**Unit 3 Crop Diversity [15 hrs]**

Wild relatives of cultivated plant; Domesticated diversity; Spice diversity; Forest diversity and wild life.

**Unit 4 Bio-prospecting [15 hrs]**

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

**Course Outcomes:**

**CO1.** 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.
**CO2.** Students will discover that life can be found almost everywhere on earth.
**CO3**. Students will identify floral and faunal species in its surrounding with their status.
**CO4**. Inputs of conservation steps according to the status of degradation in surrounding.
**CO5.** 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**

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: Environmental Science**

**SUBJECT CODE: - BSHB-AE203**

**SEMESTER – II, 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** | | **-** | **-** | **-** |
| **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)** |
| **35** | **15** | **-** | | **-** |

**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: SolidWaste-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).

**Course Outcomes:**
After completing the major in Environmental Studies, students will be able to:
**CO1.** Articulate the interconnected and interdisciplinary nature of environmental studies;
**CO2.** Demonstrate an integrative approach to environmental issues with a focus on sustainability;
**CO3.** Use critical thinking, problem-solving, and the methodological approaches of the social sciences, natural sciences, and humanities in environmental problem solving;
**CO4.** Communicate complex environmental information to both technical and non-technical audiences;
**CO5.** Understand and evaluate the global scale of environmental issues & problems; and
**CO6.** 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**

**COURSE DETAILS**

**SUBJECT TITLE: RECOMBINANT DNA TECHNOLOGY**

**SUBJECT CODE: - BSHB-SE204**

**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. : 60</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">Hts/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:

**CO1.**This course teaches RDNA techniques and their application in the field of genetic engineering

**CO2.**They learn about plasmids, vectors and gain knowledge on the construction of cDNA libraries

**CO3.**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).

**University of Patanjali, Haridwar**

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

**Core Course BSHB-CP-205 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 absorption spectra of proteins.

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

**BSHB-CP-206 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.

**University of Patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: MICROBIOLOGY (THEORY)**

**SUBJECT CODE: - BSHB-CC301**

**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** | **-** |
| **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 [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:

**CO1.** Students will gain knowledge about the different cell organelles of microorganisms and their detailed functions

**CO2.** Students will also study the growth and control of microbes as well as different bacteriological techniques involved in microbiology.

**CO3.** Know about the microorganism and pathogenicity.

**SUGGESTED READINGS**

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

2. Tortora, G.J., Funke, B.R. and Case, C.L. (2008) Microbiology: An Introduction. 9thedition. 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**

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: BIOCHEMISTRY (THEORY)**

**SUBJECT CODE: - BSHB-CC302**

**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** | **-** |
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| **SCHEME OF EXAMINATION** | | | | |
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**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, classification and bio-chemical structure of immunoglobulins with functions; Fundamentals of Bio-Energetics: Biological Oxidation, General Concept of oxidation, features of cellular Oxidation,-respiratory chain oxidative phosphorylation.

**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 nomenclature of Enzymes, basic introduction to Enzymology and regulation of Enzymatic activity. Structure of DNA, RNA, nucleic 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.

**Course Outcomes:**

**CO1.** Disciplinary knowledge and understanding of biochemistry, structure and function of biological molecules.

**CO2.** Explain biological mechanisms, such as the processes and control of bioenergetics and metabolism.

**CO3.** Fundamental properties of elements, their role in formation of biomolecules and in chemical reactions within living organisms.

**CO4.** Demonstrate an understanding of the principles, and have practical experience of, a wide range of biochemical techniques.

**CO5.** Analyze 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,

**University of Patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: ECOLOGY (THEORY)**

**SUBJECT CODE: - BSHB-CC 303**

**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**

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## 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.

## Unit 2: Ecosystem [15 Hrs]

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

**Unit 3 Pollution [15 Hrs]**

Pollution of Soil, water, air (types of pollutants and sources), noise pollution, radiation pollution, remedial measures, bio amplification Disaster management: Types ofdisasters & Management strategy

**Unit 4 Behavioral ecology [15 Hrs]**

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

**Course Outcomes:**

**CO1.** Understand the concepts and principles of Ecology
**CO2.** Be aware of the suitable use of field techniques, data collection, mapping, analysis and interpretation.
**CO3.** The student should understand the ecology and the role of human beings in shaping the ecosystem.
**CO4.** Understand various components of the ecology and interfaces.
**CO5.** Ability to understand the various ecosystem services and their role in sustaining the environment.

**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**

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: CONCEPT IN DRUG DISCOVERY & DEVELOPMENT (THEORY)**

**SUBJECT CODE: - BSHB-DC 304**

**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.**

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**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, protein 3D structure and binding site analysis, similarity based virtual screening using online tools.

## Course Outcome:

**CO1.** Critically evaluate the drug discovery process.

**CO2.** Understand the role of bioinformatics and genomics in the drug discovery process.
**CO3.** Discuss and place into context the use of high-throughput-screening in the drug discovery process.
**CO4.** Understand the importance of pharmacology in the drug discovery process.

**University of Patanjali, Haridwar**

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

**BSHB-CP-305 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 sub culturing- 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**

**BSHB-CP306 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. (Hons) Biological Science under CBCS**

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: MOLECULAR BIOLOGY (THEORY)**

**SUBJECT CODE: - BSHB-CC401**

**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** | **-** |
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| **SCHEME OF EXAMINATION** | | | | |
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| **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 – tetracycline, aminoglycosides, chloramphenicol and aminoglycosides.

**Course Outcomes:**

**CO1.** Exhibit an advanced knowledge base in genetics, cell and molecular biology, and anatomy and physiology.
**CO2.** Graduates gain the applied knowledge of molecular biology for research and development.
**CO3.** Graduates will gain knowledge in molecular biology for academic and Biotech industry placement
**CO4.** 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.

**University of Patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: SYSTEMS PHYSIOLOGY (THEORY)**

**SUBJECT CODE: - BSHB-CC402**

**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; 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.

**Course Outcomes:**

**CO1**.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.

**CO2.** 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;

**CO3.** Be able to perform, analyses and report on experiments and observations in physiology;

**CO4.** Describe the structure of major human organs and explain their role in the maintenance of healthy individuals.

**University of patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: METABOLISM AND INTEGRATION (THEORY)**

**SUBJECT CODE: - BSHB-CC403**

**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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**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; myopia.

## Course Outcome:

**CO1.** Understand the concepts of metabolism and their process.

**CO2.** Illustrate the metabolism of carbohydrates through various anabolic and catabolic pathways like glycolysis, Kreb's cycle, Glycogen metabolism, glucuronic acid cycle etc.

**CO3.**Understand the regulation of glycolysis and TCA cycle.

**University of patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: BIOMATERIAL & NANOSCIENCE (THEORY)**

**SUBJECT CODE: - BSHB-DC404**

**SEMESTER – IV, 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** | **-** |
| **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 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 froma 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.

**Course Outcome:**

After completion of the course, the students are able to

**CO1**. Understanding about biomaterials and their uses.

**CO2.** How to biomaterials use in medical domain.

**CO3.** formation of biomaterials for specific uses.

**CO4.** Analysis of biochemical and biophysical study of biomaterials.

**University of Patanjali, Haridwar**

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

**BSHB-CP-405 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.

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.

**SYSTEMS PHYSIOLOGY BSHB CP406 (PRACTICALS)**

**TOTAL HOURS: 30 CREDITS: 2**

1. Effect of isotonic, hypotonic and hypertonic saline's on erythrocytes

2. Enumeration of RBC using hemocytometer

3. Estimation of total count of WBC using hemocytometer

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 xerophyte

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

**BSHB CP407 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

**University of Patanjali, Haridwar**

**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.**

| **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 : 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:

**CO1.** Revising the Mendelian Genetics and molecular basis of heredity.

**CO2.** Applying the gene transformation in recombination.

**CO3.** Analyzing the types gene mutation and causes on genetic disorders.

**CO4.** Revising the Mendelian Genetics and molecular basis of heredity.

**University of Patanjali, Haridwar**

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

**Core Course**

**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** | **-** |
| **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 [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.

## Course Outcome:

**CO1**. To have in depth insight in basic brain structure and function reaching from the molecular to systems level.

**CO2.** To understand how neural systems contribute to sensory experiences, thoughts, emotions, behavior.

**CO3.** To apply and adopt experimental methods to gain new knowledge.

**CO4.** To formulate a research question based on adequate insight into current knowledge.

**University of patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY (THEORY)**

**SUBJECT CODE: - BSHB-DC503**

**SEMESTER – V, TOTAL HOURS: 60 CREDITS: 4**

**Course Objectives:**

**1. To make the students knowledgeable with respect to the subject and its practicable applicability.**

***2.*** **To expose the students to various emerging areas of *Industrial Microbiology***

| **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]**

Scope of microbes in industry and environment; Bioreactors/Fermenters and fermentation processes: Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuousfermentations. Components of a typical bioreactor, Types of bioreactors-laboratory, pilotscale and production fermenters; Constantly stirred tank fermenter, tower fermenter, fixed

bed and fluidized bed bioreactors and air-lift fermenter. A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations.

**Unit 2 [15 HRS]**

Microbial production of industrial products: Microorganisms involved, media, fermentation conditions, downstream processing and uses;Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration,lyophilization, spray drying; Hands on microbial fermentations for the production and estimation (qualitative and quantitative) of Enzyme: amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin)

**Unit 3 [10HRS]**

Microbial enzymes of industrial interest and enzyme immobilization: Microorganisms for industrial applications_and hands on screening microorganisms for caseinhydrolysis; starch hydrolysis; cellulose hydrolysis. Methods of immobilization, advantages andapplications of immobilization, large scale applications of immobilized enzymes (glucoseisomerase and penicillin acylase).

**Unit 4 [05HRS]**

Microbes and quality of environment: Distribution of microbes in air; Isolation of microorganisms from soil, air and water.

**Unit 5 [10HRS]**

Microbial flora of water: Water pollution, role of microbes in sewage and domestic waste water treatment systems. Determination of BOD, COD, TDS and TOC of water samples; Microorganisms as indicators of water quality, check coliform and fecal coliform in water samples.

**Unit 6 [05HRS]**

Microbes in agriculture and remediation of contaminated soils: Biological fixation; Mycorrhizae; Bioremediation of contaminated soils. Isolation of root modulating bacteria, arbuscular mycorrhizal colonization in plant roots.

**Course Outcome:**

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

**CO1.** Identify the main concepts of microbial ecology

**CO2.** List the positive and negative roles of microorganisms in the environment.

**CO3**. list the general characteristics of the different environments

**CO4.** Describe the effect of general characteristics of the different environments of its microflora.

**University of Patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: Fundamentals of Yoga and Ayurveda**

**SUBJECT CODE: - BSHB-AE504**

**SEMESTER – V, TOTAL HOURS: 30 CREDITS: 2**

**Course 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** | | - | - | - |
| **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)** | |
| **35** | **15** | - | - | |

**Unit 1 General Introduction to Yoga [7Hrs.]**

Brief introduction to origin of Yog**a** Psychological aspects leading to origin of Yoga, Historyand 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.

**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

**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) andSoul, PañcaPañcaka: The Five Pentads, Mala: Digestion and Metabolism, Prakṛti, Srotas: Body Channels

**Unit 4 Anatomy & physiology and DravyagunaVigyan [7 hours]**

Basic introduction to Anatomy (SareerRachana) and Physiology (SareerKriya), *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:**

**CO1**. The course will provide deeper insight into the curriculum of Yogic Sciences along with the therapeutic applications of Yoga and alternative therapies.
**CO 2.** At the Master level it is also intended that students should get familiar with the original texts of Yoga.
**CO 3.** 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). Ausadh Darshan. Haridwar, India: DivyaPrakashan.
2. Acharya, B. (2005). Ayurveda Jadi-buti Rahasya. Haridwar, India: Divya Prakashan.
3. Dasgupta S. N: History of Indian Philosophy, Motilal Banarsidas, 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.

**BSHB-CP505 GENETICS (PRACTICALS)**

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.

**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-CP506 NEROBIOLOGY (PRACTICALS)

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

## SUGGESTED READINGS

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

**University of patanjali, Haridwar**

**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.**

<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">Hts/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: 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:

**CO1.** Gain conceptual understanding of evidences, theories and mechanisms of evolution

**CO2.** Explain the evolutionary history of man

**CO3.** Obtain comprehensive knowledge of comparative anatomy of chordates and to recognize their evolutionary trends

**University of Patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: DEVELOPMENTAL BIOLOGY AND PHYSIOLOGY-PLANTS (THEORY)**

**SUBJECT CODE: - BSHB-CC602**

**SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4**

**Course Objectives:**

1. **Name, describe and order the main stages of development common to most multicellular organisms.**
2. **Describe the main anatomical changes that occur during development.**
3. **Identify the cellular behaviors that lead to morphological change during development.**

| **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.Developmental Biology [05 HRS]**

Introduction and scope

**Unit 2. Structural organization of flower [10 HRS]**

Initiation and differentiation of floral organs; structure and development of anther, microsporogenesis, structure and types of ovule, megasporogenesis, types of embryo sacs

**Unit 3. Fertilization: [05 HRS]**

Pollination, pollen-pistil interaction; double fertilization.

**Unit 4. Plant water relationship [10HRS]**

Significance of water, water potential, water absorption and transport, transpiration, mechanism of opening and closing of stomata.

**Unit 5. Mineral nutrition [05 HRS]**
essential elements, micro and macronutrients, soil factors affecting their availability, physiological basis of deficiency, symptoms, ion uptake and role of mycorrhiza. (

**Unit 6.Role of growth regulators [10HRS]**
auxin, gibberellins, cytokinins, ABA, ethylene, Brassinosteroids and Jasmonates; signal transduction (overview).

**Unit 7. Photosynthesis [10HRS]**
brief history, pigments, mechanism of light absorption and energy transfer, PSI & PSII e-transport, ATP synthesis C3 C4 & CAM Photorespiration. (Ch 7,8,9,10 Hopkins & Huner) (10 Periods)

**Unit 8. Solute transport: [05HRS]**
Transport of inorganic and organic components, transport pathways-xylem and phloem.

**Course Outcome:**
CO1. Acquire knowledge in various physiological processes occur in plants.

CO2. The basic knowledge of plant development process

CO3. Relationship of plant and their environments.

CO4. Plant anatomical changes and their behaviour in response to environment.

**University of patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: ENDOCRINOLOGY (THEORY)**

**SUBJECT CODE: - BSHB-DC603**

**SEMESTER – VI, 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.**

<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">Hts/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: Introduction [8HRS]**

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 Unit 7: Gastrointestinal hormones No. of Hours:
**Unit 5:** A brief account of hormones of gastrointestinal tract and kidney.

## Course Outcome:

After the course the student should be able to comprehend: -
CO1. Biosynthesis & Receptor mechanism of Hormones and its Disorders
CO2. Reproductive cycle of Vertebrate, Mensuration cycle, Lactation, Pregnancy, and mechanism of Parturition.
CO3. Hormonal regulation of gametogenesis
CO4. Hormone & Behavior.
CO5. The physiology changes upon change in hormone.

**University of Patanjali, Haridwar**

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

**Core Course**

**COURSE DETAILS**

**SUBJECT TITLE: Human Values and Ethics**

**SUBJECT CODE: - BSHB-AE604**

**SEMESTER – VI, TOTAL HOURS: 30 CREDITS: 2**

**Course Objectives**

1. **A value system is a set of consistent values and measures. Knowledge of the values will be inculcated through education.**
2. **It contributes in forming true human being, who will be able to face life and make it meaningful. There are different kinds of values like, ethical or moral values, doctrinal or ideological values, social values and aesthetic values.**

| **Total Number of Hrs. : 30** | | **Theory** | **Practical** | **Tutorial** |
|---|---|---|---|---|
| **Credits** | | **-** | **-** | **-** |
| **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)** |
| **35** | **15** | **-** | | **-** |

**Unit 1 Definition of Ethics & Development of Morality (8hrs)**
Character and conduct; Relation of Ethics with Psychology, Sociology and Politics.
The level of instinct -the level of custom -the level of conscience. Relative, Subjective and Naturalistic theories of the Moral standard -absolute and relative ethics-the standard as subjective -non-subjective naturalism-the naturalistic fallacy.Ethics for Teachers and Students. Problems of Students and solutions

**Unit 2 The Nature and Scope of Applied Ethics. (7hrs)**

Physical and mental health: The importance and cultivation of physical and mental health. Alcoholic and other narcotic drugs -Their Impact on physical and mental health. Use and abuse of medicines Medicines Vs Nature Cure.

**Unit 3 Human Values (8hrs)**
Value education-its purpose and significance in the present world –Value system –The role of culture and civilization-Holistic living –Balancing the outer and inner –Body, Mind and Intellectual level-Duties and responsibilities.

**Unit 4 Salient values for life (7hrs)**
Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, and inclusiveness, Self-esteem and self-confidence, punctuality –Time, task and resource management –Problem solving and decision making skills-Interpersonal and Intra personal relationship –Team work –Positive and creative thinking.

## Course Outcome

After completion of this course, students will be able to:
**CO1:** Understand and analyse the essentials of human values and skills, self-exploration, happiness and prosperity.
**CO2:** Evaluate coexistence of the "I" with the body.
**CO3:** Identify and evaluate the role of harmony in family, society and universal order.
**CO4:** Understand and associate the holistic perception of harmony at all levels of existence.
**CO5:** Develop appropriate technologies and management patterns to create harmony in professional and personal lives.

**Suggested Reading**


1. Herald H. Titus Ethics for Today, Eurasia Publishing House private Ltd., Ram Nagar, New Delhi.
2. Peter singer, Practical Ethics.
3. An Introduction to Applied Ethics, (Ed.,) John H. Piet and Ayodhya Prasad, Cosmo Publications.
4. M.G.Chitakra: Education and Human Values,A.P.H.Publishing Corporation, New Delhi, 2003.
5. Chakravarthy, S.K.: Values and ethics for Organizations:Theory and Practice, Oxford University Press, NewDelhi, 1999.
6. Satchidananda, M.K.: Ethics, Education, Indian Unityand Culture, Ajantha Publications, Delhi, 1991.
7. Ruhela, S.P. : Human Values and education, SterlingPublications, New Delhi, 1986.
8. Kaul, G.N.: Values and Education in Independent Indian,Associated Publishers, Mumbai, 1975.
9. NCERT, Education in Values, New Delhi, 1992.

## BSHB-CP 605 BIOLOGY OF EVOLUTION (PRACTICALS)

(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),

## SUGGESTEDREADINGS

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-CP606 DEVELOPMENTAL BIOLOGY AND PHYSIOLOGY-PLANT PRACTICALS**

1. Structure of young anther wall, microsporogenesis, mature anther (permanent slides).

2. Study of monoscope (Polygonum) type of embryo sac development (permanent slides/photographs).

4.Determination of stomatal index of leaf of the given plant material.

5.Determination of stomatal frequency of the leaf of given plant material.

6. Determination of a effect of an environmental factor on the rate of transpiration by an excised twig using photometer.

7. Study the effect of $CO_2$ concentration on the rate of photosynthesis.

8.Study the effect of light intensity on the rate of photosynthesis.

**SUGGESTED BOOKS**

1. Hopkins WG & Huner PA (2009) 4th edn. Introduction to Plant Physiology. John Wiley and Sons
2. Dickinson WC (2000) Integrative Plant Anataomy, Harcourt Academic Press, USA
3.Raghavan V (2000) Developmental Biology of Flowering Plants, Springer-Verlag, New York
4. Bhojwani, S.S. & Bhatnagar, S.P. (1999), Embryology of Angiosperms, 4th edn. Vikas Pub. House Pvt. Ltd., New Delhi
5. Raven P.H., Evert R.F. and Eichhorn S.E. (2005), Biology of Plants, 7th edn., W.H. Freeman Company Publishers

**BSHB-DCP607 ENDOCRINOLGY (PRACTICALS)**

**TOTAL HOURS: 30 CREDITS: 2**

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

2. Estrous cycle of rat. - Vaginal smear

3. Compensatory ovarian hypertrophy or adrenal hypertrophy

4. Castration/ ovariectomy

**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).