Bachelor of Technology (Biotechnology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – III (w.e.f. the session 2019-20)

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours/Week		Major Test	Minor Test	Practical	Total	
1	BTE-201	Cell Biology & Genetics	3	0	0	3	3.0	75	25	0	100	3
2	BTE-203	Microbiology	3	0	0	3	3.0	75	25	0	100	3
3	BTE-205	Biochemistry	3	0	0	3	3.0	75	25	0	100	3
4	BTE-207	Principles of Biostatistics	3	0	0	3	3.0	75	25	0	100	3
5	HM-901	Organizational Behavior	3	0	0	3	3.0	75	25	0	100	3
6	BTE-209L	Cell Biology & Genetics Lab	0	0	3	3	1.5	0	40	60	100	3
7	BTE-211L	Microbiology Lab	0	0	3	3	1.5	0	40	60	100	3
8	BTE-213L	Biochemistry Lab	0	0	3	3	1.5	0	40	60	100	3
		Total	**15**	**0**	**9**	**24**	**19.5**	**375**	**245**	**180**	**800**	
9	BTE-215	Industrial Training-I	2	0	0	2	-	-	100	-	100	-
10	*MC-902	Constitution of India	3	0	0	3		75	25	0	100	3

Note: BTE-215 is a mandatory credit less course in which the students to be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

***MC-902** is a mandatory credit less course in which the student will be required to get passing marks in the major test

Bachelor of Technology (Biotechnology)
Credit-Based
SCHEME OF STUDIES/EXAMINATIONS
Semester – IV (w.e.f. the session 2019-20)

S. No.	Course No.	Course Title	Teaching Schedule				Credits	Allotment of Marks				Duration of Exam (Hrs.)
			L	T	P	Hours /Week		Major Test	Minor Test	Practical	Total	
1	BTE-202	Molecular Biology	3	0	0	3	3.0	75	25	0	100	3
2	BTE-204	Bio-analytical Techniques	3	0	0	3	3.0	75	25	0	100	3
3	BTE-206	Immunology	3	0	0	3	3.0	75	25	0	100	3
4	BTE-208	Industrial Biotechnology	3	0	0	3	3.0	75	25	0	100	3
5	BS-202	Basics of Thermodynamics and Organic Chemistry	3	0	0	3	3.0	75	25	0	100	3
6	BTE-212L	Molecular Biology Lab	0	0	3	3	1.5	0	40	60	100	3
7	BTE-214L	Bio-analytical Techniques Lab	0	0	3	3	1.5	0	40	60	100	3
8	BTE-216L	Industrial Microbiology Lab	0	0	3	3	1.5	0	40	60	100	3
9	BTE-218L	Immunology Lab	0	0	3	3	1.5	0	40	60	100	3
		Total	**15**	**0**	**12**	**27**	**21**	**375**	**285**	**240**	**900**	
10	MC-901*	Environmental Sciences*	3	0	0	3		75	25	0	100	3

*__MC-901__ is a mandatory credit less course in which the student will be required to get passing marks in the major test.
Note: All the students have to undergo 4-6 weeks industrial training after IV semester and to be evaluated in V semester.

BTE-201	Cell Biology and Genetics (B.Tech. Biotechnology) Semester-III						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3hrs**
Purpose	To familiarize the students with the basic of cell biology and genetics.						
Course outcome							
CO1	Student to learn the fluidity and structural organization of bio membrane and cytoskeleton						
CO2	To learn the fundamentals of inheritance via both qualitative and quantitative patterns.						
CO3	Able to understand the basic concept of evolution and genetic basis of variations.						
CO4	Student will learn about the genome mapping by different techniques ranging from bacteria to human beings.						

UNIT-1

Bio membrane-Physical and chemical properties, Structural organization, Cell signaling (Different Pathways), cell recognition and membrane transport, Membrane receptor for macromolecules and regulation of receptor expression and function. Receptors for neurotransmitters

Structural organization and functions -Microtubule, Microfilament and Inter-mediatery filaments.

UNIT-II

Mendelism – History of Mendel, Monohybrid, Di- hybrid and Tri-hybrid cross, Gene interaction, Concept of dominance - incomplete ,complete and co-dominance(Blood group system in human beings),Multiple alleles(Skin color in rabbit),Concept of lethality and pedigree analysis. Sex linked, sex influenced and sex limited inheritance.

Quantitative inheritance-History, Yule experiment, Nelsson-Ehle experiment, skin color in human beings, Basis of genetic variation. Numerical problems on quantitative inheritance.

UNIT-III

Population Genetics- Concept of Random Mating and controlled mating and Inbreeding. Hardy Weinberg Law-Allele frequency, Genotype frequency, Causes of variations (Mutation, Migration, Random genetic drift, and Natural selection).

Mutation-Classification, application, detection, site directed mutagenesis and DNA repair Mechanism-(Mismatch repair, Photo-reactivation, tolerance, retrieval system.

UNIT-IV

Genome mapping-Difference between cytological, physical and molecular mapping. Recombination, Linkage, Gene mapping based on Two point cross in Neurospora and Three point test cross in wheat. History and development of human genome project.

Muscle contraction-Types of muscles, Structural proteins of muscles , regulation and energetic of muscle contraction.

Nerve Transmission- structure and function of neurons. Action and resting potential, Mechanism of nerve transmission, Neuromuscular junction.

Text /ReferenceBooks

1. Cell Biology: Organelle structure and function, Sadava, D.E.(2004) Panima Pub., New Delhi.
2. Fundamentals of Genetics, Singh, B.D., Kalyani Publishers, New Delhi.
3. Basic Genetics. (2000) Miglani, G.S., Narosa Publishing House, New Delhi.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-203	Microbiology (B.Tech. Biotechnology) Semester- III						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3.0**	**75**	**25**	**100**	**3hrs**
Purpose	To familiarize the students with the basic of Microbiology						
Course outcome							
CO1	To learn the history and classification of microbiology						
CO2	To learn microbial nutrition and various microbiological techniques						
CO3	Able to understand microbial growth and genetics						
CO4	Student will learn about various microbial diseases and drugs						

UNIT - I

1. **History and scope of Microbiology**: Development of Microbiology, various branches of microbiology and applications of microbiology.
2. Classification of Microorganisms: Microbial Taxonomy- criteria used including molecular approaches. Microbial phylogeny and current classification of bacteria.

UNIT - II

3. **Microbial Diversity**: Morphology and cell structure of major groups of microorganisms e.g. bacteria. fungi, algae, protozoa and viruses.
4. **Cultivation and microbial nutrition of Microorganism**: Methods of isolation, purification and preservation. Pure culture technique and sterilization methods. Requirement for C, N, S and growth factors. Nutritional categories of microorganisms.

UNIT - III

5. **Microbial Growth and Metabolism**: Growth curve (normal and biphasic) and generation time. Measurement of growth. Synchronous, batch and continuous cultures. Microbial fermentation and its types.
6. **Microbial Genetics**: Bacterial plasmids. Bacterial recombination: transformation, transduction and conjugation. Formation of endospores and mechanism of sporulation.

UNIT - IV

7. **Environmental Microbiology**: Normal and contaminating microflora of water, soil and air. Methods to study water and air pollution.
8. **Medical Microbiology**: Antibacterial, Antiviral, Antifungal and Antiprotozoan drugs, Major water, air and soil borne microbial diseases.

Text Book:

1. Microbiology 5th Edition. Prescott, L.M.; Harley, J.P. and Klein, D.A.(2003) McGraw Hill, USA.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. (1993) Tata McGraw Hill, New Delhi.

References Books:

3. Modern Food Microbiology. Jay, J.M. (1996) CBS Publishers and Distributors, New Delhi.
4. Food Microbiology 2nd ed, Adam, M. R. and Moss (2003) Panima Pub, New Delhi.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-205	Biochemistry (B.Tech Biotechnology) Semester-III						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs.
Purpose	To introduce the students with basics of Biochemistry						
Course Outcomes							
CO1	The students will be able to learn the structure and functions of carbohydrates and proteins						
CO2	The students will be able to learn structure and functions of lipid and nucleic acids along with basic concepts of enzymes.						
CO3	The students will be able to write major pathways of carbohydrates and lipid metabolism						
CO4	To make the students learn synthesis and degradation of pyrimidine nucleotides						

UNIT-I

1. **Amino acids & Proteins –**Structure and properties of amino acids. Peptide bonds.

   Proteins classification based on their biological roles. Forces stabilizing protein structure and shape. Different levels of structural organization of proteins. Ramachandran plot, alpha helix, beta plated sheets, domain motif and fold.

2. **Carbohydrates-Structure and functions:** Structures and properties of glucose and fructose, distinguishing features of different disaccharides. Ring structure and mutarotation. Structure and brief introduction of starch, glycogen and cellulose.

UNIT – II

3. **Lipids-Structure and functions:** Classification of lipids based on their biological roles and their general functions. Membrane lipids and brief discussion on fatty acids.
4. **Nucleic Acids-Structure and functions:** Structure and properties of purine and pyrimidine bases.A brief introduction of ATP, GTP, CTP AND UTP.

5. **Enzymes:** Classification of Enzymes according to enzyme commission report. Activation energy and rate of reaction. Rate constant, reaction order. A brief introduction of mechanism of enzyme catalysis. Enzyme inhibition and concept of allostery. Michaelis-Menten equation.

UNIT-III

6 **Carbohydrate Metabolism:** Glycolysis and TCA cycle. Pentose phosphate pathway and its significance. Gluconeogenesis pathway. Biosynthesis of lactose, sucrose and starch. Glycogenolysis, glycogenesis and control of glycogen metabolism.

7.Lipid Metabolism: Beta -oxidation of saturated fatty acids, Degradation of triacylglycerols by lipases. Biosynthesis of saturated fatty acids. Biosynthesis of triacylglycerols, phospholipids.

UNIT -IV

8 Amino Acid Metabolism: General reactions of amino acids metabolism- transamination, oxidative andnon-oxidative deamination and decarboxylation. Urea cycle and its regulations.

9. Nucleic Acid Metabolism: Catabolism,*de novo*-biosynthesis and salvage pathway.

10. Mitochondrial oxidative phosphorylation: Mitochondrial electron transport chain. Hypotheses ofmitochondrial oxidative phosphorylation.

Text

1. Biochemistry, concepts and connections, 1st edition, by Dean R. Appling, Spencer J. Anthony-Cahill and Christopher K. Matthews (2015). Pearson Education, Inc.

2. Biochemistry, 4th edition, by L. Stryer (1995). W.H. Freeman & Co. NY

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox (2000) Maxmillan/ Worth publishers

References Books:

1. Biochemistry, 4th edition, by G. Zubay (1998). Wm.C. Brown Publishers.

2. Biochemistry, 2nd edition, by Laurence A. Moran, K.G. Scrimgeour, H. R. Horton, R.S. Ochs and J. David Rawn (1994), Neil Patterson Publishers Prentice Hall.

3. Biochemistry, 2nd edition, by R.H. Garrett and C.M. Grisham (1999) . Saunders college Publishing, NY. Sons, NY.

4. Fundamentals of Biochemistry by Donald Voet and Judith G Voet (1999) , John Wiley & Sons, NY

5. Harper's Biochemistry, 25th edition, by R.K. Murray, P.A. Hayes, D.K. Granner, P.A. Mayes and V.W. Rodwell (2000). Prentice Hall International.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-207	Principles of Biostatistics (B.Tech Biotechnology) Semester-III						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3

Purpose **To Introduce statistical concept for biological data interpretation**

Course Outcomes

CO1	**To develop basic understanding about statistics**
CO2	**To develop basic knowledge of probability and different tests.**
CO3	**To derive numerical approach between data correlation and their variations.**
CO4	**To understand the numbers and errors**

UNIT-1

Introduction: Basic concept of statistics, Difference between statistics and mathematics, Samples and variables, Frequency distribution curve and basic quantitative method: Mean median, mode, standard deviation and variance.

UNIT-II

Probability distribution: Basic concept of probability, binomial distribution, Poisson distribution and normal distribution.

Hypothesis testing: Students T-test, estimation of null hypothesis, confidence limit of variance and chi-square test.

UNIT-III

Analysis of Variance:F-test, Two way ANOVA and Three way ANOVA

Correlation and Regression: Analysis of correlation and their different types, analysis of covariance and multiple regressions.

UNIT-IV

Approximation and error: Introduction, Accuracy of numbers: approximate number, significant number, rounding off. Different types of error.

Role of computer in solving biostatical problem: Genetic Algorithm, Application of statistical methods in biotechnology.

Text Books:

1. Statistical Methods. S.P.Gupta. Sultan chand and sons, New delhi

Reference Books:

1.Introduction to Biostatistics. Glover T. and Mitchell K. (2002). MacGraw Hill, New York.

2. Fundamentals of Biostatistics. Rosner Bernard. (1999), Duxbury Press.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

HM-901	OrganizationaL Behavior(B.Tech Biotechnology) Semester-III						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3
Purpose	To make the students conversant with the basics concepts of organizational culture and behavior for nurturing their managerial skills						
COURSE OUTCOMES							
CO1	An overview about organizational behavior as a discipline and understanding the concept of individual behavior						
CO2	Understand the concept and importance of personality ,emotions and its importance in decision making and effective leadership						
CO3	Enabling the students to know about the importance of effective motivation and its contribution in group dynamics and resolving conflicts						
CO4	Understand how to overcome organizational stress by maintaining proper organizational culture and effective communication						

UNIT -I

Introduction to Organizational Behavior*:* Concept and importance of Organizational Behavior, Role of Managers in OB, Foundations or Approaches to Organizational Behavior, Challenges and Opportunities for OB

Foundation of individual behavior: Biographical characteristics, concept of Abilities and Learning , Learning and Learning Cycle, Components of Learning, concept of values and attitude, types of attitude, attitude and workforce diversity

UNIT-II

Introduction to Personality and Emotions: Definition and Meaning of Personality, Determinants of Personality, Personality Traits Influencing OB, Nature and Meaning of Emotions, Emotions dimensions, concept of Emotional intelligence

Perception and individual decision making*:* Meaning of perception, factors influencing perception, Rational decision making process, concept of bounded rationality. Leadership- Trait approaches, Behavioral approaches, Situational approaches, and emerging approaches to leadership.

UNIT-III

Motivation: concept and theories of Motivation, theories of motivation- Maslow, Two Factor theory, Theory X and Y,ERG Theory, McClelland's Theory of needs, goal setting theory, Application of theories in Organizational Scenario, linkage between MBO and goal setting theory, employee recognition and involvement program

Foundations of Group Behavior and conflict management:Defining and classifying of Groups, stages of group development, Informal and Formal Groups - Group Dynamics, Managing Conflict and Negotiation , a contemporary perspective of intergroup conflict, causes of group conflicts, Managing intergroup conflict through Resolution.

UNIT-IV

Introduction to Organizational Communication: Meaning and Importance of Communication process, importance of Organizational Communication, Effective Communication, Organizational Stress: Definition and Meaning Sources and Types of Stress, Impact of Stress on Organizations, Stress Management Techniques

Introduction to Organization Culture- Meaning and Nature of Organization Culture, Types of Culture, Managing Cultural Diversity, Managing Change and Innovation - Change at work, Resistance to change, A model for managing organizational change.

Text Books

Colquitt, Jason A., Jeffery A. LePine, and Michael Wesson. *Organizational Behavior: Improving Performance and Commitment in the Workplace*. 5th ed. New York: McGraw-Hill Education, 2017.

Hitt, Michael A., C. Chet Miller, and Adrienne Colella. *Organizational Behavior*. 4th ed. Hoboken, NJ: John Wiley, 2015.

Robbins, Stephen P., and Timothy Judge. *Organizational Behavior*. 17th ed. Harlow, UK: Pearson Education, 2017.

Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.

Reference Books

Schermerhorn, Hunt and Osborn, Organisational behavior, John Wiley.

Udai Pareek, Understanding Organisational Behaviour, Oxford Higher Education.

Mc Shane & Von Glinov, Organisational Behaviour, Tata Mc Graw Hill.

Aswathappa, K., Organisational Behaviour– Text and Problem, Himalaya Publication

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-209L	Cell Bio and Genetics Lab (B.Tech. Biotechnology) Semester –III						
Lecture	Tutorial	Practical	Credit	Minor Test	Practical	Total	Time
-	-	3	1.5	40	60	100	3 Hrs
Purpose	To learn working of instruments and their principles to study basic concepts.						
Course Outcomes							
CO1	Students will be able to learn basic instruments need to study all types of cellular structures.						
CO2	Preparation of permanent slides to study histology of different organ systems..						
CO3	Students will come to know about the procedure of division of cells in both somatic and gametic cells.						
CO4	Students will learn Techniques of DNA extraction and its application in fingerprinting.						

LABORATORY EXPERIMENTS

1. Study of different types of microscopes.
2. Microscopy: Structure of Prokaryotic and eukaryotic cell.
3. Microtomy. Histology of various organ systems (Nervous, digestion, reproductive, respiratory and circulatory system).
4. Cell division in onion root tip.
5. Cell division in insect gonads/flower bud.
6. Isolation of Chloroplasts/ Mitochondria from Plants.
7. Fluorescence labeling of cellular organelles.
8. Isolation of DNA and study of its denaturation spectrophotometrically & viscometrically.

Reference books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), Cambridge University Press, Cambridge.
2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House, New Delhi.
3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw-Hill, Book Company, UK.

BTE-211 L	MICROBIOLOGY LAB (B.Tech. Biotechnology Semester III)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
-	**-**	**3**	**1.5**	**40**	**60**	**100**	**3 Hrs**
Purpose	**To learn the practical aspects of Microbiology**						
Course Outcomes							
CO1	**Students will be able to know about the instruments and their working principles.**						
CO2	**Learning of Culture Media Preparation for Microbial Growth.**						
CO3	**Students will learn Pure Culture Techniques for isolation and preservation of microbes.**						
CO4	**Students will learn about staining methods for identification of microbes and effect of different factors on growth of microbes.**						

LABORATORY EXPERIMENTS

1. Rule and Regulations of working in the laboratory.
2. To know about the instruments and equipments used in the laboratory
3. Preparation of culture media for culturing microbes.
5. Collection of samples from different sources and serial dilution method.
6. Culture techniques- Pour plate and spread plate.
7. Isolation of pure colonies by streaking method.
8. Gram Staining method to differentiate between gram positive and gram negative bacteria.
8. To analyze the waste water samples for presence of microbes.
9. Measurements of growth and study of effect of various factors on growth of microorganisms-temperature, pH, salt concentration,
10. Milk Microbiology- Testing the quality of milk.

Text and References Books:

1. Experiments in Microbiology, Plant Pathology and Biotechnology. 4th Edition. Aneja, K.R. (2003)New Age International Publishers, New Delhi.
2. Microbiology- a laboratory manual. 4th edition. Cappuccino J. and Sheeman N. (2000) Addison Wesley, California.
3. Environmental Microbiology – A Laboratory Manual Pepper. I.L.; Gerba, C.P. and Brendecke, J.W.(1995) Academic Press, New York.

BTE-213L	BIOCHEMISTRY LAB (B.Tech. Biotechnology) Semester-III						
Lecture	Tutorial	Practical	Credit	Minor Test	Practical	Total	Time
-	-	3	1.5	40	60	100	3 Hrs
Purpose	To learn the practical aspects of Biochemistry						
Course Outcomes							
CO1	Students will be able to learn qualitative and quantitative estimation of biomolecules						
CO2	Students will be able to learn procedure to perform enzyme assay of any common enzyme.						
CO3	Students will learn effect of environmental factors on enzyme activity						
CO4	Students will be able to calculate Km and Vmax of any common enzyme						

LABORATORY EXPERIMENTS

1. Qualitative tests for amino acids, proteins, Lipids and carbohydrates.
2. Quantitative estimation of proteins by Lowry method.
3. Determination of reducing sugar by Nelson-Somogyi's method
4. Assay of any commonly occurring enzyme.
5. Effect of pH, temperature, enzyme concentration and protein denaturation on an enzyme activity.
6. Determination of Km and Vmax of any commonly occurring enzyme.

Text/ Reference Books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), Cambridge University Press, Cambridge.

2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House, New Delhi.

3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw-Hill, Book Company, UK.

MC-902	Constitution of India (B.Tech. Biotechnology) Semester- III					
Lecture	Tutorial	Practical	Major Test	Minor Test	Total	Time
3	-	-	75	25	100	3 Hrs.
Purpose	To know the basic features of Constitution of India					
Course Outcomes						
CO1	The students will be able to know about salient features of the Constitution of India.					
CO2	To know about fundamental duties and federal structure of Constitution of India.					
CO3	To know about emergency provisions in Constitution of India.					
CO4	To know about fundamental rights under constitution of India.					

UNIT-I

1. Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India.
2. Scheme of the fundamental rights

UNIT - II

3. The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.
4. Parliamentary Form of Government in India – The constitution powers and status of the President of India

UNIT - III

5. Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India.
6. Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self Government – Constitutional Scheme in India.

UNIT-IV

7. Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19.

8. Scope of the Right to Life and Personal Liberty under Article 21.

Text Books

1. Constitution of India. Prof. Narender Kumar (2008) 8th edition. Allahabad Law Agency**.**

Reference Books:

1. The constitution of India. P.M. Bakshi (2016) 15th edition. Universal law Publishing.

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BTE-202	Molecular Biology (B.Tech. Biotechnology) Semester -IV						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs.
Purpose	To familiarize the students with basic concepts of molecular biology.						
Course Outcomes							
CO1	The students will be able to learn the Basic structure of DNA RNA.						
CO2	To learn the process of DNA replication and regulation.						
CO3	The students will be able to understand the process of Transcription of DNA in Prokaryotes and Eukaryotes.						
CO4	The students will be able to explain the process of Translation.						

UNIT- I

1.Genes : DNA/RNA as the genetic material. Double helical structure of DNA.Types of DNA.Super coiling and periodicity of DNA.Linking number of DNA.Nature of multiple alleles, Cis- acting sites and Trans–acting molecules.Euchromatin and heterochromatin.Nucleosomes.Organelle DNA- Mitochondrial and chloroplast DNA.

2. From Genes to Genomes : exons and introns, repetitive and non –repetitive DNA, C-value paradox.

3. DNA Replication : Origin of DNA replication. Bacterial and eukaryotic replicons.DNA polymerases.Mechanism and regulation of DNA replication in prokaryotes and eukaryotes.

UNIT - II

4. Transcription: Various RNA species and their properties- tRNA as an adapter and turnover of mRNA.

a) **Transcription in Prokaryotes:** RNA polymerases. Mechanism of transcription-initiation, elongation and termination.Role of sigma factor in transcription.

b) **Transcription in Eukaryotes:** RNA Polymerases. Downstream and upstream promoters. Techniques to define promoters- foot printing experiment. Mechanism of transcription.Interaction of upstream factors with basal apparatus.Role of enhancers.Post-transcriptional modifications of various RNA species.Transcription in mitochondria and chloroplast.

c) **The Operon:** Positive and negative control of transcription, repressor-inducer complex, catabolite repression and attenuation.

d) **Regulation of Transcription:** DNA binding domains- zinc finger motif, helix loop helix, leucine zippers and homeodomains. Demethylation and gene regulation.

UNIT -III

5. Genetic Code: Evidence for triplet code. Properties of genetic code, Wobble hypothesis.Mitochondrial genetic code. Suppressor tRNAs.

6. Protein Synthesis : Structure of prokaryotic and eukaryotic ribosomes and their role in protein synthesis. Mechanism of initiation, elongation and termination of protein synthesis.Regulation of translation in prokaryotes and eukaryotes. Post translational modifications of proteins.

7. Protein folding : Role of molecular chaperones.

UNIT -IV

8. Nuclear Splicing : Lariat formation, Sn RNAs, cis-splicing and trans-splicing reactions. Catalytic RNA- Ribozymes- Ribonuclease P, small RNAs, group I &II introns.

Text/Reference Books :

1. Genes XI Lewin, Benjamin(2013)OUP, Oxford.
2. Genomes,2nded, Brown, T. A.(2002) John Wiley and sons ,Oxford
3. Molecular biology of cell 4thed Alberts, Bruce; Watson,J D(2002) Garland Science Publishing, New York.
4. Molecular cell biology 4thedLodish, Harvey and. Baltimore,D(2000) W.H. Freeman and Co., New York
5. Cell and Molecular Biology 8thed, Robertis, EDP De &Robertis, EMF De(2002) lippincott Williams & Wilkins international student edition, Philadelphia.
6. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston
7. Cell and Molecular Biology: concepts and experiments 3rded Karp, Gerald(2002) John Wiley and sons, New York.
8. The Cell-a molecular approach, 3rded Cooper, G M&Hausman, R E(2004) ASM Press, Washington D C

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

BTE-204	Bioanalytical Techniques (B.Tech. Biotechnology) Semester- IV

Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs.
Purpose	To acclimatize students about different bioanalytical techniques.						
Course Outcomes							
CO1	The students will be able to understand the principle of microscopy.						
CO2	The students will be able to understand the principle and applications chromatography techniques.						
CO3	The students will be able to learn underlying principle and applications of spectroscopy.						
CO4	The students will be able to learn process of detection and measurement of radioactivity.						

UNIT- I

1. **Principles of Microscopy:** Light, electron (scanning and transmission), fluorescence microscopy, marker enzymes.
2. **Centrifugation: Basic concepts and** applications, differential centrifugation, high speed and ultracentrifugation techniques.

UNIT- II

3. **Electrophoresis**: basic principle and applications of Paper and gel electrophoresis, isoelectric focussing, two-dimensional electrophoresis.
4. **Principles of Chromatography**: Ion-exchange, gel filtration, affinity, gas chromatography, High Pressure Liquid Chromatography (HPLC), FPLC and Hydrophobic Interaction Chromatography.

UNIT- III

5. **Principle and applications of Spectroscopy:** UV/visible, IR, NMR, ESR, fluorescence, Raman.
6. **Mass spectroscopy**: LC-MS, X-ray diffraction (molecular crystals), CD.

UNIT- IV

7. **Radioisotope Techniques**: Nature of radioactivity, properties of α, β and γ-rays, detection and measurement of radioactivity, use of radioisotopes in research, autoradiography, radio-immunoassay.

Text/ References Books:

1. Physical Biochemistry, 2nd edition, by D Friefelder (1983). W.H. Freeman & Co., U.S.A.
2. 4. Analytical Chemistry for technicians: John Kenkel (1994), Lewis Publishers. Boca Raton.
3. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), Cambridge University Press, Cambridge.
4. Biophysical Chemistry: Principles and Techniques, 2nd edition by A. Upadhyay, K. Upadhyay and N. Nath. (1998). Himalaya Publishing House, Delhi.
5. Physical Biochemistry, 2nd edition, by K. E. VanHolde (1985), Prentice Hall Inc, New Jersey.

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BTE-206 IMMUNOLOGY (B.Tech Biotechnology) semester-IV							
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To learn the role of various components of immune system and their response against various diseases**						
Course Outcomes							
CO1	**The students will be able to learn the basic concepts of cells and organs related to immune system.**						
CO2	**Able to learn the formation, maturation and functions of B cells and T cells.**						
CO3	**To learn the concepts of various Immunological techniques and understanding various effector responses of body against an infection.**						
CO4	**To learn the immunological reasons behind various diseases.**						

UNIT – I

1. **Introduction to immune system**: Innate and acquired immunity, cells and organs of immune System- B-Lymphocytes and T-Lymphocytes, primary and secondary lymphoid organs, humoral and cell mediated immune response.

2. Immune System: Antigens. Immunoglobulins- structure and function, antigenic Determinants (isotype, allotype, idiotype).

UNIT –II

3. Generation of B-Cell and T-Cell Responses: Major histocompatibility complex. Antigen Processing and presentation.

4. Cell mediated immunity: T-cell receptor, T-cell maturation, activation and differentiation.

UNIT –III

5 Immunological techniques: Immunoprecipitin reactions, agglutination reactions, ELISA, RIA, Immunofluorescence.

6. Immune effector responses: Cytokines. Complement system.

UNIT – IV

7. Immune System in Health and Disease: Hypersensitive reactions. Auto immunity and immune response to infectious diseases. Immune response to transplants. Vaccines.

Text Book:

1. Kuby's Immunology, 5th ed. Goldsby, R A. Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York

Reference Books

1. Essential Immunology, 10th ed Roitt, Ivon; Delves, Peter (2001) Blackwell Scientific Publications Oxford.
2. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York.
3. Immunology by Presscot.

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BTE-208	INDUSTRIAL BIOTECHNOLOGY (B.Tech. Biotechnology) Semester -IV						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs.
Purpose	To learn the various aspects of Industrial Biotechnology						
Course Outcomes							
CO1	To learn basic concepts of Fermentation Bioechnology						
CO2	To learn the theoretical aspects of Process Technology for the production of various products						
CO3	To learn the concepts of biopesticides, biofuels and biofertilizers.						
CO4	To understand the concept of integrated strain improvement program.						

UNIT-I

1. Industrial Biotechnologyy: Introduction, objectives and scope**.**

2. Fermentation Technology:. Biochemistry of fermentation. Ttaditional and modern biotechnology-A brief survey of organisms, processes and products. Basic concepts of upstream and downstream processing in fermentation technology

UNIT - II

3. Production of Primary metabolites and alcoholic beverages Organic acids, dextran, amino acids (Glutamic acid, L-Lysine) and alcohols and alcoholic beverages (wine and beer.

4. Production of Industrial Enzymes- Amylase, protease, lipase, xylanase, lignocellulase**.** production of acrylamide, adipic acid and 1,2-Propanediol.

UNIT-III

5. Production of Biopesticides and Biofertilizers: Characteristics of biopesticides. Important biopesticides- Bt-toxin, Kasugamycin, Beauverin, Devine and Collego. Beneficial Soil Microorganisms. Biofertilizers.

6. Production of Biofuels: Basic concepts and important types of biofuels. Fuel from biomass, production and economics of biofuels, biogas, biorefineries, Microbial Enhanced Oil Recovery (MEOR).

7. Production of other industrial bioproducts- Single Cell Protein & Mushroom Culture, Biopreservatives Nisin), Cheese, Biopolymers (Xanthan gum, PHB). Biosynthetic Technology. Bioflavours and biopigments: microbial production of flavours and fragrances. Microbial pigments in textile and food industries.

UNIT-IV

8. Strain Improvement Strategies- Improvement of industrially important microorganisms, selection of mutants, use of rDNA technology. Integrated Strain Improvement Program (Precision Engineering Technology)

9. **Microbial Production of Pharmaceuticals**. Antibiotics (penicillin, streptomycin and tetracycline), Enzyme Inhibitors. Production of Vitamin E, K, B_2 and B_{12}, Genetic engineering of microorganisms for production of non-ribosomoal peptides (NRPS) and polyketides (PKS), antiacancer drugs.

Text

1. A Textbook of Basic and Applied Microbiology. Aneja, K. R., Jain, P. and Aneja, R. (2008). New Age International Publishers, New Delhi

Reference Books:

1. Industrial Microbiology.Casida Jr., L.E. (1968) New Age International (P)Ltd. New Delhi.

2. Prescott & Dunn's Industrial Microbiology. Ed. E.G. Reed (1987).CBS Publishers, New Delhi.

3. Biotechnology: A Textbook of Industrial Microbiology 2nd Edition. Crueger, W. and Crueger, A. (2000) Panima Publishing Corporation, New Delhi.

4. Enzymes: Biochemistry, Biotechnology, Clinical chemistry. Palmer, T. (2000) Horwood publishing Colphon.

5. Process engineering in biotechnology. Jackson, A.T. (1991) Prentice Hall.

6. Manual of Industrial Microbiology and Biotechnology 2nd Edition. Ed. Arnold L. Demain and Julian E. Davies (1999) ASM Press Washington D.C.

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BS-202	Basics of Thermodynamic and Organic Chemistry (B.Tech. Biotechnology Semester IV)						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs
Purpose	To familiarize the students with basic concepts of thermodynamic and organic chemistry.						
Course Outcomes							
CO1	The students will be able to know the basic concepts of naming of organic compounds and general organic reactions.						
CO2	Able to know about spatial arrangement of molecules and their bonding.						
CO3	Able to know about basic concepts of thermodynamics.						
CO4	Able to know about concept of free energy in biomolecules and binding used in biochemical reactions.						

UNIT-I

IUPAC Nomenclature: Systematic IUPAC nomenclature of alkenes, alkynes, cycloalkanes, aromatics, bicyclic and polyfunctional organic compounds. Bond line notation.Types of Organic Reactions: Substitution, Addition, Elimination reactions. Wanger-Meerwin rearrangement reaction. Hyperconjugation : concept and consequences, mole concepts.

UNIT-II

Bonding: Hydrogen bonding- Nature, type, stability and its importance in organic compounds. Tautomerism-Concept, Ring-chain tautomerism, Ring-chain isomerism, properties and reactions of keto-enol tautomers.

Stereo Chemistry: Classification of stereomers, diastereomers, separation of enantiomers, absolute configuration (R & S), projection formulae, stereochemistry of compounds containing two asymmetric C- atoms, stereochemistry of biphenyls. Geometrical isomerism-concept, E & Z nomenclature and aldol condensation

UNIT –III

Thermodynamic parameters –internal energy, enthalpy; their relationship and their significance. First law of thermodynamics. Kirchoff's Equation. Heat capacity at constant pressure and volume and their relationship.

Concepts of Entropy, Second law of thermodynamics. Entropy changes for reversible and irreversible processes. Entropy of mixing.

Third Law of Thermodynamics. Numerical problems on Laws of Thermodynamics.

UNIT-IV

Basic concept of Equilibrium and steady state conditions, Free energy and its relation with equilibrium constant, Chemical potential, Gibbs-Duhem equation and their application, Standard biochemical state and standard free energy changes. Thermodynamic basis of Biochemical reactions, solvent extraction for purification of compounds. Binding – Non-cooperative binding, Co-operative binding and its biological significance

Text/Reference Books:

1. Organic Chemistry V1:6th ed. Finar,I L(2003) Pearson Education, Delhi

2. Organic Chemistry V2:5th ed. Finar,I L(2003) Pearson Education, Delhi.

3. Organic Chemistry 6th ed. Morrison,R & Boyd,T.(2003) Pearson Education, Delhi.

4. Organic Chemistry. Paula Yurkanis Bruice; Pearson Education, Delhi.

5. Principle of Organic Synthesis. Richard Norman and James M Coxon.

6. Organic Chemistry:Reactions & Reagents,37th ed. Aggarwal (2003) Goel Publishing House,Meerut.

7. Organic Analytical Chemistry. Jagmohan (2003) Narosa pub. New Delhi.

Kinetics and Thermodynamics in Biochemistry : Bray & White.

8. Biophysical chemistry Vol. I : Edsall and Wyman

9. Non Equilibrium Thermodynamics in Biophysics : Katchalasky and Curran; Harvard University Press.

10. Principles of Physical Biochemistry : Kensel. E.Van Holde, W. Curtis Johnson, P. Shing Ho (2005) 2 nd edition, Prentice Hall

11. Physical basis of biochemistry: Foundations of molecular biophysics, Bergethan, P.R.(2000) Springer.

BTE-212L		Molecular Biology Lab (B.Tech. Biotechnology Semester IV)					
Lecture	Tutorial	Practical	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	60	40	100	3 Hrs.
Purpose		To familiarize the students with basic concepts of molecu.					
	Course Outcomes						
CO1		Students will be able to learn Isolation of DNA from Prokaryotic and Eukaryotic Cells					
CO2		Learning of Gel Electrophoresis for separation of DNA, RNA and Proteins					
CO3		Students will learn the technique of PCR Amplification of Nucleic Acids					
CO4		Students will learn Restriction Mapping of Plasmid DNA					

LABORATORY EXPERIMENTS

1. Isolation of genomic DNA from eukaryotic cells.

2. Isolation of RNA from eukaryotic cells.

3. Isolation of proteins from eukaryotic cells.

4. Isolation of genomic DNA from prokaryotic cells.

5. Isolation of plasmid DNA from Prokaryotic cells.

6. Restriction mapping of plasmid DNA:This experiment involves single and double digestion of the plasmid with restriction enzymes.

7. Gel electrophoretic separation of DNA and molecular wt. determination.

8. Gel electrophoretic separation of RNA.

9. Gel electrophoretic separation of proteins.

10. Transblot analysis of DNA.

11. Gel Extraction of DNA.

12. PCR amplification of DNA: Visualization by gel electrophoresis.

Reference Book:

Molecular Cloning – A laboratory manual: 3rd Edition Vol. 1-3. Sambrook J and Russell D.W. (2001). Cold Spring Harbor laboratory Press, New York.

BTE-214L	Bioanalytical Techniques Lab (B.Tech. Biotechnology) Semester- IV						
Lecture	Tutorial	Practical	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	60	40	100	3 Hrs
Purpose	To learn the Bioanalytical Techniques used in the field of Biotechnology						
Course Outcomes							
CO1	Students will learn about working of spectrophotometer.						
CO2	Students will be able to learn about technique of paper chromatography.						
CO3	Students will be able to learn about technique of electrophoresis.						
CO4	Students will be able to estimate DNA and RNA in any sample.						

LABORATORY EXPERIMENTS

1. To verify the validity of Beer-Lambert's law and determine the molar extinction coefficient of NADH/NAD
2. Separation of amino acids/ sugars by paper chromatography.
3. Extraction and estimation of total lipid content in a given sample of oil seed.
4. Partial purification of an enzyme by ammonium sulphate fractionation,
5. Native gel electrophoresis of proteins.
6. To demonstrate the working of HPLC.
7. Quantitative determination of DNA and RNA by spectrophotometric method.

Reference Books:

1. Principles and techniques of Practical Biochemistry: K. Wilson and J. Walker (1994), Cambridge University Press, Cambridge.

2. Introductory practical Biochemistry by S.K. Sawhney and Randhir Singh (2000), Narosa Publishing House, New Delhi.

3. An introduction to Practical Biochemistry by David T. Plummer (1988), McGraw-Hill, Book Company, UK.

BTE-216L	Industrial Microbiology Lab (B.Tech. Biotechnology) Semester -IV						
Lecture	Tutorial	Practical	Credit	Minor Test	Practical	Total	Time
-	-	3	1.5	40	60	100	3 Hrs
Purpose	To learn the Practical Aspects of Industrial Microbiology						
Course Outcomes							
CO1	Learning of Sterilization Techniques used in Microbiology Lab						
CO2	Learning of Identification of industrially important microorganisms						
CO3	Students will learn production of antibiotics and enzymes from microbes						
CO4	Students will learn determination of microbial cell growth						

LABORATORY EXPERIMENTS

1. Sterilization Techniques (Media, air & water)
2. Construction of various fermenters (bioreactors)
3. Identification of industrially important microorganisms e.g. molds, yeasts and bacteria.
4. Production of various products in the lab. Alcohol, wine, cellulase, protease and bread.
5. Isolation of antibiotic producing microorganisms from the soil.
6. Penicillin production and testing of antimicrobial activity.
7. Isolation of streptomycin-resistant mutants by replica plating method.
8. Isolation of UV induced auxotrophic mutants.
9.Determination of cell growth.
10.Production of organic acids (Citric and lactic) by microorganisms.
11. Production of industrially important enzymes (protease, amylase) by microorganisms.

Reference Books:

1. Experiments in Microbiology, Plant Pathology and Biotechnology. Aneja, K.R.(2003) 4th Edition. New Age International Publishers, New Delhi.
2. Fermentations & Biochemical Hand Book: Principles, Process Design and Equipment. HC Vogel and Noyes(1983).
3. Microbiology Labortary Manual. Cappuccino, J. and Sheeman, N.(2000), 4th Edition, Addison Wesley, California.
4. Manual of Industrial Microbiology and Biotechnology. 2nd Edition. Ed. Arnold L. Demain and Julian E. Davies (1999) ASM Press Washington D.C.

BT-218L	Immunology Lab (B.Tech. Biotechnology) Semester -IV						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
-	**-**	**3**	**1.5**	**40**	**60**	**100**	**3 Hrs**
Purpose	**To learn the practical aspects of Immunology**						
Course Outcomes							
CO1	**Students will be able to learn basic techniques in handling laboratory animals.**						
CO2	**Learning of techniques for purification of immunoglobulins.**						
CO3	**Students will learn the technique of Immunoprecipitation and Agglutination.**						
CO4	**Students will learn the principles of ELISA.**						

LABORATORY EXPERIMENTS

1. Routine techniques in handling laboratory animals: feeding, cleaning and bleeding procedure for mice and rabbit.
2. ABO blood group typing
3. Estimation of heamoglobin in blood sample
4. Detection of antigen/antibody from test sample
5. Purification of immunoglobulins.
6. Immunoprecipitation techniques
7. Agglutination techniques
8. ELISA

Reference Books:

1. Using Antibodies: A Laboratory Manual. Harlow & Lane(1998) Cold Spring Harbor Lab Press.
2. Immunological Techniques Made Easy. Cochet, et al.(1998)Wiley Publishers,Canada.

MC-901	ENVIRONMENTAL SCIENCES (B.Tech. Biotech IV th Sem)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**-**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To learn the multidisciplinary nature, scope and importance of Environmental sciences.**						
Course Outcomes							
CO1	**The students will be able to learn the importance of natural resources.**						
CO2	**To learn the theoretical and practical aspects of eco system.**						
CO3	**Will be able to learn the basic concepts of conservation of biodiversity.**						
CO4	**The students will be able to understand the basic concept of sustainable development.**						

UNIT I

The multidisciplinary nature of environmental studies.Definition, Scope and Importance. Need for public awareness. Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

(a) Forest Resources: Use and over-exploitation, deforestation, case studies. Timber eztraction, mining, dams and their effects on forests and tribal people.
(b) Water Resources- Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
(c) Mineral Resources- Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
(d) Food Resources- World Food Problems, changes caused by agriculture and overgazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
(e) Energy Resources- Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
(f) Land Resources- Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyle.

UNIT II

Ecosystem-Concept of an ecosystem.Sturcture and function of an ecosystem.Producers, consumers and decomposers.Energy flow in the ecosystem.Ecological Succession.Food Chains, food webs and ecological pyramids. Introduction, types,characteristic features, structure and function of the following ecosystem-

a. Forest Ecosystem
b. Grassland Ecosystem
c. Desert Ecosystem
d. Aquatic Ecosystems(ponds, streams, lakes, rivers, oceans, estuaries

Field Work. Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain.Visit to a local polluted site- Urban /Rural Industrial/Agricultural. Study of common plants, insects and birds. Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

UNIT III

Biodiversity and its conservation. Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversityof global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity. Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts. Endangered and endemic species of India.Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

Environmental Pollution Definition. Cause, effects and control measures of- (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards
Solid waste management- cause, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides

UNIT IV

Social Issues and the Environment.From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns. Case Studies.

Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.Wasteland Reclamation.Consumerism and waste products.

Environment Protection Act.Air (Prevention and Control of Pollution) Act.Water (Prevention and Control of Pollution) Act.Wildlife Protection Act.Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public Awareness.

Human population and the Environment.Population growth, variation among nations. Population explosion-Family Welfare Programme. Environment and human health.

Human rights.Value Education.HIV/AIDS, Women and Child Welfare.Role of Information Technology in Environment and Human Health.Case Studies.Drugs and

their effects; Useful and harmful drugs; Use and abuse of drugs; Stimulant and depressan drugs. Concept of drug de-addiction. Legal position on drugs and laws related to drugs.

Text Books

1. Environmental Studies- Deswal and Deswal. Dhanpat Rai & Co.
2. Environmental Science & Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India
3. Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
4. Environmental Science- Botkin and Keller. 2012. Wiley , India

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