COURSE CURRICULUM

FOR

B.Sc. (Hons.) BIOTECHNOLOGY

Effective from session 2009-10

HIMACHAL PRADESH UNIVERSITY
SUMMER-HILL, SHIMLA-171005

B.Sc. (HONS.) BIOTECHNOLOGY PROGRAMME

GENERAL INSTRUCTIONS/GUIDELINES FOR EXECUTION OF CURRICULUM

1. The B.Sc. (Hons) Biotechnology programme will be of three years duration.

2. There will be twenty Four courses for B.Sc. (Hons.) Biotechnology programme. In the first year, second and third year there will be nine, eight and seven courses respectively. Each course will consist of a theory and a practical paper except course No. I (English), VIII (Hindi-I), IX (Environmental Studies), X (Hindi-II) and course No. XXIV (Introduction to Intellectual Property Rights & Entrepreneurship) which will have only theory paper.

3. (a) The theory paper will be of 50 marks, practical paper of 30 marks and internal assessment of 20 marks. Except for Courses I (English) and XXIV (Introduction to Intellectual Property Rights & Entrepreneurship) in which theory will be of 80 marks and internal assessment will be of 20 marks and IX (Environmental Studies) which will be of 100 marks each. Hindi-I and Hindi-II will be of 50 marks each in which 40 marks will be of theory and 10 marks of internal assessment. The pass percentage and Divisions shall be as for other B.Sc. pass courses.

   (b) The split of the 20 marks of internal assessment (except Hindi) will be: attendance 05 marks; Assignment (one) 02 marks; Presentation 03 marks; Class test (two, half hour each) 05 marks and Final house test 05 marks. For Course Hindi, the internal assessment test will be of 10 marks (Attendance 05 marks and Final house test 05 marks). The award of marks for attendance will be as follows: i) upto 75% lectures including condonation of lectures as per ordinances : zero mark, ii) without condonation of lectures upto 75% : 1 mark; iii) 76-80% lectures : 2 marks, iv) 81-85% lectures : 3 marks; v) 86-90% lectures : 4 marks; vi) 91% and above lectures : 5 marks.

4. The remedial course is to acquaint the non-biology students to biological systems and terminologies and to biology students to basic methods, equations and expressions in mathematics and physics. These courses will be offered in first year. There will be examination in this course and pass marks in this course will be the same as for other courses.

5. (a) The admission to B.Sc. (Hons.) Biotechnology programme of Himachal Pradesh University will be as per guidelines of Himachal Pradesh University, Shimla from time to time.

   (b) The candidate should have passed 10+2 (class XII) Examination or its equivalent from a recognized Board/University with any of the three subjects out of Physics, Chemistry, Biology (or Biotechnology/ Microbiology/ Biochemistry) and mathematics with 50% or equivalent grade (for SC/ST candidates marks of eligibility will be 45% or equivalent grade).

   (c) In case of candidates who are studying in University/Board/College/Schools in any of the foreign countries the eligibility/Qualifying marks will be the same as

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10+2 by the University or the association of the Indian _____ s of equivalent grade (for SC/ST candidates, eligibility will _____ t grade).

(d) The candidate who has appeared in the qualifying examination but whose result has so far not been declared can also apply but his/her eligibility for the entrance test will be purely provisional subject to the condition that he/she has to produced a passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling.

(e) The candidate shall not be more than 22 years of age as on 01st July of the year of admission. Date of birth as recorded in the Secondary Education Board/ University Certificate Only will be considered as authentic.

6.   Admission will be based on the merit of the entrance test to be conducted by HP University or any other mode as to be decided by the University from time to time.

7.   The tuition fee and other monthly/annual charges will be as per University rules.

OURSES OF STUDY
FOR
ONS.) BIOTECHNOLOGY

The syllabi, courses of study and credits in basic papers for B.Sc. (Hons.) Biotechnology are given below and these papers will include: English, Fundamentals of Chemistry, Basic & Applied Physics, Fundamentals of Statistics and Computer, Hindi-I, Hindi-II and Environmental Studies. In addition, there will be

- Elementary Mathematics (for +2 medical) OR Fundamentals of Life Sciences (for +2 non-medical)
- Year-wise marks distribution for B.Sc. (Hons.) Biotechnology Course will be:

        First year   850
        Second year   750
        Third year   700
        Grand Total= 2300

OUTLINES OF COURSES FOR B.Sc. (HONS.) BIOTECHNOLOGY 1st YEAR

Course No.	Title of Course	Theory				Practicals
		Periods per week	Marks		Total periods of week	Marks
			Theory	Internal Assessment		
I*	English (common with B.Sc. pass course)	3	80	20	-	-
II (a)* OR II (b)*	Fundamentals of Life Sciences OR Elementary Mathematics	3	50	20	4	30
III*	Fundamentals of Chemistry	3	50	20	4	30
IV*	Fundamentals of Statistics and Computer	3	50	20	4	30
V*	Basic & Applied Physics	3	50	20	4	30
VI*	Introductory Microbiology	3	50	20	4	30
VII**	Basic Biochemistry	3	50	20	4	30
VIII*	Hindi-I (common with B.Sc. pass course)	2	40	10	-	-
IX*	Environmental Studies (common with B.Sc. pass course)	3	100	-	-	-
Total Marks in 1st Year			**520**	**150**		**180**

Total = 520+150+180 = 850

*Common courses with B.Sc. (Hons.) Microbiology and B.Sc. (Hons.) Biochemistry.
** Common courses with B.Sc. (Hons.) Biochemistry.

OUTLINES OF COURSES FOR B.Sc. (HONS.) BIOTECHNOLOGY 2ND YEAR

Course No.	Title of Course	Theory				Practicals
		Periods per week	Marks		Total periods of week	Marks
			Theory	Internal Assessment		
X*	Hindi-II (common with B.Sc. pass course)	3	40	10	-	-
XI	Intermediary Metabolism	3	50	20	4	30
XII*	Introductory Cell Biology	3	50	20	4	30
XIII*	Concepts in Immunology	3	50	20	4	30
XIV	Fundamental Genetics & Molecular Biology	3	50	20	4	30
XV	Introduction to Industrial Microbiology	3	50	20	4	30
XVI*	Instrumental Methods of Analysis	3	50	20	4	30
XVII*	Introduction to Bioinformatics	3	50	20	4	30
Total Marks in 2nd Year			**390**	**150**		**210**

Total Marks 390+150+210 = 750

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...NS.) BIOTECHNOLOGY 3RD YEAR

		Periods per week	Theory — Marks		Total periods of week	Practicals — Marks
			Theory	Internal Assessment		
XVIII*	Basics of Recombinant DNA Technology	3	50	20	4	30
XIX	Fundamentals of Plant Biotechnology	3	50	20	4	30
XX	Elements of Animal Biotechnology	3	50	20	4	30
XXI*	Introduction to Intellectual Property Rights & Entrepreneurship	1	80	20	-	-
XXII	Concepts in Bioprocess Engineering	3	50	20	4	30
XXIII	Food Biotechnology	3	50	20	4	30
XXIV	Environmental Biotechnology	3	50	20	4	30
Total Marks in 3rd Year			**380**	**140**		**180**

Total Marks 380+140+180= 700

Grand Total Marks for B.Sc. (Hons.) Biotechnology Degree 850+750+700=2300

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HONS.) BIOTECHNOLOGY (1ˢᵗ YEAR)

COURSE: I
ENGLISH
(Common with B.Sc. pass course)

Maximum Marks: 80

Instruction to Examiner:
- As per instructions for English paper in other B.Sc. Courses of H. P. University

A. Text Book

The Threshold

Poems

1. John Milton	On His Blindness
2. William Wordsworth	The World is too much with us
3. William Blake	The Echoing Green
4. Emily Dickson	A Bird came Down The Walk
5. Robert frost	Stopping by Woods on a Snowy Evening
6. Nissim Ezekiel	Night of the Scorpion
7. Sarojini Naidu	Palanquin Bearers

Essays

1. Nehru	Work in the Sun and the Light
2. Stephen Leacock	My Financial Career
3. C.V. Raman	The Elixir of Life
4. C. Beavers	Streamlining
5. L. A. Hill	Principles of Good Writing

Stories

1. O. Henry	The gift of the Magi
2. Isaac Bashevis Singer	The Fatalist
3. Guy de Mauppasant	Duel
4. R. K. Narayan	Nitya
5. Prem Chand	The Child

B. Grammar, translation and Composition

Phrase, clause, sentence;
Number, gender;
Noun, pronoun, adjective, adverb;
Preposition, conjunction, articles, modals;
Punctuation and capital letters;
Voice narration;
Synonyms and antonyms;
One word substitution;
Translation from Hindi to English;
Comprehension (unseen passage);
Personal letter & application;
Telegram, notice and invitation;
Use of dictionary, spelling, sounds of English, pronunciation.

a. Testing of speaking/reading/comprehension ability of the students. The candidates may be given to read some sentences/a short passage in order to test their proficiency.
b. Testing the student's ability to consult a dictionary for locating a word, its meaning, pronunciation, parts of speech, use of appropriate preposition, etc.
c. Testing of students listening ability by asking them to write some words.
d. At least 8 to 10 minutes may devoted to each student in conducting the viva-voce examination (Viva-voce may be conducted before the conduct of final written examination)

D. Internal assessment:

It shall be based on the classroom performance, class tests, assignment and response of the students during the academic session.

Recommended Books:

1. **The Threshhold-**MacMillan
2. **Advanced Learner's Dictionary-**Oxford University Press
3. **Longmann's Dictionary of Contemporary English**
4. **Intermediate English Grammar (with key)-Raymond Murphy**
5. **Suplimentary Excercises-**Raymond Murphy, Hashemi
6. **Living English Structure-**W. Stannard Allen
7. **English Vocabulary in Use-**Michael McCarthy and Palicity O'Deil

COURSE: II (a)
NTALS OF LIFE SCIENCES

Maximum Marks-50

Instructions for Examiner:
- Set nine questions in all Q. No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit 1

General Biology: The nature of life, definition of life, characteristics of life, differences between animals and Plants, principal divisions in biology, importance of biology

Unit II

Introduction to various Systems in human body: Digestive system, Respiratory system Circulatory system, Endocrine system, Reproductive system

Introduction to various systems in Plants: Basic Anatomy of flowering plants, nutrition, transport, reproduction.

Basics of Cell Biology: Definition of cell- fundamental cell types, difference between Prokaryotic and Eukaryotic cell types, cell structure cell wall, plasma membrane

Different organelles and their functions. Cell division, cell cycle and its regulation

Basics of Genetics and Evolution: Mendeløs work and experiments, Gene bearer of heredity character, chemical basis of heredity. Chromosome structure, alterations in structure, Human karyotype, Human genome project and its implications

Origin of life, evidences of evolution from Plant and Animal Kingdom. Modern Concept in Evolution.

Unit III

Basic Molecular Biology-I: Nucleic Acids (DNA and RNA)
Chemical Structure, hybridization, double helical structures, replication, concepts of gene and genetic code, transcription and translation, mutations and their implications.

Basic molecular Biology-II: Proteins.
Amino acid structure, chemical nature of residues, levels of protein structure, polypeptide chain folding, concepts of pH, pkI, buffer, aqueous medium. Introduction to enzymes, their types and functions

Lipids: fatty acids, acyglycerols, phospholipids, sphingolipids, cholesterol and membranes; isoprenoids, eicosanoids and their biological importance.

Carbohydrates: monosaccharides, oligosaccharides, polysaccharides, proteoglycans and glycoproteins.

Unit IV

General Microbiology: A brief History of Microbiology, Microbes in our Lives-Definition of Microorganisms, naming and classification of Microorganisms, The diversity of Microorganisms-Bacteria, Fungi, Protozoa, Algae, Viruses, Multicellular Animal

Microorganisms living in Humans and Animals, their role, microorganisms used to produce food and Chemicals, Disease causing Microorganisms.

Recommended Books:

1. Life Sciences -**Rastogi and Dubey**
2. Microbiology -**Pelczar & Chan.**
3. Plant Molecular Biology **-Grierson & S.N.Covey .**
4. Cell biology -**Lodish** *et al.*
5. Concepts in Biology **- Enger & Ross**
6. Biology- **Neil A. Cambell.**

List of Practical:

Maximum Marks- 30

1. Preparation of different types of stains, different types of staining techniques and methods of fixation.
2. To study cell structure from onion leaf peels, *Hydrilla*, *Spirogyra*, *Amoeba, Paramoecium* and *Euglena.*
3. Examination of various stages of mitosis and meiosis
4. Titration of Amino Acids
5. Assay of enzyme activity (Amylase, Invertase and Protease)
6. Effect of various parameters such as pH, temperature, concentration on the activity of commonly used enzymes.
7. Make a temporary preparation of blood samples of mammals.
8. Determination of blood groups of human blood samples.
9. Recording of blood pressure of man.
10. Anatomical study of secondary growth in Helianthus stem and root.
11. Preparation of media, cotton plugging and sterilization techniques.
12. Experiments on isolation, spread plates, pour plates, selective media differential media, staining (simple, differential, Gram, endospore, capsule staining), count of microbes (standard plate count).
13. Study of normal and Abnormal Human Karyotypes.
14. To study the Polytene and Lampbrush Chromosomes

OR

COURSE: II (b)

NTARY MATHEMATICS

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

UNIT 1

Real Numbers

Different kinds of numbers, Integer, rational and Irrational, Surds and their Properties, Fractional Indices.

Set, relation and function

Set, Product sets, Relations, Functions (Polynomials, Trigonometric, Exponential), Graphical representation of Functions

Limit

Sequences, limits of sequences, Series, limits of functions

UNIT II

Elementary mathematical logic.

Elementary Trigonometry, Addition Subtraction, A-B, C-D Formulas.

Concept of A.P, G.P., Natural numbers, Elementary Computing Binary System

Binomial Theorem

Expanding $(x+y)^n$, Binomial Coefficients, Binomial Theorem

UNIT III

Matrices and vectors

Matrix Algebra, Determinants, Applications vector in space,

Calculus

Differentiation: Calculating gradients of chords first and higher order derivatives. Applications Increasing and Decreasing Functions, maximum and Minimum Points, Derivatives as rates of change

Integration: Finding a Function from its derivative, Definite Integral, Indefinite Integral, Calculating Areas, Volumes for bounded regions

Differential Equations: forming differential equations, First Order differential equation, growth equation, Applications.

UNIT IV

Complex Numbers

Extending the number system, Operations with complex numbers

Linear Programming

Elementary Statistics

Representation of Data: Discrete Data, Continuous data, Histogram, Polygons, Frequency Curves

Standard Deviation

Skewness

Recommended books:

1. Mathematics for Biosciences -**Arya J.C and Lardner, R.W**
2. Advanced Engineering Mathematics-**Erwin Kreyszig**

List of Practical:

Maximum Marks: 30

1. Sets
2. Product set, relation
3. Concept of A.P.G.P, Natural Number
4. Binomial Theorem and Coefficient
5. Matrix and Vectors
6. Mean, Median, Quartiles, Percentile

COURSE: III
ENTALS OF CHEMISTRY
Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q. No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit- I

Periodic properties

Position of elements in the periodic table, effective nuclear charge and its calculations, atomic and ionic radii, ionization energy, electron affinity and electronegativity definition, methods of determination trends in periodic table and applications in predicting and explaining the chemical behavior.

Chemistry of Noble gases

Chemical properties of noble gases, chemistry of xenon, structure and bonding in xenon compounds, clathrates, types and stability.

Coordination compounds

Introduction, Werner's coordination theory, naming of coordination compounds. Stereochemistry, Geometrical isomerism and optical isomerism in compounds having coordination number 4 and 6.
Bonding in metal complexes

Unit II

Chemical bonding

Covalent bond

Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridisation and shapes of inorganic molecules and ions- BeF_2, $SnCl_2$, XeF_4, BF_3, NH_3, H_2O, ClF_3, ICl_2, PF_6, SF_6 and IF7.

Molecular orbital theory, Homonuclear (elements and ions of I^{st} and 2nd row) and heteronuclear (BO, CN, CO^+, NO, CO, CN^-), multicentre bonding in electron deficient molecules (BORANES).

Weak interactions

Hydrogen bonding & Vander waals forces

Some fundamental aspects of organic chemistry, inductive effect, electromeric effect, resonance, hyperconjugation, types of reagents electrophile and nucleophiles, types of organic reactions. Reaction intermediates- carbocations, carbanions, free radicals, carbenes (with examples).

Nomenclature and classification of Alkyl halide: Methods of formation, Chemical reactions, Mechanisms and stereochemistry of nucleophillic substitution reactions of alkyl halides, SN^2 and SN^1 reactions with energy diagram. Methods of preparation of aryl halides. The Elimination-Addition mechanism (benzyne mechanism) and nucleophillic

lative reactivities of alkyl halides vs allyl, vinyl and

Alcohols and Phenols

Mechanisms of dehydration, acidity, Fries rearrangement. Mechanism of Kolbe's reaction, Reimer Tiemann reaction and mechanism, Electrophilic substitution reactions of phenol.

Unit III

Aldehydes and Ketones

Reactions with mechanism: oxidation, reduction, reductive amination, nucleophillic addition reaction, ketoenol tautomerism, aldol condensation, Cannizaro's reaction, The Wittig's reaction, Perkin's reaction.

Carboxylic Acids and derivatives

Structure of Carboxylic acids and derivatives. Acidity of carboxylic acids, Effect of substituents on acidic strength. Chemical properties of carboxylic acids. HVZ reaction with mechanism. Relative Stability and reactivity of acid chloride, esters, anhydrides, amides. Mechanism of esterification.

Introduction quantum mechanics: Failure of classical mechanics, advent of quantum theory, Schrodinger wave equation (SWE), physical interpretation of wave function, Quantization, solution of SWE for (i) particle in one dimensional box (ii) rigid bodies (iii) Harmonics Oscillators (iv) Tunnelling and its applications in biological system.

Physical properties and molecular structure: Optical activity, polarization, orientation of dipoles in an electric field, dipole moment, magnetic properties.

Unit IV

Solutions: Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient, Dilute solution, Osmotic pressure, its law and measurements. Elevation of boiling point and depression of freezing point.

Chemical Kinetics: Scope, Rate of reaction, influencing factors such as concentration, temperature, pressure, solvent *etc.* theories of chemical kinetics, Arrhenius Equation, Concept of Activation energy.

Molecular Velocities: Root mean, average and most probable velocities, qualitative discussion of Maxwell's distribution of molecular velocities, collision number, mean free path.

Recommended books:

1. Organic Chemistry -**I.L.Finar**
2. Organic Chemistry-**Morrison and Boyd**
3. Inorganic Chemistry-**J.D.Lee**
4. Inorganic Chemistry-**Puri, Sharma & Kalia**

List of Practical:

Maximum Marks: 30

1. Inorganic qualitative analysis
   Four ions including interferring ions.

2. Volumetric Analysis
   Iodimetry

   Redox titrations using cericsulphate, potassium dichromate and potassium permanganate

   Complexometric titrations using EDTA of Ca^{++}, Mg^{++} and Zn^{++}

COURSE: IV
OF STATISTICS & COMPUTER
Maximum Marks: 50

Instructions for Examiner:
-   Set nine questions in all Q.No. 1 (Objective type) is compulsory.
-   Set 2 questions from each unit and one is to be attempted.
-   Divide the questions into 3-4 short answer questions.

Unit I

Statistical methods

An introduction, types of data, collection, classification and tabulation of the Primary data, Secondary data, Discrete data and continuous data, diagrammatic and graphical representation of grouped data, frequency distribution {univariate and bivariate}, cumulative frequency distribution and their graphical representation, histogram frequency polygon and ogives.

Concept of Central Tendency or location and their measures, partition values: quantiles, deciles and percentiles, dispersion and their measures, relative dispersion.

Moments (Single and double variables) and their relationships, Karl Pearson's, Beta & Gamma coefficients, Charlier's checks and Sheppard's correction for moments for grouped data (without derivation), skew ness & kurtosis and their measures.

Unit II

Mathematical expectation (single and bivariate), expectation of sum of random variables, Variance and Covariance, moment generating and cumulate generating function.

Binomial distribution, Poisson distribution as a limiting form of binomial distribution and properties of these distributions, moments, moment generation function, cumulate generating function, Geometric distribution and exponential distribution and properties of these distributions.

Normal Distribution
Correlation and regression analysis
Hypothesis testing
Markov Models
Cluster Analysis
-   Nearest neighbour search
-   Search using stem numbers
-   Search using text signature

Probability.
Statistical Packages.

Unit III

Computers: General introduction to computers, organization to computers, digital and analogue computers, computers algorithms.

Introduction to computers and its uses: milestones in hardware and software- batch oriented/online/real time applications.

Computers as a system: basic concepts, stored programs, functional units and their interrelation: communication with computer.

Unit IV

Data storage devices: primary storage, storage addressed and capacity, type of Memory: Secondary Storage Devices: Magnetic tape- data representation and R/W: Magnetic Disks, fixed and removable, data representation and R/W: Floppy and Hard Disks, Optical Disks CD-Rom, Mass Storage Devices.

Input/ Output Devices: Key-tape/ diskette devices, light pen Mouse, , joystick, Source data automation.

Printed outputs: serial, line, page, printers, Plotters, voice response units.

Recommended books:

1. Biostatics -**P.N. Arora & P.K. Malhotra**
2. Introduction to Biostatistics- **Sokal & Rohif**
3. Statistical Methods in Bioinformatics: An introduction-**W.Evans.Grant**
4. Computers Today-**S.K.Basandra**
5. Computer fundamentals-**P. K. Sinha**

List of Practical:

Maximum Marks: 30

1. Presentation of date by frequency tables, diagrams and graphs
2. Calculation of measures of central tendencies
3. Calculation of measures of dispersion
4. Calculation of measures of skewness and kurtosis
5. Fitting of binomial distribution.
6. Fitting of Poisson distribution.
7. Probability
8. Bivariate frequency table.
9. Basics of Computer
10. Basic Commands-File Creation, Copying, moving and deleting in Linux & Windows.
11. Using
    e-mail
    browsers
    search engines.

COURSE: V
& APPLIED PHYSICS

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit I

Mechanics

Cartesian and spherical polar co-ordinate systems, area, volume, velocity and acceleration in these systems. Solid angle, centre of mass, equivalent one body problem, central forces, equation of motion under central force. Elastic collision amd C.M system, velocities, angles and energies, rigid bodies motion, rotational motion, principal moments and axes, Euler's equations, Michelson-Morley experiment and its result.Variation of mass-energy equivalence, test mass in an inelastic collision, relativistic momentum and energy.

Unit II

Vibration waves

Simple harmonic motion, energy of a SHO, transverse vibrations of a mass on a string, composition of two perpendiculuar SHM. Decay of free vibrations due to damping. Differential equation for a forced mechanical and electrical, oscillators, transient and steady state behaviours. Displacement and velocity variation with driving force frequency, variation of phase with frequency, resonance, power supplied to an oscillator and its variation with frequency.

Unit III

Electricity and magnetism

Basic ideas of vector calculus, gradient, divergence, curl and their physical significance, Laplacian in rectangular, cylindrical and spherical coordinates. Coulombs law for point charges and continuous distribution of charges, electric field due to dipole, line charge and sheet of charge. Eletric flux, Gauss's law and its applications.

Work and potential difference, as line integral of field, electric potential due to a point charge, a group of point charges, dipole and quadrupole moments, long uniformly charge wires, charge discs. Stroke's theorem and its application in electrostatic fields.

Current and current density, equation of continuity, deviation of ohm's law ($J=oE$). Permeability and susceptibility and their inter relationships. orbital motion of electrons and diamagnetism, electron spin and paramagnetism, ferromagnetism, domain theory of ferromagnetism. hysterisys loss, magnetization curve, ferrites.

Unit IV

Lorentz's force, Biot Savert's law and its application to long straight wires, circular current loops and solenoid.divergence and curl of B. Faraday's law of EM induction, Maxwell's equation. Mutual inductance and Recipricity theorm,L for solenoid, coupling of electrical circuits.analysis of LCR series and parallel resonance circuits, Q factor, power consumed, power sector.

Recommended books:

1. Mechanics- **H.S. Hans & S.P. Puri**
2. Physics of vibrations & waves-**H.J. Pain**
3. Fundamental of Electricity and magnetism-**A.F. Lipp**
4. Electricity and Magnetism, Berkeley Physics Course Vol. II -**E.M. Purcell**
5. A laboratory manual of Physics for undergraduate classes- **D.P Khandelwal**
6. B.Sc. Practical Physics- **C.L. Arora**

List of Practical:

Maximum Marks: 30

1. To find the moment of inertia of a fly wheel.
2. To study the dependence of MOI on distribution of mass by noting the time periods of oscillation using objects of various geometrical shapes of but of same mass.
3. To measure/obtain logarithmic decrement, coefficient of damping, relaxation time and quality factor of a damped simple pendulum.
4. To find the resistance by Carry Foster method after calibrating the bridge wire.
5. To find internal resistance of a cell by using potentiometer.
6. Capacitance by flashing and quenching of a neon lamp.
7. To determine the capacitance of a capacitor by discharging it through a voltmeter.
8. To Study the use of CRO by lissajous figures.
9. To trace B-H curve for different materials using CRO and find magnetic parameters from these.
10. To use a multimeter to measure DC voltage, DC current, AC voltage, Resistance, audible continuity test and diode test.

COURSE: VI

...CTORY MICROBIOLOGY

Maximum Marks: 50

Instructions for Examiner:
-   Set nine questions in all Q.No. 1 (Objective type) is compulsory.
-   Set 2 questions from each unit and one is to be attempted.
-   Divide the questions into 3-4 short answer questions.

Unit I

History of Microbiology: A.Leeuwenhoek, L.Pasteur, R.Koch, J.Lister, J.Tyndall, etc.

Biogenesis vs Abiogenesis, Koch's Postulates, Discovery of antibiotics.

Principle of Microscopy: Bright field, Dark field, Phase contrast, Fluorescent, Electron Microscopy.

Unit II

Microbial classification: Bacteria, Fungi and Algae.

Morphology of bacteria, Viruses and fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores, Sporulation/germination process.

Unit III

Microbial growth, nutritional biodiversity, phases of growth, generation time, growth rates, monoauxic, diauxic and synchronous growth, chemostat.

Microbes in extreme environment like high temperature and high/ low pH values

Physical and chemical agents to kill microbes, sterilization and pasteurization processes

Unit IV

Normal micro flora in humans/animals.

Types of microbial pathogens and disease caused by them. Microbial interactions like symbiosis and antibiosis etc. Host defense mechanism against pathogens.

Nitrogen fixing microbes in agriculture.

Microbial metabolism, unique pathways, photosynthesis, fermentation and its products, production of heterologous proteins in microbes.

1. Microbiology- **Davis, B.D Dulbecco, R., Eiser, H.N. and Ginsberg, H.S.**
2. Microbiology: an introduction- **Tortora, G.J., Funke, B.R. and Case, C.L.**
3. General Microbiology- **Stanier, R.Y.**
4. Microbiology- **Pelczar, M.T.**
5. General microbiology- **Schlegel, H.G.**
6. Industrial Microbiology- **Prescot and Dunn**
7. Microbiology: fundamentals and Applications- **Purohit, S.S.**
8. Microbes and Man- **Postgate, J.**
9. Microbiology: Laboratory manual- **Cappuccino, J.G and Sherman, N.**

List of Practical:

Maximum Marks: 30

1. Aseptic techniques
2. Cleaning of glass wares, Preparation of media, Cotton plugging and sterilization
3. Personal hygiene-microbes from hands, Tooth-scums and other body parts.
4. Isolation of microorganisms from air, water and soil samples
5. Dilution and pour plating techniques.
6. Enumeration of microorganisms total vs viable counts.
7. Identification of isolated bacteria
8. Gram staining, other staining methods, metabolic characterisation (e.g ImVIC) Tests
9. Growth curve of microorganisms.
10. Antibiotics sensitivity of microbes. Use of antibiotic discs.
11. Testing of water quality
12. Test for antibodies against given Bacteria
13. One step growth of bacteriophage.
14. Culture from body fluids (stool, Urine, blood).
15. Alcoholic and mixed acid fermentation.

COURSE: VII

IC BIOCHEMISTRY

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit I

Water and its property: Physico chemical properties of water, dissociation and association constants. pH and buffers, pI, pka, Hasselberg Handerson equation and its implication.

Carbohydrates: Structure of important mono, di, oligo and polysaccharides, glycoproteins and peptidoglycan, glycolipids and lipopolysaccharides. Reaction of monosaccharides.

Unit II

Proteins: Structure of amino acids, non-protein and rare amino acids and their chemical reactions. Structural organisation of proteins (primary, secondary, quaternary domain structure), protein classification and function. Forces stabilizing primary, secondary and tertiary structure. Laboratory synthesis of protein, lectin antibodies

Unit III

Lipids: Classification of lipids and fatty acids, general functions of major lipid subclasses, acyglycerols, phosphoglycerols, phosphoglycerides, sphingolipids, glycosphingolipids and terpens, sterols, steroids. Prostagladins, Prostaryclins, Leukotrienes etc.

Unit IV

Nucleic acids: Structure of nucleosides, nucleotides and nucleic acids, biologically important nucleotides and their functions. Applications of biochip and microarray.

Vitamins and hormones: Types of vitamins and their chemistry vitamins as cofactors, steroids and peptide hormones

1. Biochemistry- **Rawn, J.D.**
2. Principles of Biochemistry- **Lehninger, A.L. Nelson, D.L. and Cox, M.M**
3. Biochemistry- **Stryer, L.**
4. Principles of Biochemistry: Student Study Art Notebook- **Zubay, G.L, Parson, W.W. and Vance, D.E.**
5. Carbohydrate Biotechnology Protocols- **Bucke C.**
6. Principles of Biochemistry- **Horton** *et al.*
7. An Introduction of practical biochemistry- **Plummer D.T.**
8. Practical Biochemistry- **Bansal, D.D., Khardori, R & Gupta, M.M.**

List of Practical:

Maximum Marks: 30

1. Preparation of physiological buffers
2. Verification of Beer lamberts law for P-nitrophenol or cobaltchloride
3. Determination pK_a value of p-nitrophenol
4. The colorimetric estimation of inorganic phosphates
5. Estimation of carbohydrates in given solution by Anthron method.
6. Estimation of sugars in biological samples
7. Protein estimation by lowry¢s method.
8. Protein estimation by Bradford methods.
9. Analysis of urine for urea, glucose, uric acid and chloride.
10. The determination of acid value of a fat
11. Saponification value of a fat
12. Separation of lipids by thin layer chromatography.

COURSE: VIII
HINDI-I
(Common with B.Sc. pass course)

Maximum Marks: 40

सामान्य हिन्दी — पत्र-एक

समय : 3 घंटे   पूर्णांक : 40

> हिन्दी को उच्च शिक्षा की माध्यम भाषा बनाने के लिए आवश्यक है कि मानविकी, समाज विज्ञान, विज्ञान, वाणिज्य आदि सभी संकायों के विद्यार्थी हिन्दी भाषा का अध्ययन करें। यह परीक्षा 50 अंकों की होगी और इसे उत्तीर्ण करना आवश्यक होगा। श्रेणी - निर्धारण में ये अंक जोड़े जाएंगे। प्रश्न पत्र एक स्नातक प्रथम वर्ष परीक्षा और द्वितीय पत्र स्नातक द्वितीय वर्ष हेतु निर्धारित है। सामान्य हिन्दी स्नातक, बी.ए. उत्तीर्ण (पास) पाठ्यक्रम के विद्यार्थियों के लिए भी निर्धारित है।

पाठ्य विषय

संक्षेपण, पल्लवन, पत्राचार, अनुवाद, मुहावरे-लोकोक्तियाँ, शब्द-शुद्धि, वाक्य-शुद्धि, शब्द-ज्ञान-पर्याय, विलोम, अनेकार्थी, अनेक शब्दों के लिए एक शब्द, कंप्यूटर में हिन्दी का अनुप्रयोग : प्रारम्भिक परिचय, हिन्दी में संक्षिप्तीकरण, हिन्दी में पदनाम।

पाठ्य पुस्तक

डॉ॰ कृष्ण कुमार गोस्वामी, अनुप्रयोगिक हिन्दी, अरुणोदय प्रकाशन दिल्ली।

अंक विभाजन तथा प्राशिक के लिए निर्देश

संक्षेपण, पल्लवन	7 अंक
पत्राचार	7 अंक
अनुवाद	6 अंक
मुहावरे-लोकोक्तियाँ	10 अंक
शब्द-शुद्धि, वाक्य-शुद्धि, शब्द ज्ञान-पर्याय, विलोम, अनेकार्थी, समश्रुत, अनेक शब्दों के लिए एक शब्द	10 अंक
कंप्यूटर में हिन्दी का अनुप्रयोग	5 अंक
हिन्दी में संक्षिप्तीकरण, हिन्दी में पदनाम	5 अंक

आवश्यक निर्देश

उपर्युक्त अंक विभाजन के अनुसार इस प्रश्न पत्र में निर्धारित पाठ्य पुस्तक में से पर्याप्त विकल्पों के आधार पर प्रश्न पूछे जाएंगे।

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COURSE: IX
ONMENTAL STUDIES
(Common with B.Sc. pass course)

Maximum Marks: 100

Instruction for Examiner

- Answer of five questions only expected
- There will be two questions from each section and students have to answer one question from each section. Each question will be of 20 marks.
- In addition to above there will be one compulsory question of 20 marks. This will be based on entire syllabus. This question will have 10 parts of 2 marks each.

Unit-I

1. Environment óits definition, objective and importance
2. Scope of environmental education-multi disciplinary approach a fusion of subjects of science, art and humanities.
3. Environment education in historical context
4. Environment education through various subjects
5. Natural resources: Exploitation and development
6. Bio-diversity and conservation

Unit-II

1. Eco-system, community and biotic regions
2. Increasing population its education & environmental results
3. Air, water, sound, noise pollution and control
4. Forest conservation and social forestry
5. Audio-video techniques & conservation of wild life
6. Soil erosion and its conservation
7. Energy and environment

Unit-III

1. Environmental education planning and its implementation
2. Environmental awareness
3. Environment in educational institutions and in the service training
4. Environmental problem: Solution method & project method
5. Environment club, laboratory, library and publication
6. Environmental learning aids (with audio-video material)
7. Game and environment
8. Field trip and environment

Unit-IV

1. Population growth & environmental degradation
2. Bad effects of insecticides on life
3. Polluted residence one more step towards downfall
4. Man & environment: Global view of environment
5. World history of environment conservation
6. Environment protection & improvement at National level
7. International treaty, conference and environmental act
8. Environmental destruction: Future vision and healthy environment for future

Recommended book: Environmental Study-**S K Dhawan, S K Sharma** and M L Sharma

BIOTECHNOLOGY 2nd YEAR
COURSE: X
HINDI-II
(Common with B.Sc. pass course)

Maximum Marks: 40

सामान्य हिन्दी — पत्र-दो

समय : 3 घंटे   पूर्णांक : 40

हिन्दी को उच्च शिक्षा की माध्यम भाषा बनाने के लिए आवश्यक है कि मानविकी, समाज विज्ञान, विज्ञान, वाणिज्य आदि सभी संकायों के विद्यार्थी हिन्दी भाषा का अध्ययन करें। यह परीक्षा 50 अंकों की होगी और इसे उत्तीर्ण करना आवश्यक होगा। श्रेणी - निर्धारण में ये अंक जोड़े जाएंगे। प्रश्न पत्र एक स्नातक प्रथम वर्ष परीक्षा और द्वितीय पत्र स्नातक द्वितीय वर्ष हेतु निर्धारित है। सामान्य हिन्दी स्नातक, बी.ए. उत्तीर्ण (पास) पाठ्यक्रम के विद्यार्थियों के लिए भी निर्धारित है।

राठृय विषय :   खण्ड-क

निम्नलिखित लेखकों/चिंतकों के एक-एक निबन्ध का अध्ययन किया जाएगा :
महात्मा गाँधी – आकाश दर्शन; विनोबा भावे – ग्रामलक्ष्मी की उपासना; आचार्य
नरेन्द्र-समष्टि और व्यक्ति; भगवतशरण उपाध्याय – भारतीय संस्कृति की कहानी;
श्यामाचरण दूबे – परम्परा : कुछ विचार, कुछ प्रश्न।

पाठ्य पुस्तक

डॉ॰ लक्ष्मीनारायण शर्मा (सं॰), युग मनीषा, स्वर्ण जयंती, कबूलनगर शाहदरा, दिल्ली।

खण्ड-ख

हिन्दी भाषा और उसके विविध रूप-कार्यालयी भाषा, मीडिया की भाषा, विज्ञ एवं वाणिज्य की भाषा, मशीनी भाषा।

खण्ड-ग

अनुवाद व्यवहार – अंग्रेजी से हिन्दी में अनुवाद

खण्ड-ख तथा ग के लिए पाठ्य पुस्तक

डॉ॰ रहमतुल्ला, भाषा के विविध रूप और अनुवाद, विद्यानिधि, दरियागंज, दिल्ली।

अंक विभाजन तथा प्राश्निक के लिए निर्देश

दो व्याख्याएँ खण्ड-क से   2 × 7 = 14 अंक
एक आलोचनात्मक प्रश्न (सार, उद्देश्य, समस्या) खण्ड-ख   1 × 8 = 8 अंक

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1 × 8 = 8 अंक
1 × 5 = 5 अंक
1 × 10 = 8 अंक
10 × ½ = 5 अंक

) खण्ड (ग)

पारिभाषिक शब्द खण्ड (ग)

आवश्यक निर्देश :

1. खण्ड "क" के अन्तर्गत निर्धारित पाठ्य पुस्तक के विभिन्न निबन्धों में से चार व्याख्याएँ पूछी जाएंगी जिनमें से दो को व्याख्यायित करना होगा।

2. निर्धारित निबन्धों पर दो आलोचनात्मक प्रश्न सार/उद्देश्य एवं सारांश पर पूछे जाएंगे जिनमें से एक का उत्तर देना होगा।

3. निर्धारित पाठ्य पुस्तक "युग चरीखा" में से सात लघुउत्तरीय प्रश्न पूछे जाएंगे जिनमें से पाँच के उत्तर देने होंगे।

4. खण्ड "ख" में से दो प्रश्न पूछे जाएंगे जिनमें से एक का उत्तर देना होगा।

5. खण्ड "ग" में से अंग्रेजी से हिन्दी-अनुवाद के लिए पाठ्य पुस्तक से दो अनुच्छेद पूछे जाएंगे जिनमें से एक का अनुवाद करना होगा।

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COURSE: XI
INTERMEDIARY METABOLISM

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I

Enzymes: Classification, nomenclature, general properties, regulation of enzyme activity, steady state kinetics, first order and second order kinetics, covalent modifications, inhibitors, Immobilized enzymes, Ribozymes.

Unit-II

Metabolism: Metabolic pathways, biochemical reaction mechanisms, energy rich metabolites, interorgan metabolic pathways.

Carbohydrate metabolism: Biosynthesis and degradation of carbohydrates; feed pathways for glycolysis; Kreb's Cycle: Enzymes of Kreb's cycle, amphibolic nature of the Kreb's cycle; regulation of Kreb's cycle regulation of carbohydrate metabolism

Unit-III

Electron transport and Oxidative phosphorylation

Mitochondrial electron transport chain, oxidative phosphorylation and regulation of ATP synthesis.

Unit-IV

Lipid Metabolism: Biosynthesis and degradation of fatty acids; metabolism of triacyl glycerols; cholesterol metabolism and complex lipids.

Nitrogen Metabolism: Reduction and assimilation of atmospheric nitrogen, Biosynthesis and degradation of amino acids; amino acids as precursors of heme; biogenic amines; biosynthesis and degradation of nucleic acids.

Porphyry: Translation, Transcription, and Replication

1. Principles of Biochemistry- **Lehninger, A.L. Nleson, D.L. and Cox, M.M.**
2. Biochemistry- **Rawn, J.D.**
3. Biochemistry- **Stryer, L**
4. Biochemistry- **Voet D. and Voet, J.G.**
5. Fundamentals of Biochemistry- **Voet, D., Voet, J.G. and Pratt, C.W.**
6. An Introduction of Practical Biochemistry- **Plumer D.T.**
7. Practical Biochemistry- **Bansal, D.D., Khardori, R & Gupta, M.M.**

List of Practical:

Maximum Marks: 30

2. Estimation of α-amylase activity from saliva
3. Assay of acid phosphatase activity
4. Effect of temperature on enzyme activity
5. Effect of pH on enzyme activity
6. Determination of Km for acid phosphatase
7. Purification of protein using salt precipitation
8. Chromatographic methods for separation of macromolecules
   - Paper chromatography
   - Thin layer chromatography
   - Gel permeation chromatography

COURSE: XII
CTORY CELL BIOLOGY

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I

Cell as a basic unit of living systems. The cell theory. Precellular evolution: artificial creation of cells.

Broad classification of cell types: PPLOøs, bacteria, eukaryotic, microbes, plant and animal cells. A detailed classification of cell types within an organism. Cell, tissue organ and organisms as different levels of organizations of otherwise genetically similar cells.

Unit-II

Ecological amplitude of cells in high altitude, sediments, arctic, hotspring, arid, brackish, extremophytes and freshwater environments.

Biochemical composition of cells (proteins, lipids, carbohydrates, nucleic acids and the metabolic pool)

Biological Membranes: Supramolecular architecture of membranes; solute transport across membranes, model membranes and lipsomes.

Unit-III

Structure and function of cell organelles, ultra structure of cell membrane, cytosol, Golgi bodies, endoplasmic reticulum (rough and smooth), ribosomes, cytoskeletal structures (actin, microtubules etc.) Mitochondria, chloroplasts, lysosomes, peroxysomes, nucleus (nuclear membrane, nucleoplasm, nucleolus chromatin).

Unit-IV

Cell division and cell cycle: mitosis, meiosis, stages of cell cycle, binary fission amitosis.

Cell-cell interaction

Cell locomotion (amoeboid, flagellar and ciliar)

Cell senescence and death: Apoptosis and necrosis

Cell differentiation in plants and animals: totipotent, multipotent, pleuripotent cell.

1. Cell and Molecular Biology- **De-Robertis, F.D.P. and De-Robertis Jr. E.M.F.**
2. Molecular Cell Biology- **Lodish, H., Baltimore, D., Berk, A., Zipursky, S.L.Matsudaira, P. and Darnell**
3. The Cell: A Molecular Approach- **Geoffrey, M**
4. Essential techniques in Cell Biology- **Shah V.C., Bhatavdekar, J.m Chinoy, N.J. and Murthy, S.K.**
5. Cell Biology: A Laboratory Handbook- **Celis, J.E.**

List of Practical:

Maximum Marks: 30

1. Microscopy:
   a. Principles of compound, phase contrast, electron microscopy
   b. Use and care of Light compound microscope.

2. Study of cells:
   i. Prokaryotic cells: *Lactobacillus*, *E.Coli*, Blue green algae
   ii. Eukaryotic cells. Testicular material (for studies of spermatogenesis)

3. Microtomy: Introduction of the instrument, its use, care, section cutting and stretching.

4. Preparation of permanent slides: Principles and procedures; section cutting of tissues and staining of tissues with Haematoxylin/eosin method.

5. Study of permanent slides of various tissues (gut region, liver, lung, spleen, kidney, pancreas testis, ovary, tongue, skin etc.)

6. Cytochemical techniques to study carbohydrates, nucleic acids and proteins.

COURSE: XIII

PTS IN IMMUNOLOGY

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I

Introduction: Types of immunity-innate and adaptive; features of immune response-memory. Specificity and recognition of self and non-self; terminology and approaches to the study of immune system; immunity to viruses bacteria; fungi and tumours; vaccines.

Unit-II

Cells and organs of the immune system.

Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells; Monocytes, Polymorphs, primary and secondary lymphoid organs-thymus, Bursa of fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphocyte traffic

Unit-III

Humoral Immunity

Antigen-antibody interactions; affinity and avidity; high and low affinity antibodies, immuno-globulins, classes and structure, molecular mechanism of generation of antibody diversity, complement fixing antibodies and complement cascade.

Cell Mediated Immunity

T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC, structure of T-cell antigen receptors.

Unit-IV

Immunodiagnostic Procedures.

Various types of immunodiffusion and immunoelectrophoretic procedures, Immunoblot, ELISA, RIA, Agglutination of pathogenic bacteria, Haemagglutination and Haemagglutination inhibition.

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1. Immunology- **Roitt, I.M. Brostoff, J. and Male, D.K.**
2. Immunology- **Kuby, J.**
3. Principles of Cellular and Molecular Immunology- **Austyn, J.M. and Wood, K.J.**
4. Fundamental Immunology- **Paul, W.E.**
5. Monoclonal Antibodies Principles and Application- **Britch, J.R. and Lennox, E.S.**
6. Medical Immunology- **Strites, D.P.Terr, A.I. & Oparslow T.G.**
7. Clinical Immunology and Serology: A laboratory perspective- **Steverns, C.D.**
8. Cell Biology: A Laboratory Handbook- **Celies, J.E.**

List of Practical:

Maximum Marks: 30

1. Differential leucocytes count
2. Total leucocytes
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of T and B cells from PBMC by nylon wool method
7. Separation of serum from blood
8. Enumeration of T-Cells by E-rosetting method.
9. Double immunodiffusion test using specific antibody and antigen.
10. Separation of peritoneal macrophages from rat
11. Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion methods.
12. Direct and Indirect ELISA.

COURSE: XIV

NETICS & MOLECULAR BIOLOGY

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I

Nature of genetic material, nucleic acids, DNA replication

Organization of Chromosomes: Genome size and complexity, the supercoiling of DNA, the structure of prokaryotic and eukaryotic chromosome, Polytene chromosomes, euchromatin and heterochromatin, satellite DNA, centromere and telomere structure.

Unit-II

Gene organization and expression in prokaryotes and eukaryotes.

Introduction to Genes and Proteins, Genome Sequences, ORFs, Genes, Introns, Exons, Splice Variants, DNA/RNA, Secondary structure, Triplet Coding, Protein sequences, Protein Structure, Secondary, Tertiary and Quaternary structures.

Unit-III

Mendelian Laws of inheritance, gene interactions.

Extrachromosomal inheritance, mitochondrial and chloroplast genetic systems: sex linked inheritance.

Gene linkage and chromosome mapping: Linkage and recombination of genes in chromosomes, crossing over and its molecular mechanism, gene mapping by three point test crosses, mapping by tetrad analysis, somatic cell hybridization for gene linkage studies, recombination within genes.

Unit-IV

Mutation: Spontaneous versus induced mutations, types of mutations, the molecular basis of mutations, mechanisms of DNA repair, mutations, frequency, correlation between mutagenicity and carcinogenicity, mutagenic agents, chemical and radiation.

Population Genetics: Hardy-Weinberg equilibrium, gene and genotypic frequencies, introduction of eugenics.
Basic microbial genetics: Conjugation, transduction, transformation, isolation of auxotrophs, replica plating techniques, analysis of mutations in biochemical pathway, one geneó one enzyme hypothesis.

1. Microbial Genetics- **Maloy, S.R. Crown, J.E., and Freifelder, D.**
2. Genetics- **Hartl, D.L.**
3. Genetics: Analysis and Principles- **Brooker, R.J.**
4. The Science of Genetics- **Antherly A.G. Girton, J.R.**
5. Microbial Genetics- **Freifelder, D.**
6. Genetics: Analysis of Genes and Genomes- **Hartl, D.L. Jones, E.W.**

List of Practical:

Maximum Marks: 30

1. Demonstration of Law of segregation and Independent assortment (use of coloured beads, capsules etc.) Numericals for segregation and independent assortment. Use of Chi2 for prediction of phenotype/genotype frequencies of parents from progeny and vice-versa, Epistasis.
2. Segregation demonstration in preserved material (Maize)
3. Detection of Blood groups (A B O & Rh factors)
4. Inheritance of other human characteristics, ability to test PTC, Thiourea
5. Calculation of variance in respect of pod length and number of seeds/pod
6. Calculation of gene frequencies and random mating (coloured beads, capsules)
7. Paternity disputes (blood groups)
8. Dermatographics: Palm print taking and finger tip patterns.
9. Preparation and study of mitosis slides from buccal mucosa and onion root tips by squash method.
10. Preparation and study of meiosis slides from meristem tissue by squash method.
11. Demonstration of sex chromatin from buccal smear using thionin stain.

COURSE: XV
...O INDUSTRIAL MICROBIOLOGY
Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I

Introduction: Basic concept of agriculture as industry: industrially important microbes, its screening, selection and identification. Maintenance and preservation of industrially important microbial cultures. Differences between microbial industrial processes and chemical industrial processes.

Unit-II

Improvement of industrial microbes:

Improvement programme of industrial microbes, mutational programme of penicillin producing microorganisms, selection pressure in maintaining the hyper producing microbes, revertant back of higher yielding microbes into lower production, media formulation and process optimization of industrial and agro industrial microbes.

Unit-III

Industrial and agro-industrial microbes:

Microbes involved in antibiotics, pharmaceutical drugs, enzymes production, solvent production, surfactants, vermiculture, composting, herbicides and biopesticides production, biotransformation, nitrogen fixation, organic acids production, vitamins, aminoacids, single cell protein, biofertilizers, alcohols, wine, beers, mycotoxins.

Microbial processes in Agro biotechnology:

Introduction, plant microbe interactions, BT gene in BT cotton, *Rhizobium*, *Azospirillum*, *Azobacter*, *Anabena* in nitrogen fixation, *Agrobacterium*, *Spirulina* production, soil treatment with microbes, Mycorrhizal fungi, microbial pesticides, mycoherbicides.

Unit-IV

Microbial process in industrial biotechnology:

Introduction, primary and secondary metabolites production, production of vitamins, B_{12}, alcohols, wine beer, cheese, bread, citric acid, penicillins, glutamic acid, cellulases, proteases in leather industries Biochips.

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1. Plant Biotechnology in Agriculture- **K. Lindsey and M.G.K. Jones**
2. Biotechnology : A Text Book of Industrial Microbiology-**T.D. Brock**
3. Industrial Microbiology-**L.E. Casida**
4. Industrial Microbiology-**Prescott & Dunn**
5. Biotechnology-A Hand Book of Industrial Microbiology-**W. Crueger and A. Crueger**
6. Microbial Biotechnology-**A. N. Glazer and H. Nikaids.**

List of Practical:

Maximum Marks: 30

1. Autoclaving
2. Microbial cells counting by serial dilution techniques.
3. Microbial cell counting by pore plate techniques.
4. Measurement of bacterial size
5. Screening of cellulase producing microorganism from wood degrading soil.
6. Antibiotic sensitivity of the above microorganism
7. Minimum inhibitory concentration of a antibiotics for the above microorganism.
8. Additive and synergistic effect of two drugs on the above microorganisms.
9. Plating the milk samples for microbial contamination.
10. MBRT Test for determination of milk quality.

COURSE: XVI

AL METHODS OF ANALYSIS

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q. No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit I

Centrifugation: Principle, types, application

Electrophoresis: Principle, types, application

PCR techniques and DNA isolation

Unit II

Spectrophotometry (UV & Visible) and spectroflourimetry, Atomic absorption spectrophotometry

Infrared and Raman spectroscopy, ORD and circular dichroism, Nuclear magnetic Resonance and Electron Spin Resonance spectroscopy, Magnetic Resonance Imaging.

Concepts of microscopy-sections

Unit III

Crystallography and X-Ray diffraction, Electron diffraction, Neutron diffraction.

Unit IV

Radioisotope techniques: radiotracers GM Counter, Proportional and Scintillation counters, autoradiography, Mass spectrometry-GCMS and LCMS.

Recommended Books:

1. Principles and Techniques of Practical Biochemistry- **Keith Wilson & John Walker (Eds.)**
2. Spectroscopy of Biological Molecules: Modern Trends- **P. Carmona, R. Navarro, A. Hernanz (Eds.)**
3. Molecular Fluorescence: Principles and Application- **Bernard Valeur**
4. Protein NMR for the Millennium (Biological Magnetic Resonance)- **N. Rama Krishna, Lawrence J. Berliner (Eds.)**

List of Practical:

Maximum Marks: 30

1. Verification of Beer ó Lambert Law by Biuret Method.
2. To perform salting out for partial purification of protein(s) in a given mixture.
3. Preparation of serum by centrifugation.
4. To separate a mixture of amino acids by Ascending Paper Chromatography.
5. To separate a mixture of amino acids by Thin Layer Chromatography.
6. Agarose Gel electrophoresis of DNA.
7. SDS-PAGE of proteins.
8. Polymerase Chain reaction.
9. Sandwich ELISA.
10. To check the purity of DNA by UV Spectrophotometry

COURSE: XVII
INTRODUCTION TO BIOINFORMATICS

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q. No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

UNIT I

History of Bioinformatics. The notion of Homology.

Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

UNIT II

Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web.

Introduction of Data Generating Techniques, Restriction Enzymes, Gel Electrophoresis, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry, What data each generates and what Bioinformatics problems they pose.

UNIT III

Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment Phylogenetic Analysis.

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLST, FASTA, DATA Submission**.**

UNIT IV

Protein Structure: Protein structure classification, Structure Analysis, Secondary structure prediction methods, Comparative modeling

Genome Annotation: Pattern and repeat finding, Gene identification tools.

1. Bioinformatics: The Machine Learning Approach-**Pierre Baldi and Soren Brunak**
2. Bioinformatics: A practical guide to the analysis of genes and proteins- **Baxvanis (Ed.)**
3. Bioinformatics online (Methods in Enzymology V. 266 Computer methods for macromolecular sequence)- **Doolittle (Ed.)**
4. Molecular Evolution: a phylogenetic approach, -**Page, ROM and Holmas EC**
5. Bioinformatics: Sequences, structure and databanks-**Des Higgins and Willie Taylor**

List of Practical:

Maximum Marks: 30

1. Sequence information resource
2. Understanding and using on web:
3. EMBL, Genbank, Entrez,Unigene, Protein information resource
4. Understanding and using on web:
5. PDB, Swissprot, TrEMBL
6. Using BLAST and interpretation of results.
7. Multiple sequence alignment using Clustal W
8. PAGE

BIOTECHNOLOGY 3RD YEAR

COURSE: XVIII
BASICS OF RECOMBINANT DNA TECHNOLOGY

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I

Introduction, Historical Enzymes Restriction enzymes, Ligases, DNA polymerase, kinases, Reverse transcriptase, Endonucleases, Phosphatase.

Unit-II

Vectors: Plasmid, Cosmids, Lambda, Vectors (Intentional and Replacement vectors),M-13, Phagemids

Unit-III

Radioactive and non-radioactive DNA and RNA labelling techniques: Nick translation, random priming, Sequencing

Unit-IV

Southern and Northern blotting, hybridization

Introduction to site directed mutagenesis

PCR and its Applications

Transformation of *E.coli* Yeast, animal and plant cells, Genomic cloning, cDNA cloning and colony hybridization.

Application of rDNA technology to medicine, agriculture and environment.

Recommended Books:

1. Molecular cloning: A Laboratory Manual- **J.Sambrook, E.F. Fritsch and T.Maniatis**
2. Principles of Gene Manipulation: An introduction to Genetic Engineering- **R.W. Old and S.B. Primrose**
3. Gene Probes I.A. Practical Approach- **B.D.Hames and S.J.Higginis**
4. Recombinant Gene Expression Protocols- **Tuan Rockey S**
5. PCR Cloning Protocols- **White Bruce A**

List of Practical:

Maximum Marks: 30

1. DNA isolation from plants
2. DNA isolation from E.coli
3. Spectrophotometer analysis of DNA
4. Agarose gel electrophoresis of DNA
5. Plasmid DNA isolation
6. Restriction digestion of DNA
7. Southern Blotting
8. Making competent cells
9. Transformation of competent cells.

COURSE: XIX

FUNDAMENTALS OF PLANT BIOTECHNOLOGY

Maximum marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I
Plant nutrition and deficiency symptoms, Plant growth regulators and their physiological functions and role in morphogenesis, plant water relationships.

Unit-II
Culture media, culture techniques
Sterilization techniques: for glassware, tissue and media.

Unit-III
Totipotency, somatic embryogenesis, micropropagation and somaclonal variation.

Protoplast culture and somatic cell hybridization, Induction of haploids and polyploidy through tissue culture, embryo rescue embryo culture, Production of secondary metabolites by plant tissue culture.

Unit-IV
Gene transfer in plant cells their application production of transgenics.

Recommended Books:

1. An introduction of Plant Tissue Culture- **Razdan, M.K.**
2. Plant Cell and Tissue Culture- **Narayanaswamy, S.**
3. Plant Cell Biotechnology- **Rudolf, E.**
4. Plant Tissue Culture theory and practice a Revised edition- **Bhojwani, S.S. and Razdan, M.K.**
5. Plant Cell Tissue and Organ Culture- **Gemborg, O.L. and Phillips, G.C.**

List of Practical:

Maximum Marks: 30

1. Sources of contamination and decontamination measures.
2. How to clean glass/plastic ware
3. Operational use of an autoclave.
4. Functions and operations of a Laminar Air Flow Hood
5. Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid.
6. Preparation of complex nutrient medium (Murashige & Skoog's medium)
7. Laboratory design set up for a PTC laboratory.
8. Plugging and sealing of culture vessels.
9. To selection, Prune, sterilize and prepare an explant for culture.
10. Significance of growth hormones in culture medium.
11. To culture different explants for raising callus cultures.
12. To demonstrate various steps of Micropropagation.

COURSE: XX

ELEMENTS OF ANIMAL BIOTECHNOLOGY

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I

History of development of cell cultures, the natural surroundings of animal cells, stimulating natural conditions for animal cells, metabolic capabilities of animal cells.

Sterilization techniques: Aseptic techniques in animal tissue culture; sterilization of culture media, glassware and tissue culture laboratory, detection of contamination, safety considerations in ATC laboratory.

Unit-II

Animal Cell Culture Techniques: Dispersion and disruption of tissues; primary cultures, anchorage and non-anchorage dependent cells; secondary cultures, transformed animal cells, established/continuous cell lines; measurement of growth and viability of cells in culture, tissue culture media: Components their importance. Serum free media.

Unit-III

Commonly used animal cell lines, their origin and characteristic, growth kinetics of cells in culture, differentiation of cells, organ culture, expressing cloned protein genes in animal cell cultures.

Applications: Cell fusion and production of monoclonal antibodies; scale up methods for propagation of anchorage dependent and suspension cell culture; Bioreactors for large scale culture of cells, micro carrier culture, transplanting cultured cells.

Unit-IV

Genetic Engineering in animal cells: Transformation of animal cells, vectors and expression vectors, Genetic Engineering in production or regulatory proteins, blood products, vaccines and hormones, Transgenic animals and production of useful products in transgenic animals.

In vitro fertilization, embryo transfer, cloning: methodology and its applications, ethics in cloning.

1. Mammalian Cell Biotechnology – A Practical Approach- **Butler, M.**
2. Culture of Animal Cells- **Freshney, R. T.**
3. Human Cell Culture Protocols- **Gareth, E.J.**
4. The Animal Cell Culture and Technology- **Butler, M.**
5. Cell Biology-A Laboratory hand books- **Julio, E., Celis**
6. Gene Therapeutics- **Wolff, J.E.D.**
7. Genes in Medicine- **Rasko, I., and Downes, C.S.**
8. Molecular Biotechnology Therapeutic Application and Strategies- **Maulik S. and Patel, S.D.**
9. Mammalian Cell Biotechnology. A practical approach- **Butler, M.C.**
10. Culture of Animal Cells- **Freshney, R.T.**

List of Practical:

Maximum Marks: 30

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. Isolation of rat macrophages from peritoneum for culturing
7. Primary Lymphoid culture
8. DNA isolation from animal tissue
9. Quantification of isolated DNA
10. Resolving DNA on Agarose Gel.

COURSE: XXI
INTELLECTUAL PROPERTY RIGHTS &
ENTREPRENEURSHIP

Maximum Marks: 80

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
- Divide the questions into 3-4 short answer questions.

Unit-I

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions.

Unit-II

Intellectual/Industrial property and its legal protection in research, design and development.

Unit-III

Patenting in Biotechnology, economic, ethical and depository considerations.

Patentable subject matter and legal aspects of transfer of Biotechnology in India. Writing a patent specification.

Information sources in Patent Literature search.

Unit-IV

Entrepreneurship: Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.

Recommended Books:

1. Agriculture and Intellectual Property Rights: Economic, Institutional and Implementation Issue in Biotechnology-**V Santaniello, R E Evenson, d Zilberman, G A Carlson**

COURSE: XXII
CONCEPTS IN BIOPROCESS ENGINEERING

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
  Divide the questions into 3-4 short answer questions.

Unit-I

Introduction

Fundamental principles of Chemical Engineering and biochemical engineering. Applications of physical and chemical laws on biological samples *e.g.*, light reaction, photolysis of water, enzymatic reaction and simple kinetics.

Unit-II

Microbial Growth Kinetics:

Simple kinetics of microbial growth, yield coefficient, doubling time, specific growth rate, substrate inhibition kinetics, product inhibition kinetics, internal and external feed back systems, metabolic and biomass productivities, effect of temperature, pH and inducer on product synthesis.

Sterilization:

Introduction air and media sterilizations, design of batch sterilization process, Del factor, sterilization cycle, continuous sterilization process, sterilization of fermenters.

Unit-III

Design of fermenter:

Introduction, fermenter for microbial, animal and plant cell culture, Aseptic operation of fermenter, control and measurement equipments of fermenter, pH and D.O. probes, impeller and spargers, batch, fed batch, C.S.T.B.R. plug flow and air loop bioreactors, operation and agitation and its kinetics.

Unit-IV

Down stream processing:

Introduction, removal of microbial cells and other solid matters. Foam separation, filtration, industrial filters and its principles, centrifugation and industrial centrifuges, cell disruption, aqueous two phase extraction system, super critical fluid extraction, whole broth processing, effluent treatment, aerobic and anaerobic slug treatment process, fermentation economics.

1. Comprehensive Biotechnology, Vol. 104- **Young M.Y.**
2. Environmental Biotechnology- Principles & Applications- **Young M.Y.**
3. Principles of Fermentation Technology- **Stanbury, P.F., Whitaker, A. and Hall, S.J.**
4. Biochemical Engineering Fundamentals- **Bailary, J.E. and Ollis, D.F.**
5. Principles of Microbes and Cell Cultivations- **S.J.Pirt**
6. Bioprocess Engineering: Basic Concepts,-**Shuler, M.L. and Kargi, F.**

List of Practical:

Maximum Marks: 30

1. Isolation of industrially important microorganisms for microbial processes.
2. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganism for design of a sterilizer.
3. (a)   Determination of growth curve of a supplied microorganism and also determine substrate degradation profile.
   (b)   Compute specific growth rate (m), growth yield (Yx/s) from the above.
4. Production and estimation of Alkaline Protease.

COURSE: XXIII
D BIOTECHNOLOGY

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
  Divide the questions into 3-4 short answer questions.

Unit-I

Historical Background, Composition of Food, Improvement of food resources through Biotechnology (e.g. Golden Rice, Potato etc.), Traditional fermented foods (meat, fish, bread, sauerkraut, soy bean, coffee, cocoa, tea)

Unit-II

Food Fermentations: Fermented milk, Cheese, Butter, Yoghurt
Alcoholic beverages (Beer, Wine, Whisky), Sauerkraut, Pickles, Soy products,
Tea, coffee etc.

Unit-III

Value addition products like High Fructose Syrup, Invert Sugars etc.
SCPs (e.g. Spirulina, Yeast etc.) as food supplements, Edible fungus: Mushrooms
Potential of Probiotics
Flavour enhancers: Nucleosides, nucleotides and related compounds
Organic acids (Citric acid, Acetic acid) and their uses in foods/food products
Importance of Vitamins and their supplementation in foods and feedstock.
Food preservation and storage
Food Processing

Unit-IV

Growth of microorganisms in food: Intrinsic and extrinsic factors
Food Spoilage (microbial and non-microbial)
Control mechanisms of food spoilage: Physical and Chemical
Food and water borne diseases: Gastroenteritis, Diarrhea, Shigellosis, Salmonellosis, Typhoid, Cholera, Polio, Hepatitis, Dental Infections, etc.
Food borne intoxications: Staphylococcal, Bacillus, Clostridium etc.
Detection of food-borne pathogens.

Recommended Books:

1. Food Sciences and Food biotechnology- **G.F.G. Lopez, G. Canaas, E.V.Nathan**
2. Genetically Modified Foods- **M.Ruse, D. Castle (Eds.)**
3. Biotechnology of Food Crops in Developing Countries- **T.Hohn and K.M. Leisinger (Eds.)**

Process Engineering- **H.G. Schwartzberg, M.A.**

5. Food Biotechnology- **(Eds.) R.Angold, G.A.Beech, J.Taggart.**
6. Food Biotechnologyô Microorganisms-**(Ed.) Y.H. Hui et al.**
7. Modern Food Micro-Biology -**J.M.Jay**

List of practical

Maximum Marks: 30

1. Estimation of Total Plate Count in any food sample.
2. Detection of *Salmonella, E. coli* in food material.
3. MBRT test of milk samples.
4. Malt preparation for beer making.
5. Cheese making (Non-ripened cheese).
6. Sauerkraut production
7. Acetic acid/Vinegar Production and estimation of the product.
8. Toxin detection in the food materials.
9. Effect of internal factors on microbial growth in food *i.e.* ph, Temperature, Water Activity.

COURSE: XXIV
ENVIRONMENTAL BIOTECHNOLOGY

Maximum Marks: 50

Instructions for Examiner:
- Set nine questions in all Q.No. 1 (Objective type) is compulsory.
- Set 2 questions from each unit and one is to be attempted.
  Divide the questions into 3-4 short answer questions.

Unit -I
Introduction: Historical importance, Environment pollution and its types, Impact of pollution on health

Unit-II

Introduction to toxicology including genetic toxicology, common assays to detect genetic toxicology, mutagenesis, carcinogenesis, Use of genetic engineering techniques in genetic toxicology.

Unit-III
Biodegradation of organic compounds, Bioremediation, Biosorportion of heavy metals, Waste water treatment, Methanogenesis, Composting, Volatile toxic gases and biofilteration

Unit-IV
Biomining and bioleaching, Biocides, Biosafety levels, Plastic menace, biodegradable plastics, Biofertilizers

Recommended Books:

1. Wastewater Engineering ó Treatment, Disposal and Reuse- **Metcalf and Eddy**
2. Comprehensive Biotechnology-**M. Moo-Young.**
3. Environmental Chemistry- **A.K. De**
4. Introduction to Biodeterioration- **D. Allsopp and K.J. Seal**
5. Recombinant Microbes for Industrial and Agricultural Application-**Yoshikatsu M. and Tadayuki, I**.
6. Genetic Control of Environmental Pollutants- **Gilbert S. Omenn and Allexander, H.**
7. Experimental Toxicology-**Anderson, D. & Conning, D.M.**
8. Microbial Degradation of Organic Compunds- **David T.G.**
9. Environmental Biotechnology- **Omenn, G.E.**

Maximum Marks: 30

1. Detection of coliforms for determination of the purity of potable water.
2. Determination of total dissolved solids of water.
3. Determination of dissolved oxygen concentration of water sample.
4. Determination of biological oxygen demand (BOD) of a sewage sample.
5. Determination of chemical oxygen demand (COD) of sewage sample.
6. Survey of degradative plasmids in microbes growing in polluted environment.