

**Krishna University, Machilipatnam**  
 Course structure and syllabus  
 for  
 M.Sc ., Biotechnology (5-years Integrated)

**Details**

1	Title of the course	M.Sc. Biotechnology (5 years Integrated)
2	Duration of course	5 years
3	Eligibility criteria for admission	Students who have completed 10+2 level in Biological/Physical Sciences.
4	Intake	40 Seats (20 for M.P.C. stream and 20 for Bi.P.C stream) : seats interchangeable
5	Mode of admission	Through EAMCET Rank/Entrance test conducted by Krishna University/Merit in the qualifying examination (aggregate percentage is considered. If the aggregate is equal, group percentage will decide the tie. If tie still remain the date of birth is considered. In this case, the elder will get priority.).
6	Objectives of the course	To train human resource in various aspects of biotechnology to cater to the needs of industry/ society. To promote innovative research in various aspects of biotechnology in general and Agricultural/ Marine biotechnology in particular.
7	Course Requirement	The course shall include Theory papers, Tests, Labs, Seminars, Assignments and Project Work.
8	Course structure and Scheme of examination	The course will be conducted on credit system and evaluation will be on seven point grading system.
9	Credit system	In this system credits will be allotted to each paper. Each theory paper will be given credits on the basis of number of teaching hours shown against each paper in the following table. One hour of teaching of theory paper in a week will be given one credit. Each practical will be given credits on the basis of number of practical hour shown against each practical in the following table. Three hours of practical paper in a week will be given one credit.
10	Gradation system	The course will be evaluated and the students will be graded on ten point scale with seven letter grades i.e., <b>O, A, B, C, D, E, F.</b>
11	Number of working days	On each semester at least 90 working days (15 weeks of 6 working days) must be dedicated for theory classes, practical classes & seminars

## COURSE STRUCTURE

The student has to study the general as well as the core subjects pertain to the different aspects of biotechnology. However, in the last two semesters, the student has to specialize in Agricultural/ Marine biotechnology.

The Department should decide the number of students permitted under each specialization from time to time

### First Year - SEMESTER-I

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	External marks	Internal marks	No. of Credits
<b>Theory</b>						
IBT101	English	3	Core	70	30	4
IBT102	Second language (Tel/Hind)	3	Core	70	30	4
IBT103	Inorganic Chemistry	4	Core	70	30	4
IBT104	Basic Mathematics	4	Core	70	30	4
IBT105	Biodiversity and Taxonomy	4	Core	70	30	4
<b>Practical</b>						
IBT106	English	6	Core	35	15	3
IBT107	Inorganic Chemistry	6	Core	35	15	3
IBT108	Biodiversity and Taxonomy	6	Core	35	15	3
	<b>TOTAL</b>	<b>36</b>				<b>29</b>

### SEMESTER-II

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	External marks	Internal marks	No. of Credits
<b>Theory</b>						
IBT201	English	3	Core	70	30	4
IBT202	Second language (Tel/Hindi)	3	Core	70	30	4
IBT203	Bioorganic Chemistry	4	Core	70	30	4
IBT204	Contemporary India	4	Core	70	30	4
IBT205	General Microbiology	4	Core	70	30	4
<b>Practical</b>						
IBT206	Language lab	6	Core	35	15	3
IBT207	Bioorganic Chemistry	6	Core	35	15	3
IBT208	General Microbiology	6	Core	35	15	3
	<b>TOTAL</b>	<b>36</b>				<b>29</b>

**SECOND YEAR****SEMESTER-III**

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	Marks		No. of Credits
				External	Internal	
<b>Theory</b>						
IBT301	English	3	Core	70	30	4
IBT302	Second Language	3	Core	70	30	4
IBT303	Physical Chemistry	4	Core	70	30	4
IBT304	Computer Applications in Biology	4	Core	70	30	4
IBT305	Tools and Techniques in Biology	4	Core	70	30	4
<b>Practical</b>						
IBT306	Physical Chemistry	6	Core	35	15	3
IBT307	Computer Applications in Biology	6	Core	35	15	3
IBT308	Tools and Techniques in Biology	6	Core	35	15	3
<b>TOTAL</b>		<b>36</b>				<b>29</b>

**SEMESTER-IV**

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	Marks		No. of Credits
				External	Internal	
<b>Theory</b>						
IBT401	English	3	Core	70	30	4
IBT402	Second Language	3	Core	70	30	4
IBT403	Genetics	4	Core	70	30	4
IBT404	Enzymology	4	Core	70	30	4
IBT405	Cell Biology	4	Core	70	30	4
<b>Practical</b>						
IBT406	Genetics	6	Core	35	15	3
IBT407	Enzymology	6	Core	35	15	3
IBT408	Cell Biology	6	Core	35	15	3
<b>TOTAL</b>		<b>36</b>				<b>29</b>

### Third year

#### SEMESTER-V

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	Marks		No. of Credits
				External	Internal	
<b>Theory</b>						
IBT501	Bio-statistics	4	Core	70	30	4
IBT502	Bioenergetics and Biomembranes	4	Core	70	30	4
IBT503	Intermediary Metabolism	4	Core	70	30	4
IBT504	Molecular Biology	4	Core	70	30	4
IBT505	Immunology	4	Core	70	30	4
<b>Practical</b>						
IBT506	Biostatistics, Bioenergetics and Intermediary Metabolism	8	Core	35	15	4
IBT507	Molecular Biology and Immunology	8	Core	35	15	4
	<b>TOTAL</b>	<b>36</b>				<b>28</b>

#### SEMESTER-VI

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	Marks		No. of Credits
				External	Internal	
<b>Theory</b>						
IBT601	Genetic Engineering	4	Core	70	30	4
IBT602	Cell, Tissue Culture & Stem Cell Biology	4	Core	70	30	4
IBT603	Plant Physiology	4	Core	70	30	4
IBT604	Animal Physiology	4	Core	70	30	4
IBT605	Molecular Virology	4	Core	70	30	4
<b>Practical</b>						
IBT606	Genetic Engineering, Cell, Tissue Culture & Stem Cell Biology, Molecular Virology	8	Core	35	15	4
IBT607	Plant and Animal Physiology	8	Core	35	15	4
	<b>TOTAL</b>	<b>36</b>				<b>28</b>

**Fourth year**

**SEMESTER-VII**

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	Marks		No. of Credits
				External	Internal	
<b>Theory</b>						
IBT 701	Developmental Biology	4	Core	70	30	4
IBT 702	Cancer Biology	4	Core	70	30	4
IBT 703	Bioinformatics	4	Core	70	30	4
IBT 704	Endocrinology	4	Core	70	30	4
IBT 705	Immuno technology	4	Core	70	30	4
<b>Practical</b>						
IBT706	Developmental Biology and Cancer Biology	8	Core	35	15	4
IBT707	Immuno Technology, Endocrinology & Bioinformatics	8	Core	35	15	4
<b>TOTAL</b>		<b>36</b>				<b>28</b>

**SEMESTER-VIII**

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	Marks		No. of Credits
				External	Internal	
<b>Theory</b>						
IBT801	Genomics & Proteomics	4	Core	70	30	4
IBT802	Microbial Biotechnology	4	Core	70	30	4
IBT803	Environmental Biotechnology	4	Core	70	30	4
IBT804	Food & Industrial Biotechnology	4	Core	70	30	4
IBT805	Animal reproduction, Cloning and Transgenics	4	Core	70	30	4
<b>Practical</b>						
IBT806	Genomics & Proteomics, Microbial Biotechnology and Environmental Biotechnology	8	Core	35	15	4
IBT807	Food & Industrial Biotechnology and Animal reproduction, Cloning and Transgenics	8	Core	35	15	4
<b>TOTAL</b>		<b>36</b>				<b>28</b>

**Fifth year –  
SEMESTER-IX**

Paper Code	Title of the Paper	No of hrs/week	Core/ Elective	Marks		No. of Credits
				External	Internal	
<b>Theory</b>						
IBT 901	IPR, Patenting, Bioethics and Bio-safety	4	Core	70	30	4
IBT 902	Bioprocess Engineering and Technology	4	Core	70	30	4
IBT 903	Pharmaceutical Biotechnology	4	Core	70	30	4
IBT 904	Agriculture Biotechnology	4	Core	70	30	4
IBT 905	Marine Biotechnology	4	Core	70	30	4
<b>Practical</b>						
IBT 906	Bioprocess Engineering and Pharmaceutical Biotechnology	8	Core	35	15	4
IBT 907	Agriculture and Marine Biotechnology	8	Core	35	15	4
<b>TOTAL</b>		<b>36</b>				<b>28</b>

**SEMESTER-X**

S. No	Subject Code	Title	Internal/ External Marks	No. of Hours/ week	No. of Credits / week
1.	IBT1001	Project work	200	36	36
2.	IBT1002	<i>Viva-voce</i>	100		
		Total	300	36	36

Total number of credits per 10 semesters.

Semester	Credits
1 <sup>st</sup> semester	29
2 <sup>nd</sup> semester	29
3 <sup>rd</sup> semester	29
4 <sup>th</sup> semester	29
5 <sup>th</sup> semester	28
6 <sup>th</sup> semester	28
7 <sup>th</sup> semester	28
8 <sup>th</sup> semester	28
9 <sup>th</sup> semester	28
10 <sup>th</sup> semester	36
<b>Total</b>	<b>292</b>

M.Sc.BIOTECHNOLOGY  
SEMESTER – I

Regulation:2008

IBT 101 – English

**UNIT-1:**

Ode To Autumn                   - *John Keats*  
Dover Beach                   - *Matthew Arnold*  
Poem 36 Gitanjali              - *Rabindranath Tagore*

**UNIT 2:**

Is Progress Real               - *Will and Ariel Durant*  
Conjuror's Revenge         - *Stephen Leacock*  
I Have a Dream               - *Martin Luther King*

**UNIT 3:**

Merchant of Venice         - *William Shakespeare*  
(Casket Scene Only)

**UNIT 4:**

How Far Is The River       - *Ruskin Bond*

**UNIT 5:**

Reading Comprehension  
Synonyms  
Antonyms  
Verb Forms  
Punctuation  
(To Be Given For One Act Play)

**References:**

- 1) English Work                              Dept Of English  
  (Osmania University)
- 2) Building Competency                    Dept Of English  
  (Osmania University)
- 3) High School English Grammar         Wren and Martin  
       And Composition

IBT – 102 TELUGU (SECOND LANGUAGE)

†Çüx\~ Đ 1 ( ã†□p# H>q`ÇpO)

1. Q®OQê %o×O`Ç#°□ H>^ŠÍ
2. =ü+²H> =¶~ÇEû□ =Š`ÇEëO`ÇO

†Çüx\~ Đ 2 ( P^□Î°xH> H>q`ÇpO)

1. =¶ Hùní `³□Á^ù~j`Ç#O
2. =°, -ðã,, -ª□Ö#O

†Çüx\~ Đ 3 (H>^ŠYxH>□°)

1. Qêe"ÇE#
2. PH>e

†Çüx\~ Đ 4 (←O^□Î°□°)

1. ←O←ø\$`Ç Đ `³□°Q®° ←O^□Î°□° (←=~jân~jÉ, Q®°}, †Ç°}i^Í%o×, =ŠkÖ, ãuH>, Q®←\_È^Í"ÇE^Í%o×, ~j°QêQ®=°, @°QêQ®=°, Jã"Í°\_□`Ç, J`Çp←Ok□)

†Çüx\~ Đ 5 (←=¶ª□□°)

- \_\_\_\_\_ `Ç`Ç°æ~j°+¬, H>~jâ^□Y~j†Ç°, ^ÎpO^Îp,kpQ®, |,¬•ãg,²i a^□Î°~j¶ª□□°



**IBT - 102 – SECOND LANGUAGE (HINDI)**

- I. Prose (Gadya sandesh)**
- a) Sahitya ki mahata
  - b) Sachi veerata
  - c) Mitrata
  - d) Am phir boura gaye
  - e) Poos ki raat
- II. Non-detailed (Katha lok)**
- a) Muktidhar
  - b) Goodad sai
  - c) Usne kaha tha
  - d) Thes
  - e) Jaria
- III. Grammar**
- a) Re-writing of sentences as directed based on case, gender, number, tense, voice
  - b) Usage of words into sentences
- IV. Letter writing**
- a) Personal letters
  - b) Official letters
  - c) Leave letters
- V. TRANSLATION (from English to Hindi)**

**IBT 103 – Inorganic Chemistry****Unit – I****Inorganic reaction mechanism.**

Classification of reactions; dissociation and association; electron transfer; elimination, chain and polymerization reaction, (examples only). Substitution reactions, SN1 & SN2 reactions, unimolecular and bimolecular nucleophilic substitution, lability and inertness of the complexes, factors affecting lability. Hydrolysis of silicon halides and phosphorous oxides.

**Unit - II****Hard and soft acids & bases**

- a. Classification, Pearson's concept of hardness and softness, application of HSAB principles- stability of complexes, predicting the feasibility of a reaction.
- b. Essential and trace elements, Biological significance of Na, Mg, Zn and Co. Toxicity of As, Hg and Pb.

**Unit - III****Organometallic compounds**

Definition, nomenclature and classification based on metal carbon bond-ionic, sigma and pi covalent. Preparation, properties and applications of alkyl and aryls of Li, Mg, Al and Cd.

**Unit - IV****Solutions**

Liquid-liquid mixtures, ideal liquid mixtures. Raoult's and Henry's law. Non ideal systems. Azeotropes- HCl-H<sub>2</sub>O, ethanol-water systems..

**Unit – V****Separation techniques & consolute temperature**

Fractional distillation. Steam distillation. Partially miscible liquid phenol-water, trimethylamine-water, nicotine-water systems, lower and upper consolute temperature. Effect of impurity on consolute temperature.

**Practicals:**

1. Mixed salt analysis (without interfering radicals)
2. Titrimetry
  - a. Estimation of Dissolved Oxygen (through Winkler's method & Electrode probe).
  - b. Estimation of Carbon dioxide.
  - c. Estimation of Carbonates & Bicarbonates.
  - d. Estimation of Hardness.
  - e. Estimation of Phosphates.
  - f. Estimation of Iron.
  - g. Estimation of pH (By pH probe / pH electrode)
  - h. Estimation of salinity.

## IBT 104 – Basic Mathematics

**Unit-I : TRIGONOMETRY****30 marks ( 2 - Bit, 2 -Questions & 1- MainQuestion)**

- Definition of Trigonometric functions
- Relations between them
- Particular Values
- Variations of Sin  $\theta$ , Cos  $\theta$  and Tan  $\theta$
- Ratios of Angles of any magnitude
- Simple Problems on these ratios
- Trigonometric Ratios of compound angles such as Sin ( A+B), Cos (A+B) and Tan (A+B) without proofs.
- Ratios of 2A, 3A and A/2 and simple problems on them.
- Transformations

**Unit-II : ALGEBRA****10 marks ( 1- Bit, 1 -Questions)**

- **Logarithms** :- Definition and Results like Log(mn) and Log(m/n) etc., and Simple Problems.
- **Partial Fractions** :- Splitting Fraction of the Form  $f(x)/g(x)$
- When  $g(x)$  contains 1) Non-repeated Linear factors  
2) Repeated Linear Factors and  
3) Non-repeated quadratic factors

**Unit-III: LIMITS****20 marks ( 2- Bit, 2 -Questions)**

- Definition of RHL and LHL and some standard limits
- Continuity with Simple illustration
- Standard limits
- Continuity with Simple illustration

**Unit-IV : DIFFERENTIATION****30 marks ( 3- Bit, 3 -Questions)**

- Definition
- Differentiation of a Function at a point and on an interval
- Differentiation of Sum, Difference and quotient of Functions
- Derivatives of Composite functions
- Differentiation by substitution
- Parametric Differentiation

**Unit-V : INTEGRATION****30 marks ( 3 - Bit, 3 -Questions)**

- Integration as line inverse process of differentiation
- Standard forms
- Integration by substitution
- By partial fractions
- Integration by parts and simple problems

[Each bit carries 2 marks. Each question carries 8 marks & 10 marks for main question]  
Scope is as in the Telugu Academy Intermediate Mathematics Text books.

## IBT 105 – BIODIVERSITY AND TAXONOMY

### Unit – I. Biodiversity : an outline

- 1) Biodiversity: Earth summit (Convention on Biological Diversity) Definition levels, Organizations and valuing biodiversity : Enumeration of biodiversity. **species diversity**: Concept of species, zoological / botanical code.
- 2) Genetic Diversity: Origin of Genetic variation; measuring genetic variation. Wild relatives of cultivated/ domesticated/ cultured organisms (microbes, Plants and animals).
- 3) **Eco system Diversity**: Terrestrial and Aquatic Biomes. Land scape Diversity: Alpha, beta and gamma diversity. Centers of mega diversity and Hot Spots in India.

### Unit – II. Survival and Sustainability

**Threats to Biodiversity**: IUCN Categories: Rare endangered categories; extinct plants and animals of India.

Biodiversity vs. Biotechnology and Bioproductivity perspectives. Bioprospecting, biosafety, biopiracy and Intellectual Property rights (IPR).

**Biodiversity and Sustainability**: Sustainable management of Biodiversity. Indian Acts on biodiversity. Functions of Biodiversity Boards (National and State).

### Unit – III. Principles of Taxonomy

**Systematics**: Introduction; objectives; Taxonomy and Systematics. Systems of Classification. Five Kingdom classification.

**Principles of Taxonomy**: Fundamentals of Taxonomy, Taxogram, Taxonomic hierarchy. Brief introduction to bacterial taxonomy.

**Identification**: Traditional and current Methods of identification of organisms (Microbes to higher organisms)

**Current Concepts in Taxonomy** : Systematic Anatomy, Cytotaxonomy, Chemotaxonomy, Molecular taxonomy and Numerical taxonomy. Taxonomic Institutions for plants and animals.

### Unit - IV

Taxonomy of Plants and Animals: Taxonomy of Invertebrates : General account of Groups such as Protozoa, Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, arthropoda, Onychophora, Mollusca, Echinodermata  
General account of Prochordata, Cyclostomata, Pisces, Amphibia, Reptilia, Aves and Mammals.

### Unit-V

Salient features of Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

**SEMESTER – II**  
**IBT 201 – English**

**UNIT - I**

The Unknown citizen	- W.H.Auden
Myriad-Winged bird	- A.Sathyavathi Devi
Telephone Conversation	- Wole Soyinka

**UNIT-II**

The Best Investment I Ever Made	-A.J.Cronin
Prospectus of Democracy	-Dr. B.R.Ambedkar
Letter to a Teacher	-Nova Rossi and Tom Cole

**UNIT-III**

The Boy Come Home (One act Play)	-A.M.Milne
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**UNIT-IV**

Little Girls are Wiser than Men (Short story)	- Leo Tolstoy
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**UNIT-V**

Homonyms and  
One Word Substitutions  
Idioms  
Detection of Error

IBT – 202 -TELUGU (SECOND LANGUAGE)

ã±p# „-^Î¼f□iQ®O

1. ,~iO<Ô KÇãH>”“œH> <-O”œ^ÎO

2. Z~i°H>`Ç

P^□Î°xH> H>q`ÇbO

1. =ð<sup>a</sup>□,,!~i°□°

2. "Î°,,!~o^Î¶`ÇO

H>^ŠYxH>□°

1. #=òàã>½#ß <Í□

2. \*ÿá□°

L„-“œKCH>O

1. ã„- [□ =<sup>o</sup>#<sup>o</sup>+<sup>2</sup> ð =\÷“ã>€@ P`iB~i° a□bq°

“œ½H>~;iO%ø§□°

1. <sup>a</sup>□^□Î°~;¶±□□°

**PAPER-202- HINDI (SECOND LANGUAGE)**

**UNIT- I: PROSE**

1. Vahi – ki – vahi baat
2. Pruthviraj ki aankhe
3. Sanskruti aur sahitya ka paraspar samband
4. Binda
5. Bharat ek hai
6. Beyimani ki Parat
7. H.I.V. Aids

**UNIT – II: NON-DETAILED**

1. Bhook hadtal
2. Mai har gayi
3. Bhagnav shesh

**UNIT – III: NON-DETAILED**

1. Parmatma ka kutta
2. Aur vah pad gayi

**UNIT – IV: GRAMMAR**

1. Correction of Sentences
2. Karyalaya hindi:- Administrative Terminology, Official designations (padnam) – 200 words.
3. Sandhi viched
4. Antonyms

**UNIT – V: LETTER WRITING**

1. Letter of Complaints
2. Application for appointment

**IBT -203: Bioorganic Chemistry****Unit-I****Halogen Compounds:**

Nomenclature and classification of alkyl (into primary, secondary, tertiary), aryl, aralkyl, allyl vinyl, Benzyl). Chemical reactivity reduction, formation of  $\text{RMgX}$ , Nucleophilic substitution reaction-classification into  $\text{SN}_1$  and  $\text{SN}_2$  (Walden inversion),  $\text{SN}_1$  (Racemisation), explanation of both by taking the example of optically active alkyl halide 2-Bromobutane. Structure & reactivity ease of hydrolysis, Comparison of alkyl, Benzyl, Vinyl and Aryl halides.

**Unit-II****Hydroxyl compounds:**

Nomenclature & classification of hydroxyl compounds. Preparation from carbonyl compounds. Aryl carbinols by hydroxyl methylation. Phenols-(a) by diazotization (b) from sulfonic acid (c) by hydrolysis of Halo benzene.

Physical properties- Hydrogen bonding (inter molecular and intramolecular) effect of hydrogen bonding on boiling point and water solubility.

Chemical properties (a) Acidic nature of phenols (b) formation of alkoxide/phenoxides and their reaction with  $\text{R}_x$  (c) replacement of  $\text{OH}$  by using  $\text{PCl}_2$ ,  $\text{Pbr}_3$ ,  $\text{SOCl}_2$  and with  $\text{IIX/Z}_2\text{Cl}_2$ . Esterification by (a) Acid halides, anhydrides and acids (mechanism) (b) Esters of inorganic acids (c) dehydration of alcohols. Oxidation of alcohols by  $\text{CrO}_3$ ,  $\text{KMnO}_4$ . Special reactions of Phenols- (a) Bromination, (b) Kolbe reaction (c) Reimer Tlemen (d) azocoupling. Identification of alcohols by oxidation-  $\text{KMnO}_4$ . Ceric ammonium Nitrate- Lucas reagent, Phenols by reaction with  $\text{FeCl}_3$  and by the solubility in  $\text{NaOH}$ , polyhydroxyl compounds- Pinacol- Pinacolone rearrangement, Oxidative cleavage ( $\text{Pb}(\text{Oac})_4$  and  $\text{HIO}_4$ ).

**Unit-III****Ethers & Epoxides**

Nomenclature preparation by (a) Williamson's synthesis (b) From alkenes by the action of conc.  $\text{H}_2\text{SO}_4$  Physical properties absence of hydrogen bonding, insoluble in water, Low Boiling point. Chemical properties- Inert nature, action of conc.  $\text{H}_2\text{SO}_4$  & Acid & base catalyzed ring opening of epoxides- Orientation.

**Unit-IV**

Nomenclature, classification & methods of preparation (a) Hydrolysis of Nitrates, Amides & Esters. (b) Carbonation of Grignard reagents. Special methods of preparation of Aromatic acids. Oxidation of the side chain. Hydrolysis of Benzotrichloride. Kolbe reaction. Physical properties-Hydrogen bonding. Diametric association, Acidity- strength of the acids with the Examples of trimethyl acetic acid & trichloroacetic acid, relative difference in the acidity of aromatic & aliphatic acids. Reduction of acid to the corresponding primary alcohol via Ester or acid chloride, Degradation of carboxylic acids by Hunsdiecker reaction, Schmidt reaction (decarboxylation). Amdt Eistret synthesis, Halogenation by Hell Volhard Jensen reaction, Carboxylic acid derivatives, reactions of acid halides, acid anhydrides, acid amides & ester (mechanism of ester hydrolysis by base & acid).

**Unit-V****Synthesis based on carbanions:**

Acidity of Hydrogen's, Structure of carbanion. Preparation of Aceto acetic ester by Claisen condensation and synthetic application of Acetic ester, (a) Acidic hydrolysis & Ketonic hydrolysis. Preparation of (i) Monocarboxylic acids (ii) Dicarboxylic acids (b) Malonic ester. Synthetic applications. Preparation of (i) substituted monocarboxylic acids (ii) substituted dicarboxylic acids (iii) trialkyle acetic acid.

**Practicals**

Qualitative organic compound analysis-

Identification of the functional groups present in the given organic compounds.

1. Carboxylic acids : Acetic acid, Benzoic acid, Oxalic acid, Cinnamic acid.
2. Phenols : Phenol, Resorcinol,  $\alpha$ -naphthol,  $\beta$ -Naphthol.
3. Aldehydes : Acetaldehyde, Benzaldehyde.
4. Ketones : Acetone, Acetophenone, Benzophenone.
5. Amines : Aniline.
6. Amides : Acetamide, Benzamide, Urea.



7. Carbohydrates : Glucose, Fructose.

**IBT -203: Bioorganic Chemistry****Unit – I**

Carbohydrates: Definition and Classification of carbohydrates, reactions of monosaccharides, acid derivatives of monosaccharides, Amino sugars, disaccharides, oligo saccharide, mucopolysaccharide, bacterial cell polysaccharides, lectins, glycoproteins.

**Unit – II**

Amino acids and Peptides: Classification, structure and physico-chemical properties of amino acids, stereoisomerism, chemical reactions of amino acids and chemical procedures affecting amino acid side chain.

Peptides: Structure and confirmation of peptide bond; Peptide synthesis - reactive ester method and modified Merrifield solid phase peptide synthesis. Non-ribosomal peptide synthesis - glutathione cyclic antibiotics (gramicidin). Identification of peptide sequence – protease treatment, site directed mutagenesis.

**Unit - III**

Proteins: Classification and biological functions of proteins (Eg: Hemoglobin, Myoglobin). Structural organization of proteins - primary, secondary, tertiary and quaternary structure of proteins. Protein folding and significance. Ramachandran plot.

**Unit – IV**

Lipids and porphyrins: Classification, physical and chemical properties of fatty acids.

Characterization of natural fats, oils structure and biological role of triacyl glycerol, phospholipids, sphingolipids, prostagladins, thromboxanes, leukotrienes, and steroids. Lipids as signaling molecules.

Porphyrins: Structure and function of porphyrin, protoporphyrin, cytochrome, heme, chlorophylls.

**UNIT V**

Nucleic acids: Structure of purines and pyrimidines, modified bases. Structure of DNA ( Primary, Secondary and Teritary). Structure of RNA: mRNA, tRNA, rRNA ( Primary, Secondary and Teritary). Physico-chemical properties of nucleic acids, denaturation, hyper chromic effect,  $T_m$ , kinetics of reassociation, cot values, Isolation of nucleic acid: DNA, RNA and Plasmids.

**Practicals:**

1. Titration of Amino acids
2. Colorimetric determination of pKa
3. Model building using space, filling/ball and stick models
4. Reactions of amino acids, sugars and lipids, including diagnostic tests
5. Isolation, purity determination and quantization of cholesterol DNA and RNA
6. Quantization of proteins and sugars
7. Analysis of oils-iodine number, saponification value and acid number
8. UV, visible, fluorescence and IR spectroscopy and absorption spectra

**IBT – 204: Contemporary India: Economy, Polity, and Society**

**Unit-I**

Basic feature of Indian Economy – Trends in National Income – Agriculture importance – Problems – Remedial measures; Industry: Large Scale – Small Scale: Problems and Remedial measures: A brief Review of the Industrial Politics in India. Role of Public Section in the Context of Globalization, Growing importance of Service sector

**Unit-II**

Population, poverty, unemployment and Income Inequalities – cause and consequences – Remedies – Inflation causes and Remedies, Economic Reforms and their impact on Indian Economy – Indian Tax structure.

**Unit-III**

Indian National movement various stages – its legacy. Integration of Native states and Formation of modern India.  
Basic characteristic of Indian constitution Indian political party system, Emergence of All India Parties – Regional Parties – collation politics.

**Unit-IV**

Center – State Relations – Changes and various commissions – Importance of Human Rights – Violation of Human Rights- Indian Foreign policy – non – Aligned movement – Local self Governments 73, 74 constitutional amendments. Right to information act.

**Unit-V**

Salient features of Indian Social system, social groups: primary and Secondary, Association – Institution. Status and role – Norms, Values and customs. Concept of Socialization – Agencies of Socialization.

Gender Issues : Domestic violence, Women Empowerment Entrepreneurship programmes: a brief mention of Different ongoing Welfare Schemes of the central and state Government for Women, Children aged and youth. Child Labour : causes – prevention.

## IBT 205 – General Microbiology

**Unit-I**

History, scope and significance of Microbiology, Cell structure of prokaryotic and eukaryotic cell. Comparison of the structure and function of each component of eubacterial cell and archebacteria. Biosynthesis of bacterial cell wall. General characters of Fungi (Yeast, Dermatophytes, and opportunistic pathogens), Algae (Cynobacteria, Chlorella), Protozoa (Entamoeba, Plasmodium). Principles of bacterial taxonomy, classification of bacteria and general characteristics of each group including Rickettsia, Pplo and Chlamydiae.

**Unit-II**

Nature and general properties of viruses – Classification, nomenclature of RNA and DNA viruses, Principles of virus structure, chemical composition and general steps in replication of viruses. General methods of cultivation, purification, detection and quantification of bacterial, animal and plant viruses. Prions and Virusoids, viroids, satellite and defective virus practices.

**Unit-III**

**Microbiological techniques:** Sterilization and disinfection – Physical and chemical methods. Isolation of pure cultures. Cultivation of aerobic and anaerobic microbes. Media for growth of microorganisms (bacteria, fungi, algae). Preservation and maintenance of cultures. Methods of identification of bacteria.

Nutrition and growth: nutritional groups of bacteria (autotrophy and heterotrophy). Nutritional mutants and their use in metabolic studies. Growth cycle of bacteria, estimation of bacterial growth, factors influencing growth (physical and chemical), synchronous culture and continuous culture and continuous growth of microbes.

**Unit-IV**

**Modes of gene transfer in bacteria-** Conjugation, transformation and transduction, **Recombination in bacteria-** Homologous recombination, transpositional recombination and site-specific recombination.

**Environmental Microbiology-** Nitrogen cycle, Regulation of nif and nod genes, Carbon Cycle, Sulphur cycle and Phosphorous cycle.

**Unit-V**

**Industrial Microbiology-** Brief outline and type of reactions in fermentation, production of alcohol, citric acid and vinegar, production of amino acids(Glu, Asp, Lys, Phe and His), Production of vitamins( Riboflavin, Vitamin B12 and carotenoids), Production of penicillin and streptomycin .

**Practicals**

1. Sterilization techniques- Autoclaving, Heat sterilization, filtration, UV-irradiation and chemical.
2. Preparation of media.
3. Staining techniques in bacteria- Simple, differential and special staining, AFC, Capsule, Flagella.
4. Isolation and Cultivation of pure cultures.
5. Techniques of maintenance of stock cultures.
6. Anaerobic culture of bacteria.
7. Testing the efficiency of disinfectant action, dettol Phenol (reidel-walker test).
8. Growth curve and generation time of bacteria.
9. Detection of bacterial toxins and extra cellular enzymes.
10. Isolation of phages from sewage.
11. Quantification of phage by plaque assay.

**Reference Books:**

1. Stainer R.Y. Adelberg, E.A., Ingrham J.L. General Microbiology. 4<sup>th</sup> ed. Macmillan, 1976.
2. Davis, B.D. Dulbecco, R.Eisen, H.N., Ginsberg H.S Microbiology Harper & Row publishers 1980.
3. Pelczar, M.L.Chan, E.C.S. Krieg, N.R. Microbiology, Mc Graw-Hill Book Company, 1986.
4. Freeman B.A. Burrows Text book of Microbiology Saunders HB Company, 1985.
5. Joklik, W.K., Willet H.P., Amos, D.B. and Wilfert C.M. Zinssers Microbiology, 19<sup>th</sup> ed. Prentice- Hall International Inc. 1988.
6. Paul J. Vandemark, Barry L. Batzing th microbes. The Benjamin/ cummings publishing company, Inc.1987.
7. Lansing M. Prescott, John P.Harley, Donald. A.Klein, Microbiology, 3<sup>rd</sup> edition brown publishers, 1996.

**IBT 205 – General Microbiology**

**Unit – I**

History, Scope and Significance of Microbiology, Cell structure of prokaryotic and eukaryotic cell. Principles of bacterial taxonomy, classification of Bacteria and general characteristics of each group including Rickettsia, Mycoplasma, Chlamydia, and Actinomycetes. Characteristics of archeobacteria and fungi (Yeast, Dermatophytes, and opportunistic pathogens), Algae protozoa (Entamoeba and Plasmodium).

**Unit – II**

Ultra structure of Bacterial cell. Structure and function of variants (capsule, Flagellum, Cilia, Endospore, inclusion bodies and Plasmids), Invariants (Cell wall, Cell membrane, Nucleoid, and Ribosomes) components.

**Unit – III**

Nature and general properties of viruses – classification, Nomenclature of RNA and DNA Viruses, General Characteristics of TMV, Lambda Phage and HIV, general steps in replication of viruses, General Methods of Cultivation, Purification, detection and quantification of bacterial animals and plant virus, Prions and Virusoids, Viroids, satellite and defective virus practices

**Unit – IV**

Microbiological Techniques: Sterilization and disinfection – Physical and Chemical methods. Isolation of pure Cultures, Cultivation of aerobic and anerobic microbes. Media for growth of microorganisms (bacteria, Fungi, algae). Preservation and maintenance of cultures. Principle and applications of microscopy in microbiology- Bright field, Dark field, and Electron Microscopy (SEM and TEM). Methods of identification of bacteria.

**Unit – V**

Nutrition and growth: Nutritional groups of Bacteria (autotrophs and heterotrophs) Nutritional mutants and their use in metabolic studies. Growth cycle of bacteria, Estimation of bacterial growth, factors influencing growth (physical and Chemical), synchronous culture and continuous growth of microbes.

**Practicals**

1. Sterilization techniques- Autoclaving, Heat sterilization, filtration, UV-irradiation and chemical.
2. Preparation of media.
3. Staining techniques in bacteria- Simple, differential and special staining, AFC, Capsule, Flagella.
4. Isolation and Cultivation of pure cultures.
5. Techniques of maintenance of stock cultures.
6. Anaerobic culture of bacteria.
7. Testing the efficiency of disinfectant action, dettol Phenol (reidel-walker test).
8. Growth curve and generation time of bacteria.
9. Detection of bacterial toxins and extra cellular enzymes.
10. Isolation of phages from sewage.
11. Quantification of phage by plaque assay.

**Reference Books:**

- Stainer R.Y. Adelberg, E.A., Ingrham J.L. General Microbiology. 4<sup>th</sup> ed. Macmillan, 1976.  
Davis, B.D. Dulbecco, R.Eisen, H.N., Ginsberg H.S Microbiology Harper & Row publishers 1980.  
Pelczar, M.L.Chan, E.C.S. Krieg, N.R. Microbiology, Mc Graw-Hill Book Company, 1986.  
Freeman B.A. Burrows Text book of Microbiology Saunders HB Company, 1985.  
Joklik, W.K., Willet H.P., Amos, D.B. and Wilfert C.M. Zinssers Microbiology, 19<sup>th</sup> ed. Prentice-Hall International Inc. 1988.  
Paul J. Vandemark, Barry L. Batzing th microbes. The Benjamin/ cummings publishing company, Inc.1987.  
Lansing M. Prescott, John P.Harley, Donald. A.Kleein, Microbiology, 3<sup>rd</sup> edition brown publishers, 1996.

Reference Books:

- Stainer R.Y. Adelberg, E.A., Ingrham J.L. General Microbiology. 4<sup>th</sup> ed. Macmillan, 1976.
- Davis, B.D. Dulbecco, R.Eisen, H.N., Ginsberg H.S Microbiology Harper & Row publishers 1980.
- Pelczar, M.L.Chan, E.C.S. Krieg, N.R. Microbiology, Mc Graw-Hill Book Company, 1986.
- Freeman B.A. Burrows Text book of Microbiology Saunders HB Company, 1985.
- Joklik, W.K., Willet H.P., Amos, D.B. and Wilfert C.M. Zinssers Microbiology, 19<sup>th</sup> ed. Prentice-Hall International Inc. 1988.
- Paul J. Vandemark, Barry L. Batzing th microbes. The Benjamin/ cummings publishing company, Inc.1987.
- Lansing M. Prescott, John P.Harley, Donald. A.Kleein, Microbiology, 3<sup>rd</sup> edition brown publishers, 1996.

**SEMESTER III**

**IBT - 301 -ENGLISH**

**UNIT – I**

**POETRY**

- 1) The sunne Rising - *John Donne*
- 2) Road not taken - *Robert Frost*
- 3) Good bye party for Mrs. Pushpa T.S - *Nissim Ezekiel*

**UNIT – II**

**PROSE**

- 1) Mr. Know All - *Somerset Maugham*
- 2) Not just Oranges - *Premchand*
- 3) On shaking Hands - *G.Gardiner*

**UNIT – III**

**ONE ACT PLAY**

- Julius Caesar (caesar's murder scene only) - *William Shakespeare*

**UNIT – IV**

**SHORT STORY**

- Gajar Halwa - *Gita Hariharan*

**UNIT – V**

**COMMUNICATION AND COMPOSITION**

- 1) . Note Making
- 2) Resume Writing
- 3) Description of Pictures
- 4) ParagraphWriting (with hints from short stories)



IBT-302 - TELUGU

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**†Cüx˘D4**

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**†Cüx˘D5**

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**IBT 303 - PHYSICAL CHEMISTRY****Unit-I - Chemical Kinetics**

Rate of reactions, factors influencing the rate of a reaction - concentration, temperature, pressure, solvent, light and catalyst. Mathematical characteristics of simple chemical reactions - Zero order, first order, second order, pseudo first order, half-life and mean life. Determination of order of a reaction - differential method, method of integration, half - life method and isolation method. Arrhenius equation and concept of activation energy. Theory of chemical kinetics: effect of temperature on rate of a reaction - simple collision theory based on hard sphere model.

**Unit-II - Photochemistry**

Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus - Draper law, Stark - Einstein law, Quantum Yield, photochemical combination of hydrogen - chloride and hydrogen - bromine. Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radioactive processes (internal conversion, intersystem crossing), photosensitized reactions - energy transfer processes (simple examples).

**Unit-III - Thermodynamics-I**

Definition of thermodynamic terms: system, surroundings, types of systems, and intensive and extensive properties. State and path functions and their differentials. First law of thermodynamics: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's Thomson coefficient and inversion temperature. Temperature dependence of enthalpy - Kirchoff's equation.

**Unit-IV - Thermodynamics-II**

Second law of thermodynamics: Need for law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature. Concept of entropy, Gibbs and Helmholtz functions. Catalysis - Definition, characteristics, mechanisms, theories of catalysis - acid base catalysis, enzyme catalysis, auto catalysis.

**Unit-V - Solutions:**

Liquid - liquid mixtures, ideal liquid mixtures. Raoult's and Henry's law. Non ideal systems. Azeotropes - HCL-H<sub>2</sub>O, ethanol-water systems. Fractional distillation. Partially miscible liquids phenol-water trimethyl, amine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature. Steam distillation.

**Dilute solutions and Colligative Properties:**

Dilute solutions, Colligative properties, Ideal & Non ideal solutions. Raoult's Law, Relative lowering of vapour pressure, Molecular weight determination. Osmosis, Laws of Osmotic pressure and Osmosis, their measurement, Elevation of boiling point and depression of freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, Van's holt factor, Degree disassociation and association of solutes.

**IBT 304 - COMPUTER APPLICATIONS IN BIOLOGY****Unit –I**

**Computer hardware:** The significance of hardware, the central processing unit, computer memory, computer hierarchy, input technologies, output technologies

**Computer software:** Software history and significance, system software, application software, software issues, programming languages.

**Unit –II**

**Microsoft office:** Introduction and facilities available. Shortcut bar; customizing toolbar; using common office techniques- Starting an office application.

**Microsoft word:** starting a new document, opening existing document, moving and copying text, Creating and editing work documents: formatting documents; working the tabs, tables and columns, working with long documents.

**Unit –III**

**Microsoft excel:** Introducing excel worksheet, workbooks, functions and formulae, creating database.

**Microsoft power point:** Creating presentations, working with slides, showing slide show, creating an organization charts and graphs, printing a presentation.

**Unit –IV**

**The Internet, Intranets and Extranets:** What exactly is the Internet?, the evolution of the Internet, the operation of the Internet, services provided by the Internet, the World Wide Web, Internet Challenges, Intranets, Extranets.

**Unit –V**

Introduction and applications of operating systems . database management, and programming languages.

**IBT 305: TOOLS AND TECHNIQUES IN BIOLOGY****Unit I**

pH Determination – Measurement of pH, biochemical buffers, selection of biochemical buffer, oxygen electrode and biosensors. Cell disruption methods: French press, sonication, freeze-thaw techniques, enzymatic method, use of liquid nitrogen in cell disruption. Centrifugation – Basic principles of sedimentation, types of centrifuges and rotors. Preparative ultracentrifugation - differential centrifugation, density-gradient, analytical ultracentrifugation and applications in determination of molecular weight, purity and detection of conformational changes in macromolecules.

**Unit II**

Separation methods - General principles and definitions. Methods based on polarity – Partition chromatography (Paper chromatography), adsorption chromatography (thin-layer chromatography), gas-liquid chromatography, reverse phase liquid chromatography.

Methods based on size - Principle of Gel filtration, methodology and applications. Dialysis, ultra filtration, lyophilization. Methods based on affinity – Principle of Affinity chromatography, methodology and applications (purification of proteins, nucleic acids).

High-performance liquid chromatography – Principle, instrumentation, practical procedure and applications. Ion-exchange chromatography – Principle, ion exchangers, methodology, pH and salt gradients for elution of proteins, amino acids and nucleotides. Amino acid analyzer.

**Unit III**

Electrophoresis – General principles and definitions. PAGE – Native-PAGE, SDS-PAGE, Isoelectric focussing, 2D electrophoresis, identification of novel proteins in 2D gels, capillary electrophoresis. Agarose gel electrophoresis - Preparation, separation and determination of molecular size of DNA, denaturing agarose gel electrophoresis and their applications, recovery of DNA from agarose gels. Pulse-field gel electrophoresis – principle, methodology and applications in separation of large DNA fragment.

**Unit IV**

Spectroscopy - Electromagnetic spectrum of light, simple theory of absorption of light by molecules, Beer-Lambert law, types of detectors. UV-visible spectrophotometry, infrared Spectroscopy, Raman Spectroscopy, fluorescence Spectroscopy, flame photometry, atomic absorption, plasma emission, mass, ESR and NMR spectrophotometry. Optical rotatory dispersion (ORD) and Circular Dichroism (CD), X-ray diffraction and X-ray crystallography.

**Unit V**

Radioisotope and tracer techniques - Nature and types of radioactivity, decay units, preparation of labeled biological compounds, detection and measurement of radioactivity (GM counter, scintillation counter, Cerenkov radiation, auto radiography, gamma-ray counter), quench correction. Biological uses of radioisotopes, safety measures in handling radio-isotopes.

**Recommended Books:**

1. Separation methods in biochemistry by S.J. Morris and P. Morris (Pitman)
2. The tools of Biochemistry by Terrance G. Cooper (Wiley)
3. Biochemical research technique (A practical introduction by Ed. John M. Wrigglesworth)
4. Analytical biochemistry by David J. Holmes and Hazel peck
5. A Biologist's guide to principles and techniques of practical biochemistry, 2<sup>nd</sup> edition Ed. by BL. Williams and K. Wilson (Edward Arnold)
6. Biophysical chemistry D. Freifelder, W.H. Freeman
7. Experimental techn. Ex ques in biochemistry by Drewes Pesec, AJ. And As worth, R.B.
8. Principles of Physical Biochemistry by K.E. Vanholdem W.C. Johnson, P.S. Ho, (Prentice Hall), 1998.
9. Manometer and biochemical techniques by W.W Umbricht and R.H. Burris (Burgens)
10. The determination of Molecular Structure by P.J. Wheatly (Oxford Clarendons press) 1968
11. Molecular Biophysics – R.B. Setlow and E.C. Pollard (Addison Wiley publishing Co. USA)1962
12. Biophysics – Edited by W. Hoppe, W. Lehman Hi. Maskal and H. Ziegler (Springer verlag, Berlin) 1983

13. Practical biochemistry: Principles & Techniques – Edited by Wilson & Walker, Cambridge Univ. Press, New York) 1986.
14. Biological Spectroscopy by Iain D. Campbell and Raymond A. Dwek, the Benjamin/Cumming Pub. Co., California, London.
15. Biophysical Chemistry by C.R. Cantor and P.R. Schimmel, W.H. Freeman & Co., NY.
16. Introduction to Biophysical Methods for Protein and Nucleic Acid Research, Ed. J.A. Glasel and M.P. Deutscher, (Academics Press), 1995.

**Practicals :**

1. Preparation of buffers and measurement of pH
2. Separation and identification of amino acids/plant pigments by paper chromatography.
3. Separation and identification of sugars by TLC.
4. Separation and identification of lipids by TLC.
5. Separation of amino acids by Ion-exchange chromatography.
6. Separation of proteins by Gel filtration
7. Absorption spectra of amino acids, Proteins and nucleic acids
8. Verification of Beer's law.
9. Determination of molar extinction coefficient of p-nitrophenol.
10. Measurement of inversion of sucrose by polarimetry.
11. Dialysis.
12. HPLC demonstration
13. Separation of proteins by SDS-PAGE
14. Separation of DNA by agarose gel electrophoresis
15. Isolation and spectrophotometric characterization of plant pigments
16. Isolation of mitochondria by density gradient centrifugation

**IBT 401- ENGLISH**

**POETRY**

- 1.The Solitary Reaper
2. Refugee Mother and Child
3. I will embrace only the sun

**UNIT-I**

William Wordsworth  
Chinua Achebe  
Tripuraneni Srinivas

**PROSE**

1. FilmMaking
2. Talk on Advertising
3. Decolonizing the Mind

**UNIT-II**

Satyajit Ray  
Herman Wouk  
Ngugi wa Thiong'o

**OneActPlay**

1. Refund

**UNIT-III**

Ritz Karintha

**UNIT-IV**

**Short Story:**

1. My Brother, My Brother      Norah Burke (from *IndiaLiterature*, MarApr1995,  
Vol XXXVIII, No: 2, SahityaAcademy)

**UNIT-V**

**COMMUNICATION AND COMPOSITION**

1. Report Writing
2. eCorrespondence
- 3 Expansion of Proverbs and Ideas
4. Jumbled Passages (from one act plays)

IBT-402 - TELUGU

**†Cüx\`D1**

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**†Cüx\`D2**

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**†Cüx\`D3**

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**†Cüx\`D4**

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**†Cüx\`D5**

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## IBT 403 – Genetics

**Unit-I**

Mendel's Laws - Monohybrid and Dihybrid cross. Test cross and back cross. Sex determination. Sex-linked inheritance. Linkage and crossing over. Recombination frequency. Hardy and Weinberg law.

**Unit-II**

**Nature of genetic material:** Evidence to prove DNA and RNA as genetic material. Gene as a unit of expression. Modern concept of gene, Colinearity of gene and polypeptide. Chromosome organization and aberrations.

**Unit-III**

**Mutations and mutagenesis:** Types of mutations, Molecular bases of mutations, Mutagenic agents, Mechanism of Mutagenesis, Transposon mutagenesis, Site-directed mutagenesis and its applications. Evaluation of mutagens by Ames test and micro nuclei test.

**DNA repair:** Photoreactivation, Excision repair, post replication, Recombination and SOS repair mechanism. Heat shock and adaptive responses, role of rec gene in DNA repair.

**Unit-IV**

**Mechanism of genetic transfer in bacteria:** Transformation, Transduction (generalized, specialized and abortive) and Conjugation ( $F^+$  and  $F^-$ ,  $F'$  and  $F^-$  and Hfr and  $F^-$ ). Genetic recombination in bacteria. Models (Break-join, Copy-choice, Break-copy) Role of recombination proteins. Mapping of bacterial chromosome by transformation, conjugation and transduction.

**Unit-V**

**Plasmids:** types, copy number, replication and regulation of col E 1 plasmid. Methods of plasmid transfers – micro injection, electroporation, calcium chloride treatment, triparental mating

**Transposons:** Transposable elements in prokaryotes and eukaryotes, Types of bacterial transposons-insertional sequences, complex transposons. Mechanisms of transposition (Replicative and Non replicative), Transposable viruses and retrotransposons.

**Practicals**

Demonstration of Mendelian laws using color marbles or beads

Evaluation of segregation and random assortment using Chi square test or test of fitness.

Construction of genetic maps based on Problems in two and three factor crosses



## IBT 403 – Genetics

**Unit-I**

Mendel's Laws - Monohybrid and Dihybrid cross. Test cross and back cross. Sex Chromosomes and determination. Sex-linked inheritance. Linkage and crossing over. Recombination frequency. Numerical changes in chromosomes - euploidy, haploidy - their fundamental and practical significance. Polyploidy – induction. Aneuploidy - type and genetic significance. Population Genetics- Hardy and Weinberg law.

**Unit-II**

Nature of genetic material: Evidence to prove DNA and RNA as genetic material. Gene as a unit of expression. Colinearity of gene and polypeptide. Modern concept of gene. Fine structure and analysis of rII locus of T4 bacteriophage- Establishment of recon, muton and cistron. Complementation test. Types of genes- House keeping genes, homeotic and regulatory genes.

**Unit-III**

Plasmids: types, copy number, replication and regulation of col E1 plasmid. Methods of plasmid transfers – micro injection, electroporation, calcium chloride treatment, triparental mating. Transposons: Types of bacterial transposons- insertional sequences, complex transposons. Retroposons- Transposons of Eukaryotes-Copia P3 and TY elements. Mechanisms of transposition (Replicative and Non replicative),

**Unit-IV**

Mechanism of genetic transfer in bacteria: Genetic recombination in bacteria. Models (Break-join, Copy-choice, Break-copy) Role of rec proteins. Transformation, Transduction (generalized, specialized and abortive) and Conjugation ( $F^+$  and  $F^-$ ,  $F'$  and  $F^-$  and Hfr and  $F^-$ ). Mapping of bacterial chromosome by transformation, conjugation and transduction.

**Unit-V**

Mutations and mutagenesis: Types of mutations, Mutagenic agents, Molecular bases of mutations, Mechanism of Mutagenesis, Transposon mutagenesis, Site-directed mutagenesis and its applications. Evaluation of mutagens by Ames test and micro nuclei test. Thymine dimer repair: Photo reactivation, Excision repair, post replication, Recombination and SOS repair mechanism. Heat shock and adaptive responses, role of rec gene in DNA repair.

**Practicals**

Demonstration of chromosomal (structural and numerical) aberrations  
Study of polytene chromosomes (lamp brush chromosomes and giant chromosomes).  
Karyotypic study.  
Effect of colchicine on chromosomes  
Demonstration of Mendelian laws using color marbles or beads  
Evaluation of segregation and random assortment using Chi square test or test of fitness.  
Construction of genetic maps based on Problems in two and three factor crosses

## IBT 404 – Enzymology

**Unit-I**

Properties of enzymes : catalytic power, specificity, holoenzymes, apoenzyme, coenzyme and cofactor. Nomenclature and classification of enzymes, active site- Fischer and Koshland models. Collision theory, activation energy and transition state energy, the law of mass action and order reaction.

**Unit-II**

Enzyme kinetics: Kinetics of single substrate enzyme catalysed reaction, equilibrium steady state assumption (Michaelis-Menten), transformation of Michaelis Menten equation, Lineweaver Burk, Eadie-Hofstee, Hanes plots. Determination of  $V_{max}$ ,  $K_m$ ,  $K_{cat}$  and their significance. Effect of pH, temperature, enzyme and substrate concentration on enzyme activity. Single displacement and Double displacement reaction.

**Unit-III**

Enzyme Inhibition: Reversible inhibition- competitive, uncompetitive and non competitive inhibition, allosteric and irreversible inhibitions.

Assay of enzymes: Coupled kinetic assay, RIA for enzymes, immunoradiometric assay, units of enzyme activity (IU), Turnover number, purification of enzymes and criteria of purity.

**Unit-IV**

Enzyme catalysis: Tapping the enzyme substrate complex, use of substrate analogues, enzyme modifications by chemical procedures affecting amino acid chain, treatment with protease, site directed mutagenesis, Factors contributing to the catalytic efficiency-proximity and orientation, covalent catalysis, acid-base catalysis, metal ion catalysis. Mechanisms of enzymes action-lysozyme, chymotrypsin and ribonuclease.

**Unit-V**

Vitamin coenzymes: structure and functions, enzyme regulation, feed back inhibition, allosteric kinetics(ATCase), cooperativity, symmetry and sequential models. Isoenzymes (LDH) Multi-enzyme complex (PDH complex), Ribozymes (catalytic RNA) Abzymes (catalytic antibodies), immobilized enzymes and applications.

**Reference Books**

1. Principles of Biochemistry general aspects 1983- Smith et al McGraw Hill.
2. Principles of Biochemistry, 2001, Nelson & Cox, CBS India.
3. Biochemistry, Lehninger, A.H.
4. Text book of Biochemistry, West, E.S., Todd, Manson & Vanbruggen. Macmillan.
5. Organic chemistry, I.L.Finar, ELBS, 1985.
6. Biochemistry, Zubay, C. Addison. Wesley 1986.
7. Biochemistry of Nucleic acids, Adams, E.T. Al. Chapman and Hall, 1986

**Practicals**

1. Assay of chymotrypsin and trypsin.
2. Isolation and partial purification of enzymes, amylases and cellulases.
3. Localization of enzymes – mitochondrial (SDH) and cytosolic (GSH)
4. Determination of characteristics of enzyme-catalyzed reaction ( $V_{max}$  and  $K_m$ ).
5. Effect of temperature and pH on the rate of enzyme catalysed reaction.
6. Effect of inhibitors/activators on enzyme catalyzed reactions.
7. Immobilization of enzymes.
8. Characterisation of immobilised enzymes.

**IBT 404 – Enzymology****Unit-I**

Properties of enzymes : catalytic power, specificity, holoenzymes, apoenzyme, coenzyme and cofactor. Nomenclature and classification of enzymes, active site- Fischer and Koshland models. Collision theory, activation energy and transition state energy, the law of mass action and order reaction.

**Unit-II**

Enzyme kinetics: Kinetics of single substrate enzyme catalysed reaction, equilibrium steady state assumption (Michaelis-Menten), transformation of Michaelis Menten equation, Lineweaver Burk, Eadie-Hofstee, Hanes plots. Determination of  $V_{max}$ ,  $K_m$ ,  $K_{cat}$  and their significance. Effect of pH, temperature, enzyme and substrate concentration on enzyme activity. Single displacement and Double displacement reaction.

**Unit-III**

Enzyme Inhibition: Reversible inhibition- competitive, uncompetitive and non competitive inhibition, allosteric and irreversible inhibitions.

Assay of enzymes: Coupled kinetic assay, units of enzyme activity (IU), Turnover number, purification of enzymes and criteria of purity.

**Unit-IV**

Enzyme catalysis: Tapping the enzyme substrate complex, use of substrate analogues, enzyme modifications by chemical procedures affecting amino acid chain, treatment with protease, site directed mutagenesis, Factors contributing to the catalytic efficiency-proximity and orientation, covalent catalysis, acid-base catalysis, metal ion catalysis. Mechanisms of enzymes action-lysozyme, chymotrypsin and ribonuclease.

**Unit-V**

Vitamin coenzymes: structure and functions, enzyme regulation, feed back inhibition, allosteric kinetics(ATCase), cooperativity, symmetry and sequential models. Isoenzymes (LDH) Multi-enzyme complex (PDH complex), Ribozymes (catalytic RNA) Abzymes (catalytic antibodies), immobilized enzymes and applications.

**Reference Books**

1. Principles of Biochemistry general aspects 1983- Smith et al McGraw Hill.
2. Principles of Biochemistry, 2001, Nelson & Cox, CBS India.
3. Biochemistry, Lehninger, A.H.
4. Text book of Biochemistry, West, E.S., Todd, Manson & Vanbruggen. Macmillan.
5. Organic chemistry, I.L.Finlar, ELBS, 1985.
6. Biochemistry, Zubay, C. Addison. Wesley 1986.
7. Biochemistry of Nucleic acids, Adams, E.T. Al. Chapman and Hall, 1986

**Practicals**

1. Assay of chymotrypsin and trypsin.
2. Isolation and partial purification of enzymes, amylases and cellulases.
3. Localization of enzymes – mitochondrial (SDH) and cytosolic (GSH)
4. Determination of characteristics of enzyme-catalyzed reaction ( $V_{max}$  and  $K_m$ ).
5. Effect of temperature and pH on the rate of enzyme catalysed reaction.
6. Effect of inhibitors/activators on enzyme catalyzed reactions.
7. Immobilization of enzymes.
8. Characterisation of immobilised enzymes.

**IBT 405 : CELL BIOLOGY**

**Unit – I**

Organization of prokaryotic and eukaryotic cell. Plasma membrane - molecular organization, current model and function, Cytoskeleton - microtubules, cilia and flagella, Structure and function of cytoskeleton.

**Unit - II**

Structure and function of endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, mitochondria and chloroplast. Nucleus - structure and function of nuclear membrane, nucleolus, structure and role of ribosomes.

**Unit – III**

Nature of *E.coli* chromosome. Eukaryotic chromosome - chromatin, its chemical nature, nucleosome structure, polytene and lamp brush chromosomes. Sex chromosomes and sex determination. Numerical changes in chromosomes - euploidy, haploidy - their fundamental and practical significance. Polyploidy – induction. Aneuploidy - type and genetic significance.

**Unit – IV**

Mechanism of cell division - mitotic apparatus, cytokinesis, chromosome movement - present concept - regulation of eukaryotic cell cycle - over view of cell cycle. Mutation causing cell cycle control.

Meiotic process - stages, chromosome pairing, chiasma formation, synaptonemal complex.

**Unit – V**

Cell to cell interaction – microvilli, tight junctions, gap junctions, desmosomes. Cell adhesion and cell signaling (autocrine, paracrine, synaptic and endocrine). Second messengers – types and mechanism of action.

**REFERENCES:**

1. Cell Biology - De Robertes & De Robertes
2. Cell and Molecular Biology - Baltimore.L
3. The Cell - Hooper
4. Cell and Molecular Biology - P.K.Gupta
5. Cell Biology- Verma and Agarwal
6. Cell Biology- Rastogi
7. Cell Biology-twyn
8. Molecular Biology of Cell – Alberts et al

**Practicals**

Preparation of cytological slides for mitosis using root tips.

Preparation of cytological slides for meiosis-I using flower buds; chiasma frequency

Identification of different stages of mitosis and meiosis.

Demonstration of chromosomal (structural and numerical) aberrations

Study of polytene chromosomes (lamp brush chromosomes and giant chromosomes).

Karyotypic study.

Effect of colchicine on chromosomes

Determination of cell size (ocular micrometer)

Determination of chlorophyll a and b.

**IBT 405: CELL BIOLOGY**

**Unit - I**

Cell Theory and the cell: Discovery of the cell and the cell theory, exceptions to the cell theory, cell shape, cell size and cell number. Prokaryotic vs. eukaryotic cells. Cell motility in prokaryotes and eukaryotes by cilia and flagella. Quorum sensing and chemotaxis, Cytoskeleton: microtubules, actin filaments and intermediate filaments.

**Unit - II**

Structure and function of plasma membrane, endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, mitochondria and chloroplast. Structure and role of ribosomes.

**Unit – III**

Structure and function of nuclear membrane. Organization of nuclear material in prokaryotes and eukaryotes. Eukaryotic chromosome – histone proteins and nucleosomes. Organization of metaphase chromosome in eukaryotes. Chromosome banding pattern, polytene and lamp brush chromosomes. Organization of nucleolus.

**Unit – IV**

Cell cycle and its regulation. Mitosis and meiosis-stages and molecular mechanism of cell division. Cell cycle and cancer.

**Unit – V**

Cell to cell interaction – microvilli, tight junctions, gap junctions, desmosomes. Cell adhesion and cell signaling (autocrine, paracrine, synaptic and endocrine). Second messengers – types and mechanism of action.

**REFERENCES:**

1. Cell Biology - De Robertes & De Robertes
2. Cell and Molecular Biology - Baltimore.L
3. The Cell - Hooper
4. Cell and Molecular Biology - P.K.Gupta
5. Cell Biology- Verma and Agarwal
6. Cell Biology- Rastogi
7. Cell Biology-twyn
8. Molecular Biology of Cell – Alberts et al

**Practicals**

1. Preparation of cytological slides for mitosis using root tips.
2. Preparation of cytological slides for meiosis-I using flower buds; chiasma frequency
3. Identification of different stages of mitosis and meiosis.
4. Determination of cell size (ocular micrometer)
5. Determination of chlorophyll a and b.

**SEMESTER - V**  
**IBT 501- Biostatistics**

**Unit-I**

Population, Sample, variable, parameter, primary and secondary data, screening and representation of data. Frequency distribution, tabulation, bar diagram, histograms, pie diagram, cumulative frequency curves. Mean median, mode, quartiles and percentiles, measures of dispersion: range, variance, standard deviation, coefficient of variation, symmetry: measures of skewness and kurtosis

**Unit-II**

**Probability Distributions:** Sample space, events, equally likely events. Definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, Examples Bernoulli, Binomial, Poisson and Normal distributions. Mean and variance of these distributions (without proof). Sketching of p.m.f. and p.d.f, Use of these distributions to describe in biological models. Model sampling and Simulation study.

**Unit-III**

Methods of sampling: Use of random numbers to generate simple random samples with replacement and without replacement. Sampling distribution and standard deviation of sample mean. Stratified sampling and its advantages.

Scatter plot, correlation coefficient ( $r$ ), properties (without proof), Interpretation of  $r$ , linear regression. Fitting of lines of regression, regression coefficient, coefficient of determination.

**Unit-IV**

Hypothesis testing: Hypothesis, critical region, and error probabilities. Tests for proportion, equality of proportions, equality of means of normal populations when variance known and when variances are unknown. Chi-square test for independence. P-value of the statistic. Confidence limits, Introduction to one way and two-way analysis of variance. Duncan's multiple range test.

**Unit-V:**

Application software: Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients etc. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL, sigma plot for presentation of data.

**Suggested Readings:**

Biostatistics : A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics.

Introductory Statistics. Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons (ASIA) Pte Ltd.

Basic Statistics-Aprimer for Biomedical Sciences-(Olive Jean Dunn).

Biostatistics-An introductory text - (Auram Gold Stein).

Statistics : An Introductory Analysis (Taro Yamane) Harper and Row Publisher 1964,67,73

**Practicals**

1. Measures of Central Tendency and Dispersion
2. Statistical Analysis using EXCEL & sigmastat. (Descriptive statistics and graphical presentation.)
3. Sketching of pmf/pdf of Binomial, Poisson and Normal distributions.
4. Correlation and Regression Analysis
5. Simple random sampling and stratified sampling.
6. Hypotheses testing and confidence intervals.
7. Analysis of Variance.
8. DMR test

**IBT-502 Biomembranes and Bioenergetics****UNIT-I**

Structure and assembly of biomembranes: Historical perspectives, organization of lipids in micelles, liposomes. Components, properties of lipid bilayer, Membrane models-Singer and Nicolson - fluid mosaic model. Biosynthesis and transport of phospholipids to plasma membrane and other organelle membranes. Biosynthesis of membrane proteins.

**UNIT-II**

Membrane transport: Active, passive transport and ion channels. Symport and antiport system. Organization, mechanism and significance of  $\text{Na}^+$  -  $\text{K}^+$  ATPase,  $\text{Na}^+$  -  $\text{H}^+$  ATPase, and  $\text{Ca}^{++}$ -ATPase pumps. Special bacterial transport systems. Permeases, Phosphotransferase system, transport through binding proteins. Transport of macromolecules. Endocytosis, pinocytosis and phagocytosis, Receptor mediated endocytosis- calcium, clathrin proteins. Transport of water – Aquaporins, Transport of glucose. Role of transport proteins in ER and Golgi and targeting.

**UNIT- III**

Membrane Receptors: Structure and functions, Methods to study membrane receptors. Excitable membrane ion gates and action potential generation, neurotransmitter types and action, G Protein – coupled receptors, Activation & inhibition of adenyl cyclase, Cell adhesion – Cadherins and Integrins. Extracellular matrix of cells. Membrane biogenesis - Liposomes and drug targeting.

**Unit-IV**

Bioenergetics - Energy transformations in the living systems, Free energy concept, exergonic and endergonic reactions, high energy compounds, phosphate group transfer potential, substrate level phosphorylation. Biological oxidations: Definition, enzymes involved-oxidases, dehydrogenases and oxygenases. Redox reactions, redox couplers, Reduction potential ( $\epsilon$ ,  $\epsilon_0$ ,  $\epsilon^{\circ}$ ). Standard reduction potential ( $\epsilon^{\circ}$ ) of some biochemically important half reactions.

**Unit-V**

Biological oxidations: Ultra structure of mitochondria, Electron transport chain and carriers involved. Oxidative phosphorylation, theories of oxidative phosphorylation-Mitchell's chemiosmotic theory  $\text{F}_0$ ,  $\text{F}_s$ -ATPase. Inhibitors of respiratory chain and oxidative phosphorylation, uncouplers. Formation of reactive oxygen species and their disposal through enzymatic reactions. Ultrastructure of chloroplasts, cyclic and non-cyclic photophosphorylation

**Suggested Readings :**

1. Molecular Cell Biology by H. Lodish, David Baltimore, et al W. H. Freeman Publication, 1996
2. Biological Membranes Findlay and Evans
3. Biochemistry of Tissues by Banks
4. Cell by Cooper
5. Lehninger's Principles of Biochemistry by D. L. Nelson and M. M. Cox, CBS Publications, 2000
6. Biochemistry by Lubert Stryer, 4th Edition

**IBT – 503 INTERMEDIARY METABOLISM****Unit-I**

Carbohydrate metabolism -Glycolysis and its regulation. TCA cycle – function and regulation. Electron transport chain- Energy yield during aerobic and anaerobic conditions, Glyoxylate cycle, Gluconeogenesis and its regulation, HMP shunt and its significance, Uronic acid pathway, Glycogen metabolism and its regulation with special reference to phosphorylase and glycogen synthase, Metabolism of fructose, galactose and lactose, cori cycle.

**Unit-II**

Essential and non-essential amino acids. General metabolic reactions of amino acids. Biosynthesis and regulation of branched chain amino acids, aromatic amino acids, histidine and methionine. Metabolic breakdown of individual amino acids. Ketogenic and glucogenic amino acids. Formation of creatinine, ammonia and urea. Regulation of urea cycle. Proteins turn over – Role of ubiquitin.

**Unit-III**

Fats as energy stores, Oxidation of fatty acids, Formation and utilization of ketone bodies. Biosynthesis of fatty acids and regulation. Metabolism of arachidonic acid – formation of prostaglandins, thromboxanes, leucotrienes. Biosynthesis of triglycerides. Metabolism of phospholipids, sphingolipids. Biosynthesis of cholesterol and its regulation, Formation of bile acids. Role of liver and adipose tissue in lipid metabolism.

**Unit-IV**

Biosynthesis of purines and pyrimidines. Degradation of purines and pyrimidines and their regulation. Structure and regulation of ribonucleotide reductase. Biosynthesis of ribonucleotides, deoxyribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis. Biosynthesis and degradation of heme.

**Unit-V:**

Metabolic disorders-In born errors of Carbohydrate metabolism - Lactose intolerance, Diabetis mellitus, Cori's disease, Inborn errors of amino acid metabolism- Alkaptonuria, Tyrosinemia, In born errors of lipid metabolism- Gaucher disease, Hyper and hypo cholesterolemia. In born errors of Nucleic acid metabolism – Gout, Hyper uricemia, Lesch – Nyhan syndrome.

**Recommended books:**

1. Principles of Biochemistry, White. A, Handler, P and Smith.
2. Biochemistry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of physiological chemistry, Harold A. Harper.
6. Text of Biochemistry, West and Todd.
7. Outlines of Biochemistry, Conn and Stumpf.
8. Metabolic pathways – Greenberg.
9. Mitochondria, Munn.
10. Biochemistry, 2nd Edition, G. Zubay.

**Practicals:**

1. Isolation and estimation of glycogen from liver
2. Isolation and estimation of Cholesterol from brain
3. Preparation of lecithin
4. Estimation of proteins by Biuret, modified Lowry and Bradford method.
5. Estimation of amino acids by ninhydrin method.
6. Estimation of glucose by glucose oxidase method
7. Titration curve of an amino acid and calculation of pK and pI values
8. Quantitative analysis of carbohydrates
9. Quantitative analysis of DNA, RNA.



**IBT 504 Molecular Biology****Unit -I**

DNA replication - Models of DNA replication Messelson and Stahl, Cairn's experiments. Enzymes involved in DNA replication. Structures of oriC. Mechanism of formation of oriC open complex. Replication initiation – elongation - okazaki fragments synthesis and processing - Direction of replication fork movement and termination - Replication of single stranded DNA - $\phi$ X174. Replication of bacteriophage lambda DNA (rolling circle). Replication of closed covalent circular DNA ( $\theta$  model of DNA replication). Problems associated with replication of linear DNA molecules. DNA Replication in Eukaryotes-Histone dissociation- replication and reassociation. Fidelity of DNA replication and inhibitors of DNA replication

**UNIT – II**

Transcription: Prokaryotic RNA polymerase – core enzyme and  $\sigma$  factors:  $-\sigma 70$ ,  $\sigma 32$  promoter elements. Promotor polymerase interaction – DNase protection method and Foot printing assays - Mapping of transcription start point (TSP). Upstream activating sequences and their role in regulation of transcription. Transcription elongation - Transcription termination -Rho-independent and Rho-dependent. Monosystronic and polycistronic mRNA. Eukaryotic RNA polymerases - Transcription factors – transcription. Structure and functions of RNA pol I, II and III dependent promoters. Enhancer sequences. Transcription factors - Mechanism of tissue specific transcription. Processing of RNA (capping, tailing and splicing). Inhibitors of transcription.

**Unit - III**

Translation: Central dogma theory and flow of genetic information, Genetic code and its elucidation, Wobble hypothesis, Structure and composition of prokaryotic and eukaryotic ribosomes, Structures of mRNA and tRNA, Events of protein synthesis (amino acid activation, initiation, elongation and termination) in prokaryotes and eukaryotes, Post-translational modification of proteins, Inhibitors of translation. Protein trafficking - Concept of signal peptide transport and membrane targeting of proteins - Sec pathway. Alternative protein transport mechanisms.

**Unit IV**

Regulation of gene expression in prokaryotes: Levels of control. Transcription factor domains and their role in regulation of gene expression: helix-turn-helix motif, zinc-finger motif, leucine-zipper and helix-loop-helix motif. Operon concept. Inducible and repressible systems. Regulation of gene expression in lac, ara and trp operon in E.coli. Regulation of nif gene expression in Klebsiella pneumonia and bacteriophage.

**Unit V**

Regulation of gene expression in Eukaryotes: Yeast gal genes. Steroid hormone induced gene expression by anti-sense RNA. Regulation of homeotic genes in insects. Gene expression as influenced by environmental factors. Regulation of gene expression by termination technology.

**Text books for reference**

1. Molecular Biology of the Gene (4th Edn) JD Watson, NH Hopkins, JW Roberts, JA Steitz and AM Weiner, The Bnjamin/Cummings Publ, Co. Inc, California.
2. Molecular Cell Biology (2nd Edn) J. Darnell, H.Lodish and D. Baltimore, Scientific American Books, Inc. USA 1994
3. Molecular Cloning: A Laboratory manual, J. Sambrook, E.Ffrisch and T. Maniatis, Old Spring Harbor Laboratory Press New York, 2000
4. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd,
5. Molecular Biology, TA Brown (Ed) Bios Scientific Publishers Ltd.,Oxford, 1991

**Practicals**

1. Isolation of genomic DNA from bacteria
2. Determination of purity of the isolated DNA by UV spectrophotometry
3. Colorimetric method (Diplhenylamine reagent)
4. Thermal denaturation of DNA and demonstration of hyperchromic effect.
5. Isolation of RNA by Trizol methods.
6. Estimation of RNA.
7. Determination of melting temperature ( $T_m$ ) and estimation of GC content.
8. Isolation of plasmids from E.coli and separation of CCC, Open circular and linear forms of

plasmids

9 Agarose gel electrophoresis – Separation and molecular size determination of DNA

10. Isolation and separation of proteins by SDS- PAGE

11. Western blot.

12. Purification of DNA fragment from agarose gels

**IBT-505 IMMUNOLOGY****UNIT I**

Introduction and overview- Types of Immunity, Innate and Acquired Immunity. Organs of the immune system. Cells of the immune system -B and T Lymphocytes, NK cells, macrophages, monocytes, granulocytes, mast cells and dendritic cells. The Antigen Presenting Cells. Antigens - Immunogenicity versus antigenicity, factors that influence immunogenicity, epitopes, haptens, adjuvants.

**UNIT II**

Immunoglobulins- Classification, structure and functions. Antibody diversity. Antigen-antibody reactions, Complement system. Major Histocompatibility Complex (MHC), the role of HLA typing in organ transplantation. T Cell maturation, activation, differentiation. The structure and functions of T cell receptors, TCR-peptide-MHC Tri molecular complexes. B cell generation, activation and differentiation. Cytokines.

**UNIT III**

The Humoral and Cell-mediated Immune Responses, B-cell activation and proliferation by Thymus independent and Thymus dependant antigens in vivo sites for induction of humoral response; B-cell differentiation, class-switching and generation of plasma cells and memory cells; Cell-mediated immune response: General properties of effector T-cells; Direct cytotoxic response; experimental assessment of cell-mediated cytotoxicity; Hypersensitivity – classification, mechanism, types, consequences of hypersensitive reactions.

**UNIT IV**

Vaccines- Classification and types. Production of vaccines and sera- conventional and biotechnological. Autoimmunity and autoimmune diseases (Rheumatoid arthritis, multiple sclerosis and SLE). Cancer and Immune system-Tumor induced cell signaling. Immune tolerance and immune suppression.

**UNIT V**

Immunotechniques- Labelled antibody based techniques- immune blotting, ELISA, RIA and immunoflourescence, FACS. Polyclonal and monoclonal antibody production and applications. Immunosorbant electron microscopy and infectivity neutralization tests. Immunodetection of viral antigens, Blood groups.

**Immunology practicals**

1. Blood Film Preparation and identification of cells. Differential count of WBC, RBC
2. Blood typing
3. Lymphoid organs and their microscopic organization.
4. Immunization and production of polyclonal antibodies
5. Double diffusion and Immuno-electrophoresis.
6. Single Radial immunodiffusion.
7. WIDAL test
8. VDRL test
9. HCG detection in Urine
10. Purification of IgG from serum.
11. Separation of mononuclear cell by Ficoll-paque.
12. Con-A induced proliferation of thymocytes (by MTT Method).
13. Western blotting.
14. ELISA

**SEMESTER-VI**  
**IBT 601: GENETIC ENGINEERING**

**UNIT - I**

Restriction enzymes - Outlines of bacterial restriction and modification systems – Classification of restriction enzymes - Type II restriction enzyme: Nomenclature, Production of DNA fragments with 3' protruding ends and blunt ends and their significance in molecular cloning - RFLP and its significance.

Isolation of gene/DNA fragments. Mechanical shearing, restriction digestion, cDNA synthesis, PCR amplification and chemical synthesis of gene.

**UNIT - II**

PCR - Concept and technology- Properties of primers -Taq DNA polymerase and its significance - Inverse, multiplex PCR, Real time PCR. Sequencing methods-sangers, Maxam-Gilbert's and automated. cDNA synthesis - Mechanism of cDNA synthesis, Strategies used to obtain full length cDNA. 5' and 3' RACE. Chemical synthesis - solid phase synthesis of oligonucleotides - Designing gene from amino acid sequence. In vitro synthesis of gene.

**UNIT - III**

Vectors for construction of genomic libraries - cosmids, bacterial artificial chromosomes (BACs), yeast artificial chromosomes (YACs). Vectors for construction of cDNA libraries - lambda ZAP. Multipurpose vectors - pUC 18/19, Blue script vectors - multiple cloning site - Strategies for unidirectional deletion of cloned DNA fragments - Generation of sequence of cloned DNA fragments. Site directed mutagenesis. Expression vectors – structure - promoters used in expression vectors - lac, tac, lambdaL, T7 promoters and their significance in constructing expression vectors. Promoter-probe vectors – Structure promoter probe vector - Reporter genes (lacZ, gfp, gus, luciferase) and strategies used to assay promoter activity. Vectors used for cloning in to mammalian cells - SV40. Vectors. Cloning of plants -binary vectors and cointegrate vectors.

**UNIT - IV**

Cloning strategies: Ligation between cohesive and blunt end DNA fragments - T4 DNA ligase - Conversion of blunt end DNA fragment into cohesive ended DNA - linkers, adapters, homopolymer tailing. Introduction of cloned genes into host - Transformation, triparental mating, conjugation, transfection, electroporation, particle bombardment, microinjection, liposome mediated DNA delivery. Identification and characterization of cloned genes - Screening of genomic/cDNA libraries - genetic, molecular hybridization - immunochemical techniques. Problems associated with expression of cloned genes-inclusion bodies.

**UNIT-V**

DNA Finger printing-RAPD, RFLP and AFLP analysis. Markers linked to drug and disease resistant genes. Application of RFLP in forensic science, pedigree analysis, biodiversity, genetic counselling and germ plasm maintenance. Antisense technology and its application. Use of transposon tagging.

**Practicals:**

1. PCR
2. RTPCR
3. Random amplified Polymorphic DNA
4. Restriction Fragment Length Polymorphism
5. AFLP
6. Southern Hybridization
7. Northern Hybridization
8. Bacterial Transformation
9. Bacterial Conjugation

**REFERENCES**

Gene transfer and expression protocols: Methods in Molecular Biology, Vol.7,1991. E.J. Murray Ed. Human Press, Clifton, NJ. PP 439.  
Genes IV, 1990. B. Lewin. Oxford University Press. PP 857.  
Microbial genetics. 1994. Freifelder, D. Springer.

Glossary of Genetics. 5 ed. Classical and molecular, 1994, Reiger. R. et al, Springer.  
 Gene regulation, 2nd ed. 1994. D, lachman. Sciential Publication.  
 Bacterial and Bacteriophage genetics. 1994. E.A. Birge. Springerscan Publication.  
 Genetics : A molecular approach. 2nd ed. 1992. T.B. Brown. Panima Publications. PP 496.  
 Principles of Gene Manipulation. 1991. R.W. Old and S.B. Prim-Rose. 2nd ed. Blackwell Scientific.  
 Practical Course  
 Molecular Biology, Vol. 7,1991. E.J. Murray ed. Humana Press. Clifton, NJ. PP 439. Genes IV. 1990.  
 B. Lewin. Oxford University Press. PP 857.  
 Guide to molecular cloning techniques : Methods in enzymology. Vol. 152. 1987. S.L. Berger and  
 A.R. Kimmel Ed. Academic Press. PP812.  
 Methods in molecular genetics : Molecular microbiology techniques Vol.3. 1994, Kenneth W.  
 Adolph. Ed, Academic Press. PP 2150.  
 Laboratory Manual in Molecular Lgenetics. 1994. Z.F. Burton and J.M.Kaguni. Harcourt Brace. PP  
 224.  
 Methods in Molecular Genetics. Vol.5, 1994. Kenneth. W. Adolph. Harcourt Brace. PP 425,  
 Molecular Cloning : A Laboratory Manual. 1989. 2nd ed.  
 J. Sambrook, E.F. Fritsch and T. Maniatis. Cold Spring Harbor Laboratory Press.  
 Methods in Enzymology. Vol.152. Guide to molecular cloning techniques. 1987. S.L. BergerandA.R.  
 Kimmel. Eds. Academic Press.  
 Recombinant DNA Laboratory manual. 1989. J.W. Zyskind and S.I. Bernstein. Academic Press  
 Methods in Molecular Genetics. Vol. 7, Viral Gene Techniques. Ed. By Kenneth W. Adoph,  
 Academic Press, 1995.  
 Gene transfer and expression protocols ; Methods in Molecular Biology, Vol.7.1991. E.J. Murray Ed.  
 Humana Press. Clifton, NJ. PP 439.

**IBT– 602: Cell and Tissue Culture, and Stem Cell Biology****UNIT – I**

Introduction to Plant Tissue Culture: Preparatory techniques – Cleaning, sterilization, handling tissue culture lab requirements. Media – Composition, preparation and sterilization. Genetic manipulation through tissue culture techniques. Concepts of differentiation and dedifferentiation. Callus – Growth pattern/characteristics. Organogenesis and plant regeneration. Somatic embryogenesis. Anther, endosperm and pollen cultures. Significance and advantages of haploid plants. Production of virus-free plants by meristem tip and other tissue culture techniques.

**UNIT – II**

Cell Culture Techniques for Micropropagation of Elite Plants.: Food and fruit crops, forest trees, fibre crops, ornamental plants, medicinal plants and endangered plants. Cell culture techniques for production of useful compounds – Hairy root cultures, transformed roots using *Agrobacterium* rhizogenesis. Production of secondary metabolites of commercial importance – Elicitors and factors affecting their yield. Immobilized cell systems, bioreactors. Selection of clones for nutritional, disease resistance, salt and drought resistance. Germplasm preservation by tissue technology. Artificial synthetic seeds. Protoplast culture – Isolation of protoplasts, culture and fusion methods, Somatic hybrids and cybrids.

**UNIT – III**

Animal Cell Lines: Definition, development, maintenance and management and cell adaptation. Established cell lines and their characteristic features and utility. Cross contamination hazards. Characteristics of cells in culture: Contact inhibition, anchorage independence, cell-cell communication etc. Cell senescence. Cell and tissue response to tropic factors, culturing of different cells. Designing of an experiment in tissue culture and response assessment. Significance of various controls. Growth studies: Cell proliferation, cell cycle, mitosis in growing cells. Organ culture: Methods, behavior of organ explant, and utility of organ culture. Organ transplants. Freeze storing of cells and transport of cultures. Mass production of biologically important compounds.

**UNIT – IV**

The Biology of Stem Cells: Different types of stem cells – embryonic stem cells, fetal tissue stem cells, adult stem cells. Nuclear transfer of stem cells. Human and animal cloning. Embryonic stem cells: The blastocyst and inner cell mass cells. Primitive endoderm implantation. Blastocyst development in vitro. Isolation and propagation of embryonic stem cells. Chimeras. Generation of knockout mice. Stem cell plasticity: Overview. Self renewal potential. Differentiation versus stem cell renewal. Transdifferentiation. Cell cycle dynamics of different stem cells. Stem cell assays and protocols: Isolation of defined stem cell populations, progenitor cell assays, sources of progenitor cells, cytokine and chemotherapy approaches to mobilization of progenitor cells; Flow cytometric techniques; Methods of cell selection using monoclonal antibodies; magnetic approaches to cell separation, Dyna beads, nano particle preparations; growth factors and ex-vivo expansion of hematopoietic stem / progenitor cells bioreactors for expansion.

**UNIT – V**

Nuclear Transfer Technology: Transfer of nuclei into eggs, development potential of transplanted nuclei, reprogramming a nucleus. Animal cloning and application in wild life and life stock: Overview. Challenges in human therapeutic cloning. Somatic cell nuclear transfer in humans. Pronuclear early embryonic development. Human embryonic stem cells and society: The religious, legal, ethical and scientific debate; the failure of the debate; the regulatory aspects of therapeutic use of stem cells.

**Practicals:**

1. Acquaintance with tissue culture laboratory: Sterilization techniques, preparation of media
2. Growth studies: cell count, protein estimation, mitotic index
3. Virus propagation in cells, cytopathogenic response of cells to viruses
4. In vitro assay of drugs, predictive test for anticancer drugs
5. Cell cloning by single cell dilution method.
6. Freeze storing and revival of cultured cells
7. Clonogenic assay, Cell-cell interaction: Co-culture of normal and mutant cells.

8. LDH isozyme analysis of the given cell lines  
Immunohistochemical staining (oncogene expression)
9. Effect of plant growth regulators on various explants for callus induction, cell suspension culture, growth analysis, cell plating efficiency
10. Organogenesis and Somatic embryogenesis
11. Shoot tip and nodal sector culture
12. Anther culture
13. Embryo culture
14. Endosperm culture

**Reference Books:**

Bioprocessing engineering principles. 1995. P.M. Doran. Har court Brace. PP 464.

Biochemical engineering. 1992. James. M. Lee Prentice-Hall.

Biochemical engineering fundamentals. 2 ed. 1986. J.E. Bailey and D.F. Oilis. Me Graw-Hill Publication.

Chemical Process Control : An introduction to theory and practice. 1984. G. Stephanopoulos. Prentice-hall.

Modelling and control of Fermentation Process. Ed. J.R.Leigh.

Biochemical Engineering by S. Aiba, AE Humphery, NF Miltis, University of Tokyo press,

Chemical Engineering by JM Coulson and JF Richarson, Pergamen Press.

Fundamentals of Biotechnology by P. Prave, U, Faust. W.Sitting and DASukatsch, VCH.

A Text Book on Biotechnology by HD Kumar, Affliated East West Press Private Ltd.

**IBT – 603: Plant Physiology****UNIT – I**

Membrane Transport: Membrane transport and translocation of water and solutes: Mechanism of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport of proteins. Root–microbe interactions in facilitating nutrient uptake.

**UNIT – II**

Photochemistry and Photosynthesis: General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes. Photooxidation of water, mechanism of electron and proton transport, carbon assimilation – Calvin cycle, Rubisco, significance of photorespiration. Subclassification of C4 plants, ecological significance and modification of CAM. Biosynthesis of starch and sucrose.

**UNIT – III**

Respiration and Lipid Metabolism: Overview of plant respiration. Anaerobic respiration. modern concept of electron transport and ATP synthesis. Inhibitors of respiration. Glyoxylate cycle, synthesis of membrane lipids, structural lipids and storage lipids and their catabolism, gluconeogenesis. Phytohormones: Biosynthesis and mechanism of action of auxin, gibberellin, cytokinin, ethylene and ABA.

**UNIT – IV**

Nitrogen and Sulphur Metabolism: Nitrogen fixation, Nitrogenase, nif genes, regulation of nitrogen fixation, products of nitrogen fixation and their transport. Mechanism of nitrate uptake and reduction, transamination, nitrogen metabolism in relation to photosynthesis and respiration. Sulphate uptake, transport, reduction and assimilation.

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, floral induction and development – Genetic and molecular analysis, role of vernalization.

**UNIT – V**

Stress Physiology: A brief idea of plant responses to water deficit, salinity, metal ion stress, freezing and heat stress, oxidative stress and drought resistance mechanism. Signal Transduction: Overview, receptors and G-proteins, phospholipids signaling, role of cyclic nucleotides, Calcium-Calmodulin cascade, protein kinases and phosphatases, specific signaling mechanisms, e.g. two component sensor regulator system in bacteria and plants.

**Practicals :**

1. Study of enzyme ATPase
2. Demonstration of ascent of sap
3. Sugar and amino acids analysis of phloem sap, with paper chromatography.
4. Determination of Chlorophyll a / b ratio of C3 and C4 plants.
5. Determination of rate of respiration in germinating seeds under aerobic and anaerobic conditions.
7. Demonstration of transpiration
8. To demonstrate that oxygen is evolved during photosynthesis
9. To demonstrate that CO<sub>2</sub> and light are necessary for photosynthesis
10. Effect of red and far red light on seed germination and study of photomorphogenesis.
11. Estimation of nitrate in different plant parts.
12. Study of enzyme glutamate oxaloacetate transaminase.
13. Study of nitrate reductase in plants.
14. Study of effect of PEG induced water stress on seed germination.
15. Measurement of growth by auxanometer
16. Effect of phytohormones on plant growth
17. Separation of chloroplast pigments by chromatography



**Reference Books:**

- Phytochemistry Vol.I, II and III - Miller, P (1973)  
Mineral nutrition of plants : Principals and prespectives - Epstein, E (1972)  
Plant Biochemistry: Bonner, J. and Varner, E. (1976)  
Biochemistry of Photosynthesis - Gregory, P (1976)  
Plant Physiology - Devlin, R.M. and Witham (1975)  
Nitrogen Metabolism in plants - Beevers, H (1976)  
Plant Physiology - Mukharjee S.P. and Ghosh A.N. (1996).  
Physiology of Plant Growth and Development - Wilkins, M.B. (1976).  
Introductory Plant Physiology - Noggle, G.R. and Fritz, G. J. (1976).  
Mineral nutrition of Higher Plants - Marschner, H. W. (1986).

**IBT – 604: Animal Physiology**

**UNIT – I**

Aim and Scope of Comparative Physiology: General functions and principles of comparative physiology. Digestion and metabolism of carbohydrates, proteins, and lipids in animals. Enzymes and their role in digestion. Vitamins and minerals – their role in biochemical reactions and significance in metabolism.

**UNIT – II**

Circulation: Blood clotting patterns – mechanism of blood clotting.  
Respiration and transport of gases in animals. General account of circulatory system in animals.  
Physiology of heart and role of respiratory pigments in transport of gases.

**UNIT – III**

Nervous and Muscle System: Comparative account of nervous system, mechanism of nerve impulse, transmission in animals. Chemo, mechano and photo receptors in animals. Thermoregulation in animals – Homeotherms, Poikilotherms and Hibernation. Muscular system – Functions and types of muscles, theories of muscle contraction. Neuromuscular junction – role of calcium in muscle contraction.

**UNIT – IV**

Excretion: Ionic and Osmotic balance in animals. Excretion in animals. Ammonotelic, Uretelic and Urediotelic organisms. Mechanism of urine formation – Ultra filtration in kidney. Regulation of salt and water balance in animals.

**UNIT – V**

Reproduction: Structure and function of male reproductive system – Hormonal regulation of spermatogenesis. Inhibition and androgen binding proteins. Capacitation of spermatozoa. Structure and function of female reproductive system – Influence of hormones on development of ovarian follicles and oogenesis. Reproductive cycles – estrus and menstrual cycle and ovulation. Atresia and corpus luteum formation. Pregnancy and lactation. Implantation and placentation. Contraception in males and females – Hormonal and chemical; recent advances in contraception research.

**Practicals:**

1. Estimation of Hemoglobin content in the given blood sample.
2. Qualitative identification and quantitative estimation of proteins in the given sample.
3. Qualitative identification and quantitative estimation of Carbohydrates in the given samples.
4. Qualitative identification of nitrogenous wastes. Viz Ammonia, Urea and Uric acid,
5. Quantitative estimation of ammonia and urea in the given sample.
6. Measurement of Quantitative estimation of unit oxygen consumption in aquatic animals (fish/crab).
7. Effect of temperature on the heartbeat of fresh water mussel.

**Reference Books:**

General and Comparative physiology - Hoar, W.S. Prentice Hall of India, New Delhi.  
Review of physiological chemistry - Harper, H.A., Rodwell, V.W. and Mayes P.A. Lange, medical publications, California.  
Lehninger's Principles of Biochemistry – Nelson & Cox. Lange Medical Publications, California.  
Comparative animal physiology - Professor C.L. and Brown, F.A W.B. Saunders, Philadelphia.  
Animal physiology Cambridge university press. Cambridge - Schmidt – Nielsen K.  
A handbook of Animal physiology - Pantelouris. EMA; W.B. Saunders Co. Philadelphia. Principles of physiology - Hantenstein A, Van Nestrand Reinhold company, New York.  
An introduction to general and comparative animal physiology - Floray, E. W.B. Saunders Co., Philadelphia.

**IBT – 605: Molecular Virology****UNIT – I**

History of Virology and Biosafety: History and principles of virology, virus taxonomy. Structures of animal and plant viruses and their morphology.

Principles of biosafety, containment facilities, maintenance and handling of laboratory animals, and requirements of virology laboratory.

**UNIT – II**

Virus Replication: Structure and replication strategies of bacteriophages – T7,  $\lambda$ ,  $\Phi$ X174, and plant viruses – ss RNA virus (TMV) and ds DNA virus (CaMV).

Structure and replication strategies of animal viruses – Influenza virus, Adeno virus and Retro virus.

**UNIT – III**

Interferon and Antiviral Agents: Viral Interference and Interferons. Nature and source of interferons, Classification of interferons. Induction of interferon.

Antiviral agents (chemical and biological) and their mode of actions.

**UNIT – IV**

Cultivation of Viruses and Viral Vaccines : Cultivation of viruses in embryonated egg, tissue culture and laboratory animals. Conventional vaccines – Killed and attenuated. Modern vaccines – Recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines). Vaccine delivery and adjuvants, large-scale manufacturing.

**UNIT – V**

Virological Methods: Methods for purification of viruses with special emphasis on ultracentrifugation methods. Quantitative diagnostic methods – Haemagglutination, complement fixation, neutralization, Western blot, flowcytometry.

Nucleic acid based diagnosis – PCR, microarray and nucleotide sequencing. Application of Microscopic techniques – Fluorescence, confocal and electron microscopic techniques.

**Practicals:**

1. Bacteriophage isolation, titration, plaque assay, single bust experiment.
2. Cultivation of viruses - Egg inoculation (CAM, Allantoic, Amniotic route inoculation)
3. Tissue culture techniques Animal inoculation techniques
4. Isolation and propagation of TMV Examination of blood smear by Leishman stain.
5. Rota viral RNA (ds RNA) analysis
6. Immunodiagnosis - ELISA tests

**Reference Books**

General Virology - Luria and Darnel

Virology and Immunology - Jokli

Text book of Virology - Rhodes and Van Royen

Plant Virology - Smith

Genetics of bacteria and their viruses - W. Hayes

Molecular Biology of the gene - Watson, Roberts, Staitz and Weiner

A laboratory guide in virology - Charles H. Lunningham

Basic lab procedures in diagnostic virology - Marty Cristensen

Review of medical microbiology - Jawitz et al

Medical laboratory Manual for tropical countries Vol I & II by Monica Cheesbrough

Text Book of Microbiology - Ananthanarayanan and Jayaram Paniker

Viral and Rickettsial infections of Man - Horsfall and Jam

Text book of Virology - Rhodes and Van Royan

Virological Procedures - Mitchal Hasking

Virology - Wilson and Topley

**Semester VII**  
**IBT -701: DEVELOPMENTAL BIOLOGY**

**UNIT-I**

Introduction and overview of animal development; Developmental control of gene expression, Cell signaling, Determining cell fate and cell commitment, Fertilization and cleavage, Gastrulation and Neurulation

**UNIT-II**

Introduction and overview of plant development in *Arabidopsis thaliana*. Developmental strategies of plants; gamete production in plants-gametophytes, microsporogenesis, megasporogenesis, pollination, fertilization; embryo development-embryogenesis, dormancy, germination, vegetative growth, development of root, shoot and leaf; vegetative to reproductive transition; senescence; Plant's response to environment.

**UNIT-III**

Examples of induction and cell fate determination; Early inductive events in *Xenopus*: axis formation, early inductive events in *Xenopus*: the Nieuwkoop center and the organizer, neural fate. Examples of determination of cell fate in the nervous system: the cerebral cortex, the retina. Consequences of Molecular evolution.

**UNIT-IV**

Introduction to developmental genetics: approaches and techniques; Introduction to *C.elegans*; Developmental genetics in practice: studying events controlled by maternal transcripts & later signaling events using *C.elegans*; epistasis and mosaic analysis to determine gene products;

**UNIT-V**

Developmental genetics in practice: studying early events in *Drosophila* development; axis formation, embryonic patterning, segmentation and segment identity in *Drosophila*. Limb development.

**PRACTICALS:**

1. Estimation of acid phosphatase levels in Tad pole tails
2. Types of anthers
3. Types of stigmas
4. Anther development in plants
5. Stages of megasporogenesis
6. Endosperm types

**IBT-702: CANCER BIOLOGY****UNIT - I**

Introduction, growth characteristics of cancer cells; Morphological and ultrastructural properties of cancer cells. Types of growth: hyperplasia, dysplasia, anaplasia and neoplasia. Nomenclature of neoplasms. Differences between benign and malignant tumors. Epidemiology of cancer.

**UNIT -II**

Cancer biology and biochemistry- Aberrant metabolism during cancer development; Paraneoplastic syndromes; Tumor markers; cellular protooncogenes- oncogene activation. Growth factors-EGF, TNF- and TGF- and growth factor receptors. Signal transduction in cancer. Role of transcription factors.

**UNIT -III**

Carcinogenesis- radiation and chemical carcinogenesis- stages in chemical carcinogenesis- Initiation, promotion and progression. Free radicals, antioxidants in cancer; Viral carcinogenesis -DNA and RNA Viruses. Hormone mediated carcinogenesis in humans.

**UNIT - IV**

Cell Cycle Regulation-Tumor suppressor genes p53, p21, Rb, BRACA1 and BRACA2. Telomeres, Telomerase, and Immortality; cell- cell interactions, cell adhesion-invasion and metastasis - VEGF signaling, angiogenesis; Epigenetics-Role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes; Apoptosis in cancer-Cell death by apoptosis, role of caspases; Death signaling pathways-mitochondrial and death receptor pathways.

**UNIT V**

Detection of Cancers, Prediction of aggressiveness of Cancer, Different forms of therapy, Chemotherapy, radiation Therapy, and Immuno therapy: advantages and limitations.

**PRACTICALS**

Karyotypic observations in cancer/normal cells  
 Chromosomal aberrations in cancer cells  
 Activity levels of SDH in normal and cancer cells  
 Activity levels of SOD in normal and cancer cells  
 Activity levels of catalase in normal and cancer cells  
 Levels of TBARS in normal and cancer cells  
 Levels of Protein Carbonyls in normal and cancer cells

**BOOKS RECOMMENDED**

1. The Biological Basis of Cancer: R. G. McKinnell, R. E. Parchment, A. O. Perantoni, G. Barry Pierce, I. Damjanov. 2<sup>nd</sup> Edition, Cambridge University Press, 2006.
2. The Biology of Cancer: R. A. Weinberg. Garland Science. 2006.
3. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication.
4. Maly B.W.J. Virology a practical approach, IRL Press, Oxford, 1987.
5. Dunmock N.J and Primrose.S.B., Introduction to modern Virology, Blackwel Scientific Publications. Oxford, 1988.
6. An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical publications, 1991. 7. Joseph M. Fernandez and James P. Hoeffler. Gene expression systems. Academic Press, 1999.

**IBT-703: BIOINFORMATICS****UNIT-I**

Foundations to bioinformatics – Evolution, similar macromolecular components, constancy of gene number and core proteome in closely related organisms. Bioinformatics data – nucleic acid sequence, protein sequence, protein structure, genomic, proteomic and metabolomic information. Bioinformatics databases – types, design, file formats, access tools with examples

**UNIT-II**

Dot-matrix comparison; Basics of sequence alignment - match, mismatch, gaps, scoring alignments, gap penalty, Types of sequence alignments (Global, local and multiple)-Pairwise alignment algorithms– Needleman and Wunch algorithm and SmithWaterman algorithm. Introduction to BLAST and FASTA. PAM and BLOSUM matrices

**UNIT-III**

Bioinformatics for genome sequencing; EST Clustering and analyses, Finding genes in prokaryotic and eukaryotic genomes: open reading frames, contents, signals; Regulatory sequence analysis: core and distal promoter sequences, transcription factor binding sites; Bioinformatics for Genome maps and markers; Bioinformatics for understanding Genome variation

**UNIT-IV**

Protein structure prediction and classification; Tools and techniques in proteomics; Methods for gene family identification; Methods of sequence based protein prediction; Methods of Bioinformatics in support of Proteomic research

**UNIT-V**

Medical application of Bioinformatics – disease genes, drug targets, pharmacogenomics, drug designing; Structural biology - Homology modeling; Bioinformatics for micro array designing and transcriptional profiling; Bioinformatics for metabolic reconstruction; Bioinformatics for phylogenetic analysis

**PRACTICALS**

1. Searching Data from NCBI Database.
2. Working on EMBL.
3. Searching structural data from PDB.
4. Genome Map viewer from NCBI.
5. Database search using BLAST.
6. Sequence alignments.
7. Sequence and structure visualization.

**BOOKS RECOMMENDED:**

1. Bioinformatics – D.Mount
2. Programming in C by Balaguru Swamy.
3. Introduction to Bioinformatics by Arthur M.Lesk, Oxford.
4. Biostatistics – Daniel. (Wiley).
5. Statistics by S.C.Gupta.
6. Statistical Methods by G.W.Snedecor & W.G.Cochran.
7. Fundamentals of Biostatistics – Khan & Khanum.
8. Let us C – Kanetkar.
9. Fundamentals of Biostatistics by U.B.Rastogi (Ame Books Ltd).

**IBT-704: ENDOCRINOLOGY****UNIT-I**

Introduction to the Vertebrate Endocrine System, Hormones general Characters, Classification of hormones. Hormone action- Receptors-types, structure (insulin, thyroid, steroid and adrenergic receptors), Signal transduction - Concept of second messengers (cAMP, IP3, calcium, and NO). Protein phosphorylation and dephosphorylation. Assay of hormones

**UNIT-II**

Role of calcium: Control of cellular calcium levels, transport and regulation. Interaction between cAMP and calcium. Calcium dependent proteins. Hypothalamic Hormones: Synthesis, secretion, transport and biological actions of hypothalamic, adenophophysial and neurohypophysial hormones. Hypothalamic and pituitary disorders. Pineal Hormones: melatonin

**UNIT-III**

Thyroidal Hormones: chemistry, function and metabolism, hypo and hyper thyroidism, Parathyroid Hormones: Para hormone and calcitonin, their role in calcium and phosphate metabolism, abnormalities of Parathyroid functions. Role of Vitamin D in calcium and phosphate metabolism

**UNIT-IV**

Pancreatic Hormone: biosynthesis of insulin and glucagon. Regulation of insulin and glucagon secretion. Role in carbohydrate, lipid and protein metabolism. Endocrine disorders of pancreas- diabetes mellitus, mellituias, hypoglycemia. Glucose tolerance test. Adrenal Medulla: chemistry, biosynthesis and function of adrenal medullary hormone. Disorders of medullary hormone.

**UNIT-V**

Adrenal Cortex: chemistry, biosynthesis and function of adrenal cortical hormones. Disorders of cortical hormones. Gonadal hormones: Chemistry, biosynthesis and function of androgens, estrogens and progesterone. Hormonal regulation of menstrual cycle and pregnancy. Hormones of Gastrointestinal Tract: Secretin, gastrin and cholecystikinin.

**PRACTICALS:**

1. Isolation and identification of endocrine glands in rats
2. Effect of insulin on blood sugar
3. Effect of glucagon on blood sugar
4. Determination of circulatory levels of insulin/corticosteroid/T3 & T4
5. Pregnancy test

**BOOKS RECOMMENDED:**

1. General Endocrinology-Turner C.D
2. Text Book of Endocrinology-R.H.Williams
3. Harper's Review of Biochemistry.
4. Endocrinology (4th Edition) M.E.Hadley (Prentie Hall).
5. Lehninger's Principles of Biochemistry –Nelson and Cox
6. Text Book Of Biochemistry With Clinical Correlation- Ed.Thomas., M.Devlin
7. Biochemistry-Lubert Stryer.
8. Mammalian Biochemistry-White Handler and Smith.

**IBT-705: IMMUNOTECHNOLOGY**

**Unit I**

**Industrial uses:** General Introduction, Polyclonal antibodies, significance of monoclonal antibodies. Hybridoma technology, General, Myeloma cell lines, fusion of myeloma cell with antibody producing B-cell. Fusion methods, selection and screening methods for positive hybrids with HAT selection, Production, purification and characterization of monoclonal antibodies. Application of monoclonal antibodies in biochemical research, in clinical diagnosis and treatment. Production of human monoclonal antibodies and their applications

**Unit –II**

**Antigen and antibody Characteristics:** Methods used in immunology: Preparation of antigens and antibodies, purification of antibodies, analysis of antibodies and antigens, preparation and uses of various types of vaccines.

**Unit III**

**Methods used in immunology I:** Immunological techniques: Immuno diffusion: One and two dimensional, single radial immuno diffusion, Ouchterlony immno diffusion. Immuno electrophoresis: rocket immunoelectrophoresis; Agglutination: Direct and Indirect, Widal test, Radioimmunoassay: ELISA – Principle, Methodology and applications.

**Unit IV**

**Methods used in immunology II:** Techniques used in immunology: Western blot analysis, Immuno electrophoresis and Hybridization techniques, immunohistochemistry, Immunoflowcytometry, Immuno fluorescence: Direct, indirect and Sandwich

**Unit V**

**Applications of antibodies:** Applications of antisera in the detection and diagnosis of various bacterial and viral diseases. Examples: syphilis, typhoid, streptococci infections, HIV, various types of Hepatitis

**PRACTICALS:**

1. Blood Film Preparation and identification of cells. Differential count of WBC, RBC
2. Blood typing
3. Lymphoid organs and their microscopic organization.
4. Immunization and production of polyclonal antibodies
5. Double diffusion and Immuno-electrophoresis.
6. Single Radial immunodiffusion.
7. WIDAL test
8. VDRL test
9. HCG detection in Urine
10. Purification of IgG from serum.
11. Separation of mononuclear cell by Ficoll-paque.
12. Con-A induced proliferation of thymocytes (by MTT Method).
13. Western blotting.
14. ELISA

**BOOKS RECOMMENDED**

1. Goldsby RA, Kindt TJ, Osborne BA. Kuby Immunology, Fourth Ed, W.H. Freeman and company, New York, 2000.



2. Rose et al., Manual of Clinical laboratory Immunology, 6<sup>th</sup> Ed ASM Publications, 2002.
3. Burdon and Khippiberg, Laboratory techniques in Biochemistry and Molecular Biology, Humana Press, 1984.
4. Weir DM, Herzenberg LA, and Blackwell C. Handbook of Experimental Immunology, Black well Science Oxford 1989.
3. Lefkovic and Pernis, Immunological methods. Academic Press, 1978.
4. Boore baeck, Antibody Engineering 2nd Ed Wiley, 1995.

**IBT-801: GENOMICS AND PROTEOMICS****UNIT-I**

Whole genome analysis: Prokaryotes and Eukaryotes, Foundations of genomics. Mapping of genome linkage mapping, High resolution physical mapping. Marker associated and clone assisted genome mapping: Genome library construction YAC, BAC and PAC libraries of genome.

**UNIT- II**

Introduction to genome structure and Organization, Organelle genomes. Comparative genomics: genomes (DNA and protein sequence), Protein structures (geometry), databases, sequence analysis of proteins and nucleic acids (clustalw), phylogenetic tree construction, Structure prediction, simple molecular modeling.

**UNIT- III**

Genetic and Physical Mapping, Linkage analysis. Genome sequencing: DNA sequencing methodology, Assembly of DNA sequence, Contig approach and shotgun approach, BACs and YACs. The structure, function and evolution of the human genome. Strategies for large-scale sequencing projects. Human disease genes. Expression. Bioinformatics for the analysis of sequence data; approaches for determining gene expression patterns and functions. Transcriptome, Studying Gene expression in microorganisms, Microarrays – DNA chips.

**UNIT- IV**

An introduction to proteomics. Property of proteins, 2D electrophoresis, Mass spectrometry: types and uses in proteomics, Protein microarray, metabolomics.

**UNIT-V**

Protein structure, secondary structure and super-secondary structure. Mechanisms of protein folding, tertiary folds. Formation of oligomers. Relationship between protein structure and function. Prions. Structure prediction and human proteomics. Mutant proteins. Use of computer simulations and knowledge-based methods in the design process. *De-novo* design; Use of databases of sequence and structure. Protein structure and drug discovery, Proteins in disease.

**PRACTICALS**

1. One and two dimensional separation of protein.
2. Scanning and image analysis of 2-D gels.
3. Spectral analysis of proteins.
4. Computer assisted demonstration of microarray technology: DNA and protein
5. Liposome preparation.
6. Identification of cystic fibrosis gene from Human genome and fattyacyl desaturase gene in Arabidopsis genome.
7. Characterization of the protein coded by gene sequence above (in Expt 4) using NCBI software online.
8. Primer designing methods: degenerate and general oligonucleotide primers
9. Protein-protein interaction: immunoneutralization (Antigen-antibody Precipitation).

**BOOKS RECOMMENDED**

1. Twyman, RM and Primrose, SB (2003). Principle of Genome Analysis, Blackwell Publisher, Brown TA (2006), Genomes 2, Wiley-Liss
2. T.W. Veenstra, TW and Tates III, JR (2006). Proteomics for biological discovery, Wiley
3. Durbin R, Eddy SR, Krogh A and Mitchison G (2000). Biological Sequence Analysis, Probabilistic Models of Proteins and Nucleic Acids, Cambridge University Press

**IBT802: MICROBIAL BIOTECHNOLOGY****UNIT-I**

Heterologous Expression: Expression vectors and hosts Generally Regarded as Safe (GRAS) organisms. Production of active recombinant proteins of mammalian/Eukaryotic origin in prokaryotes. Large scale production of proteins from recombinant microorganisms. Principles of microbial growth – Batch fermentation, feed-batch fermentation – continuous Fermentation, high density cell cultures – Bioreactors – Large scale fermentation system – tandem Airlift reactors – Single stirred tank reactors.

**UNIT-II**

Downstream processing: Harvesting microbial cells – Membrane filtration system, high speed semi continuous centrifugation – disrupting microbial cells. Gram scale purification of recombinant proteins – Chromatography systems and analytical methods for large scale purification. Stabilization of the proteins.

**UNIT-III**

Processing technology: Microbial metabolites - Organic solvents (Alcohol), Organic acids (Citric acid), Wines and beers, Antibiotics (penicillin), Vitamins (Vitamin B12), Amino acids (Aspartic acid). Production of single cell proteins.

**UNIT-IV**

Environmental pollution – Types of soil and air pollutants, methods for the measurement of air pollution. Water pollution and its control – Need for water management, sources of water pollution. Measurement of water pollution. Microbiology of wastewater treatment: Aerobic process – Activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic treatment. Treatment schemes for waste water of sugar industry. Microbiology of degradation of substituted hydrocarbons (p-nitrophenol), pesticides (2,4-D). Oil pollution, surfactants. Bioremediation of contaminated sites. Biopesticides in integrated pest management.

**UNIT-V**

Enzyme technology: Sources production, isolation and purification of enzymes for the industrial use. Application of enzymes in pharmaceutical, food processing and other industries. Different techniques of immobilization of enzymes, applications and kinetics of immobilized enzymes. Design and operation of immobilized enzyme systems and bioreactors. Whole cell immobilization. Biosensors - principle and types.

**PRACTICALS**

1. Production of alcohol by *S. cerevisiae*
2. Production of citric acid by *A. niger*
3. Production of penicillin by fermentation
4. Production of wine from apples
5. Production aspartic acid
6. Production of glucose isomerase by batch fermentation
7. Production of lysine by *Corynebacterium* sp.
8. Characterization of microbes useful in degradation of pesticides/hydrocarbons.

**BOOKS RECOMMENDED:**

1. Microbial Biotechnology. Glazer and Nikaido. 1995.
2. Biotechnology – A Text Book of Industrial Microbiology, Crueger and Crueger. 2000
3. Principles of Fermentation Technology, Stanbury. Whitaker & Hall. 1997
4. Microbial Technology Vol. I & II. Pepler & Perllman (EDS)
5. Industrial Microbiology. Prescott & Dunn's. Reed (Ed)
6. Concepts in Biotechnology. Balasubramanian, Bryce, Dharmaligan, Green & Jayaraman
7. Microbial Ecology – Fundamentals and applications. Atlas and Bartha
8. Environmental Microbiology. Mitchall
9. Environmental Microbiology. Grant & Long

**IBT-803: ENVIRONMENTAL BIOTECHNOLOGY****UNIT -1**

Structure of model ecosystem: terrestrial, aquatic ecosystems - Energy flow - Degradation of ecosystem. Consequences - Ecosystem managements - Energy conservation - Alternative energy sources - Biofuels: Production of bioethanol, biobutanol from agriculture waste - Problems and perspectives - Biodiesels: mass cultivation and use of Jatropa, marine algae for production of biodiesel.

**UNIT-II**

Types and sources of pollution - Inorganic, organic and biotic, Clinical examples of air, water and land pollutions. Environmental impact of pollution and measurement methods, Composting of organic wastes, microbial bioremediation of oil spills, Waste water treatment - sewage treatment and common industrial effluent treatment, Concepts of bioremediation (in-situ and ex-situ), Bioremediation of toxic metal ions – biosorption and bioaccumulation principles. Concepts of phytoremediation, Microbial biotransformation of pesticides and xenobiotics, Microbial leaching of ores – direct and indirect mechanisms

**UNIT- III**

Biofertilizers and their importance in crop productivity, Algal and fungal (mycorrhizae) biofertilizers, Bacterial biofertilizers (rhizobial, free living N<sub>2</sub> fixers and phosphate solubilizing bacteria), their significance and practice, Biopesticides : Bacterial (Bt pesticides), fungal (Trichoderma), Viral biopesticides – Baculovirus, NPV insecticides. Production of biofertilizers and biopesticides for large scale application

**UNIT- IV**

Genetically engineered microorganisms in environmental health, Genetically engineered plants and microorganisms in agriculture and productivity, Genetically engineered bacteria in bioremediation of organic pesticides, insecticides oil spills, Hazards of genetically engineered microorganisms, plants and animals, Policies of genetic engineering research.

**UNIT-V**

Hazardous Waste Management: Introduction - Xenobiotic compounds, recalcitrance. hazardous wastes - biodegradation of Xenobiotics. Biological detoxification - market for hazardous waste management. Biotechnology application to hazardous waste management - examples – cyanide detoxification - detoxification of oxalate, urea - toxic organics - phenols.

**PRACTICALS:**

1. Biomass estimation by different methods
2. Isolation of Biofertilizer microbes by biological enrichment method
3. Efficacy testing for biofertilizers (nodulation test for rhizobia) and biopesticides
4. Estimation of BOD
5. Testing for microbiological quality of potable water (Coli form test)
6. Microbial degradation of organic matter
7. Testing for effect of chemical pesticides on soil microbial respiration
8. Testing for microbial biodegradation of pesticides

**RECOMMENDED BOOKS**

1. Comprehensive Biotechnology (All volumes) Ed. Young, M.Y. Pub: Pergmon Press
2. Environmental Microbiology. Grant, WD and Long PE. Publ: Blakie, Glasgow
3. Biotreatment systems Vol. 22. Ed. Wise, DL.
4. Microbial Ecology: Principles, Methods and Applications by Lavin, Seidler, Rogul,
5. Laboratory Experiments in Microbiology by Gopal Reddy et al

**IBT-804: FOOD & INDUSTRIAL BIOTECHNOLOGY**

**UNIT- I**

Introduction to food processing biotechnology in relation to the food industry, nutritive value of food. Microorganisms associated with food, its sources, types and behavior in foods. Contamination of foods by pesticides, fertilizers, industrial waste and chemical contaminants. Principles underlying food spoilage: chemical, physical and physiological changes caused by microorganisms. Control measures for food poisoning.

**UNIT- II**

Food Preservation: Bioprocessing of meat, fisheries, vegetables, dairy products, enzymes and chemicals used in food processing, biochemical engineering for flavor and food production, cryopreservation, irradiated foods. Fermented Food Products. Dairy products. non-beverage plant products, beverages and related products of baking. Quality Control, case studies on Biotechnology in the evolution of food quality. Food Spoilage & Food Borne Diseases

**UNIT- III**

Utilization of microorganisms in food Industry, Single cell protein, Nutraceuticals, Natural and artificial sweeteners and their role in controlling diseases and deficiencies.

**UNIT -IV**

Industrial cultures– Bacteria, Algae, Fungi, Actinomycetes; Primary and secondary screening of microorganisms for industrial products. Isolation and preservation of microorganisms for industrial products. Production of microbial products-organic acids (citric acid), amino acids (aspartic acid), alcohols and beverages (ethanol), enzymes (proteases) antibiotics (penicillin), vaccines (BCG), vitamins (B12) and dairy products (cheese).

**UNIT-V**

Nitrogen fixation and mass production of biofertilizers - diazotrophic microorganisms, Biochemical aspects of diazotrophy. Genetics of free living and symbiotic diazotrophs. Blue Green Algae and Azolla, Mycorrhizae. Vermiculture, Mass cultivation of commercially valuable macro and micro algae for agar agar, alginates, single cell protein and other products

**PRACTICALS**

1. Estimation of ascorbic acid from tomato, grapes, lemon and bitter gourd
2. Determination of ascorbic acid oxidase in tomato, grapes, lemon and bitter gourd
3. Production of wine from grapes
4. Immobilization of an enzyme by gel-entrapment
5. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment
6. Production of protease by batch fermentation

**BOOKS RECOMMENDED**

1. Roger A., Gordan B., and John T., Food Biotechnology, 1989.
2. Frazier, Food Microbiology,

**IBT-805: ANIMAL REPRODUCTION, CLONING AND TRANSGENICS**

**UNIT - I**

Structure and function of male reproductive system- Hormonal regulation of spermatogenesis and spermeiogenesis; Inhibin and androgen binding proteins; Capacitation of spermatozoa.

Structure and function of female reproductive system - influence of hormones on development of ovarian follicles and oogenesis; Reproductive cycles; estrus and menstrual cycle; Ovulation, atresia and corpus luteum formation; Pregnancy and lactation; Implantation and placentation. Contraception in males and females; Hormonal and chemical; Recent advances in contraception research.

**UNIT - II**

Introduction - Sex determination; Principles of animal breeding; Structure of the live stock breeding industry: dairy cattle, beef cattle, swine, sheep and poultry.

Selection for qualitatively inherited characters - Gene frequency and selecting against recessive genes; detecting heterozygotes for recessive; parental determination and verification; the use of markers and/ or molecular probes, selection criteria: multiple records, pedigree selection, family selection; progeny testing: breeding value, transmitting ability and heritability; correlated characters; selection for maternal ability; factors affecting selection response; genotypes - environment interactions.

Artificial insemination (AI) techniques and their development; Estrus synchronization; Semen collection, evaluation, storage, in vitro fertilization, Embryo transfer - ICSI and preservation of endangered species.

**UNIT-III**

An overview of transgenic technology. Development of transgenic mice and other animal models: by injection of foreign DNA/gene into zygote; optimization of construct for in vivo expression.

Generation of chimeric, transgenic and knockout mice and other animals and their characterization. Potential application of transgenic animals: Models for various diseases/disorders, Production of peptides and proteins of biopharmaceutical interest (molecular pharming), Transgenic fishes, Transgenic poultry and Transgenic insects as bioreactors.

**UNIT - IV**

Applications of biotechnology to animal health - Production of vaccines, diagnostics, hormones and other products. Animal nutrition and biotechnology - Microbial supplements, non-genetic and genetic manipulation of rumen microbes, Utilization of animal waste as live stock feed.

**UNIT-V**

Biotechnology in animal production-manipulation of growth and reproduction using hormones and probiotics, manipulation of lactation, production of vaccines for better health.

**BOOKS RECOMMENDED**

1. Animal Biotechnology (1989): Comprehensive Biotechnology First Supplement: (Ed.)L.A. Babink and J.P.Phillips. Pregamon press, Oxford
2. Experimental approaches to Mammalian Embryonic Development. (1986); Rossant,J. and R.A.Pederson Cambridge University Press, Cambridge
3. Animal cell culture A practical approach. (1992) Ed. R.I.Freshney .IRL press.
4. Future Developments in the Genetic Improvements of Animals. Ed. J.S.F.Barrer, K.Hammond and A.E.McClintock, Academic Press, 1992.
5. Human Genetics: Concept and Applications. Ricki Lewis .McGraw Hill. 2003.

**IBT-901: IPR, PATENTING, BIOETHICS AND BIO-SAFETY**

**UNIT- I**

Introduction to Bioethics. Social and ethical issues in Biotechnology, causes of unethical acts, ignorance of laws, codes, policies and Procedures, recognition, friendship, personal gains. Professional ethics – professional conduct, Ethical decision making, ethical dilemmas, good laboratory practices, good manufacturing practices, laboratory accreditation

**UNIT -II**

Definition of Biosafety. Biosafety for human health and environment. Social and ethical issues of biosafety. Use of genetically modified organisms (BT cotton and BT brinjal) and their release in to the environment. Special procedures for r-DNA based products

**UNIT- III**

Intellectual property rights, and Intellectual Property protection, patents and methods of application of patents, Trade Secrets copyrights, Trade Marks, legal implications, farmers rights, plant breeder's rights. International and National conventions on biotechnology and related areas. WTO guidelines. Introduction- Basic research, applied research, needs based research (data collection, methodology, statistics), Identification of the problem, defining the problem.

**UNIT- IV**

Literature search – information sources, library resources- books, journals, abstracts, hand books, procedure manuals, encyclopedias, annual reports, data banks, CDROMS, online literature search – internet access, websites, directories of information resources. Design of the experimental programme–variables in the experiments, materials and methods, evaluation of methods, application of methods. Progress of research – evaluation of results, statistical approach, comparison with existing methodologies, validation of findings, preparation and publication of research papers

**UNIT-V**

Preparation of research proposal for funding. Origin of the proposal, National and International status, gaps in the literature, hypothesis, objectives, methodology, work plan, expected outcome of project. Sources of funding agencies (APCOST, DST, DBT, ICMR, ICAR, IISc, TIFR, Royal society fellowships by UK)

**PRACTICALS**

1. Scientific writing (research articles, project proposal and project report)
2. List of patents
3. Discussion on patents

**BOOKS RECOMMENDED:**

1. Sasson A, Biotechnologies and Development, UNESCO Publications, 1988.
2. Sasson A. Biotechnologies in developing countries present and future, UNESCO publishers, 1993.
3. Singh K. Intellectual Property Rights on Biotechnology, BCII, New Delhi.

**IBT-902: BIOPROCESS ENGINEERING AND TECHNOLOGY****UNIT - I**

Isolation, screening and maintenance of industrially important microbes; microbial growth and death kinetics (an example from each group, particularly with reference to industrially useful microorganisms); Strain improvement for increased yield and other desirable characteristics.

**UNIT - II**

Bioreactor designs; types of fermentation and fermenters; Concepts of basic modes of fermentation – batch, fed batch and continuous; conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design - mechanically agitated; pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation and air sterilization: Upstream processing; media formulation; sterilization; aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process.

**UNIT - III**

Preparation and application of Immobilized enzymes: Kinetics of Enzyme catalyzed reactions - Kinetics of immobilized enzyme catalyzed reactions - Kinetics of balanced growth - Transient growth kinetics. Gas-liquid mass transfer in cellular systems - Aeration – Agitation - Estimation of oxygen transfer rates.

**UNIT - IV:**

Bioseparation - filtration, centrifugation, sedimentation, flocculation; cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; reverse osmosis and ultra filtration; drying; crystallization; Storage and packaging; Treatment of effluent and its disposal. Large scale production and purification of recombinant therapeutics (streptokinase, epidermal growth factor, insulin).

**UNIT-V**

Industrial production of recombinant proteins (riboflavin, streptomycin, tPA). Scenario of Indian biotech industries (local, state and national wide).

**PRACTICALS:**

1. Production of protease/amylase by batch fermentation.
2. Immobilization of an enzyme (invertase/lipase/amylase) by gel entrapment.
3. Immobilization of whole cells for enzyme/antibiotic production by gel entrapment.
4. Screening of soil samples for isolation of bacteria, fungi and actinomycetes.
5. Selective isolation of actinomycetes from soil samples.
6. Microbiological assay of an antibiotic including the construction of standard curve.
7. UV survival curve.
8. Production of alcohol by *S.cerevisiae* and its estimation.
9. Production of streptomycin by fermentation.
10. Production of citric acid by *A.niger*.
11. Production of red wine from grapes.
12. Production of Glutamic acid by *M. glutamicus*.



**IBT-903: PHARMACEUTICAL BIOTECHNOLOGY**

**UNIT-I**

Introduction, history, nature and source of drug, classification of drugs, route of drug administration: types, advantages and disadvantages, prodrug: definition, antibody directed enzyme prodrug therapy (ADEPT).

**UNIT-II**

Models of pharmacokinetics: concentration dependent model and flowtype model, drug interaction, properties of drugs: Physiochemical properties of drugs, biochemical aspects of drugs, mechanism of action of drugs, Bioavailability: definition, factors influencing bioavailability, first pass elimination, extraction ratio, dose: loading dose, maintenance dose, target concentration strategy.

**UNIT-III**

Absorption: Biological membrane and drug absorption, fluid types of drug transport, factors influencing drug absorption, drug transport types, distribution: models of distribution, redistribution of drugs and influence of protein binding on distribution, elimination: models of eliminations, types of elimination: capacity limited elimination and flow dependent elimination.

**UNIT-IV**

Biotransformation (metabolism): Synthetic and nonsynthetic reactions, drug metabolizing enzymes: microsomal and non-microsomal enzymes, inhibition of drug metabolism, enzymes induction, drug assay, half life and its significance.

**UNIT-V**

Drug toxicity in relation to pharmacokinetics therapeutic index, types of toxicity, role of biotechnology in channelizing pharmacokinetics: patenting of biopharmaceutical products.

**BOOKS RECOMMENDED**

1. Rang H. Pharmacology, Fifth Edition, Churchill-Livingstone, 2003.
2. Ho et al., Biotechnology and Biopharmaceuticals Transferring Proteins and Genes. 2003
3. Leach et al., Molecular Modelling. 2nd Ed, Printieall Publication, 2001.
4. Grandi et al., Genomics, Proteomics and Vaccines. Wiley publication, 2003
5. Baxevanis and Quellette. Bioinformatics: A practical guide to the analysis of genes and Proteins. Wiley publication, 2002

**IBT-904: MARINE BIOTECHNOLOGY****UNIT-I**

Marine Biodiversity: commercially important marine micro organisms, invertebrates and vertebrates. Marine food production and dynamics. Marine environment as source of food, enzymes and bioactive compounds.

**UNIT-II**

Aquaculture biotechnology- Aquaculture: culture of shrimp, crab, edible mollusc, oysters and pearl oysters, Culture of milkfish, mullets and eel. Culture of live feed organisms- brine shrimp, rotifers, marine algae. Hormonal manipulation of sex. Chromosomal manipulation of sex in fish. Cryopreservation of fish gametes and embryo. Hormonal manipulation of induced breeding. Diseases of cultured shrimp, fish . Diagnostics, ELISA, FISH and PCR.

**UNIT-III**

Marine hydrocolloids-agar, agarose, carageenan, alginates, chitosans and chitin. Marine enzymes - Applications of enzyme for fish processing. Marine Lipids application of lipases for modification of fats and oils. Marine flavourants. Bioconversion of organic materials and fish ensilage,

**UNIT-IV**

Bioactive marine natural products- membrane receptors, anti tumor compounds, anti inflammatory / analgesic compounds, anti viral agents, isolation and identification of marine bioactive compounds such as labile proteins, toxins and carotenoids Commercial importance of marine natural products- chitosan, chitin.

**UNIT-V**

Algal biotechnology single cell protein, hydrocolloids, agarose, carrageen alginates and other by products. Marine Enzyme sources and their applications Marine Lipids sources and their applications. Bioremediation. Application of halophile.

**PRACTICALS**

1. Estimation of water quality parameters : dissolved oxygen, salinity, ammonia in sea water.
2. Antagonistic test with probiotics and fish pathogens
3. Identification and partial characterization of fish and shrimp pathogens .
4. Ploidy detection using karyotyping
5. PCR diagnosis of white spot syndrome virus, monodon baculovirus, hamotopoetic necrosis virus
6. Immunodiagnosis of fish pathogen (Western blot)
7. Enrichment of live feed organisms Artemia, Rotifers
8. Induction of breeding in fish using ovaprim-in vitro fertilization and rearing of Fry.
9. Extraction of hydrocolloids from sea weeds
10. Field visit to shrimp hatchery, farms and salt pans.

**BOOKS RECOMMENDED**

1. Aquaculture: Principles and Practices - T.V.R. Pillay -1990
2. Marine Microbiology - Austin. Cambridge press.1992
3. Aquaculture: The farming and husbandry of Freshwater & Marine organisms by J.Bardach, Ryther J. Mclarhey.W. 1972.
4. Advances in Fisheries Technology and biotechnology for increased profitability - Ed. Michael N. Voigt, J. Richard Botta. Technomic Publishing Co. Inc.(1990)
5. Biotechnology in the Marine Science- Proceedings of the first Annual MIT Sea Grant Lecture and Seminar - Colwell R.R. 1982.
6. New Developments in Marine BiotechnologyEd. LeGal and H.O.Halvorson

Plenum press 1998.

7. Italy, E (Eds). 1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.

8. Milton Fingerman and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.

9. Y. Le Gal and H.O.Halvorson 1998, New Developments in Marine Biotechnology. Springer.

10. David H. Attaway, 2001. Marine Biotechnology, Volume 1, Pharmaceutical and Bioactive Natural Products.

11. Rita R. Colwell 1984. Biotechnology in the Marine Sciences (Advances in Marine Science & Biotechnology) Wiley Interscience.

12. Scheupr, P.J. (Ed.), 1984. Chemistry of Marine Natural Products, ,Chemical and Biological Perspectives. Vol. I III, Academic Press, New York.

**IBT-905: AGRICULTURE BIOTECHNOLOGY****UNIT-I**

Clonal Propagation of Plants-Introduction to totipotency of Plant cells; Initiation of Callus and suspension cultures; Micropropagation of ornamental and horticultural plants and forest trees via organogenesis and embryogenesis; Encapsulation and production of synthetic seeds; Embryo culture and embryo rescue

**UNIT-II**

Protoplast culture and fusion. Development of somatic hybrids to overcome the incompatibility barriers; Somaclonal variations and crop improvement; Anther and pollen culture and production of haploids; Technology of freeze preservations and crop improvement

**UNIT-III**

Production of commercially useful compounds by cell cultures; Advantages of cultured plant cells and tissues as a source of secondary plant products; Cell line selection and commercial production of pharmaceutically important compounds using cell culture techniques; Physical and chemical factors that influence the production of secondary metabolites in vitro permeabilisation, elicitation and immobilization of cells for enhanced production of secondary products; Induction of hairy root cultures and their uses; Biotransformations using cell culture methods

**UNIT-IV**

Molecular mechanisms of Abiotic stress tolerance in crop plants; Drought stress tolerance; Flooding stress tolerance or submergence tolerance; Salt stress tolerance; High and low (cold) temperature stress tolerance; Photooxidative (light) stress tolerance; Metal stress tolerance

**UNIT-V**

Molecular mechanisms of Biotic stress tolerance in crop plants; Insect resistance; Bacterial resistance; Fungal resistance; Viral resistance; Molecular markers and crop improvement

**PRACTICALS**

1. Isolation of genomic DNA from dicot and monocot plants
2. Qualitative and quantitative analysis of plant genomic DNA
3. Amplification and cloning of a plant gene
4. Mapping of a plant gene. Analysis of a plant gene sequence using Clone Map Software
5. Overexpression of plant protein in *Escherichia coli*
6. Western analyses of expressed plant protein.
7. Cloning of pathogenesis related proteins in *Agrobacterium*
8. *Agrobacterium*-mediated plant transformation.
9. Analysis of transgene integration and expression in plants.

**BOOKS RECOMMENDED**

1. Roberta Smith, Plant Tissue Culture: Techniques and Experiments. 2nd ed., Academic Press, 2000.
2. Bhojwani, S.S. and Rajdan, Plant Tissue Culture: Theory and Practice. 2004

3. Roberta Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press; 2nd ed, 2000.
4. Crispeels, M.J. and Sadava, D.E., Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers (2nd Edition), 2003.
5. Bhowjwani, S.S., Plant Tissue Culture: Application and Limitations. Amsterdam, Elsevier, 1990.
6. Charles Cunningham and Andrew J.R. Porter, Recombinant Proteins from Plants: Production and Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press, 1997.
7. Bernard R. Glick and John E. Thompson, Methods in Plant Molecular Biology and Biotechnology, CRC Press, 1993.
8. I. Potrykus and G. Spangenberg, , Gene Transfer to Plants (Springer Lab Manual), Springer Verlag, 1997.
9. Peter M. Gresshoff, Plant Genome Analysis: Current Topics in Plant Molecular Biology. CRC Press, 1994.
10. John Hammond, Peter McGarvey, Vidadi Yusibov, Plant Biotechnology: New Products and Applications, Springer Verlag, 1999.