APPENDIX – 32 (R&S)
UNIVERSITY OF MADRAS

SRI SANKARA ARTS AND SCIENCE COLLEGE (AUTONOMOUS)

B.Sc., BIOTECHNOLOGY

(effective from the academic year 2018 – 2019)

REGULATIONS

Choice based credit system.

1. ELIGIBILITY FOR ADMISSION:

Candidates for admission to the first year of the Degree of Bachelor of Science courses shall be required to have passed the Higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an Examination accepted as equivalent thereof by the Syndicate of the University of Madras. Provided that candidates for admission into the specific main subject of study shall possess such other qualifying conditions as may be prescribed by the University.

2. ELIGIBILITY FOR THE AWARD OF DEGREE:

A candidate shall be eligible for the award of the Degree only if he /she has undergone the prescribed course of study in a College affiliated to the University for a period of not less than three academic years, passed the examinations all the Six-Semesters prescribed earning 140 Credits (in Parts-I, II, III, IV & V).

3. DURATION:

a) Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year the third and fourth semesters and the third academic year the fifth and sixth semester respectively.

b) The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester.

4. COURSE OF STUDY:

The main Subject of Study for Bachelor Degree Courses shall consist of the following

PART – I TAMIL / OTHER LANGUAGES

PART – II ENGLISH

PART – III CORE SUBJECTS
ALLIED SUBJECTS
PROJECT/ELECTIVES WITH THREE COURSES

PART – IV

1. (a) Those who have not studied Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Tamil comprising of two course (level will be at 6^{th} Standard).

(b) Those who have studies Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Advanced Tamil comprising of two courses.

(c) Others who do not come under a + b can choose non-major elective comprising of two courses.

2. SKILL BASED SUBJECTS (ELECTIVE) - (SOFT SKILLS)

3. ENVIRONMENTAL STUDIES

4 VALUE EDUCATION

PART – V EXTENSION ACTIVITIES

5. EXTENSION ACTIVITIES:

A candidate shall be awarded a maximum of 1 Credits for Compulsory Extension Service.

All the Students shall have to enroll for NSS /NCC/ NSO (Sports & Games) Rotract/ Youth Red cross or any other service organizations in the college and shall have to put in Compulsory minimum attendance of 40 hours which shall be duly certified by the Principal of the college before 31st March in a year. If a student

LACKS 40 HOURS ATTENDANCE in the First year, he/she shall have to compensate the same during the subsequent years.

Students those who complete minimum attendance of 40 hours in One year will get HALF A CREDIT and those who complete the attendance of 80 or more hours in Two Years will ONE CREDIT.

Literacy and population Education Field Work shall be compulsory components in the above extension service activities.

6. SCHEME OF EXAMINATION:

Scheme of Examination shall be given in

Model Scheme

Course Component Name of the course	Inst. Hour	Credits	Exam Hours	Max. Marks		
				Ext. mark	Int. mark	Total
PART-I Language				**75**	**25**	**100**
PART-II English				**75**	**25**	**100**
PART-III Core subject :				**75**	**25**	**100**
Core Subject				**75**	**25**	**100**
Allied Subject				**75**	**25**	**100**

PART – IV 1.(a) Those who have not studied Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Tamil comprising of two course (level will be at 6th Standard). (b) Those who have studies Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Advanced Tamil comprising of two courses. (c) Others who do not come under a + b can choose non-major elective comprising of two courses.						

2*Skill based subjects(Elective) – (Soft Skill)						

The following procedure is followed for Internal Marks:

Theory Papers: Internal Marks 25

INTERNAL MARKS

Tests	(2 out of 3)	= 10
Attendance		= 5
Seminars		= 5
Assignments		= 5
		---
		25 marks

Break-up Details for Attendance

Below 60%	- No marks
60% to 75%	- 3 marks
76% to 90 %	- 4 marks
91% to 100%	- 5 marks

Practical: Internal Marks 40

Attendance	5 marks
Practical Test best 2 out of 3	30 marks
Record	5 marks

Project:

Internal Marks	best 2 out of 3 presentations	20 marks
Viva		20 marks
Project Report		60 marks

7. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTER:

i. Candidates shall register their names for the First Semester Examination after the admission in UG Courses.

ii. Candidates shall be permitted to proceed from the First Semester up to Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subject of earlier semesters along the current (subsequent) Semester Subjects.

iii. Candidates shall be eligible to go to subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time.

Provided in case of a candidate earning less than 50% of attendance in any one of the Semesters due

to any extraordinary circumstances such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorised Medical Attendant (AMA), duly certified by the Principal of the college, shall be permitted to proceed to the next semester and to complete the Course of study. Such Candidates shall have to repeat the missed Semester by rejoining after completion of Final Semester of the course, after paying the fee for the break of study as prescribed by the University from time to time.

8. PASSING MINIMUM:

A candidate shall be declared to have passed:

a) There shall be no Passing Minimum for Internal.

b) For External Examination, Passing Minimum shall be of 40% (Forty Percentage) of the maximum marks prescribed for the paper for each Paper/Practical/Project and Viva-voce.

c) In the aggregate (External + Internal) the passing minimum shall be of 40%.

d) He/She shall be declared to have passed the whole examination, if he/she passes in all the papers and practicals wherever prescribed / as

per the scheme of examinations by earning 140 CREDITS in Parts-I, II, III, IV & V. He/she shall also fulfill the extension activities prescribed earning a minimum of 1 Credit to qualify for the Degree.

9. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

PART- I TAMIL / OTHER LANGUAGES

TAMIL/OTHER LANGUAGES: Successful candidates passing the Examinations for the Language and securing the marks (1) 60 percent and above and (ii) 50 percent and above but below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND class, respectively. All other successful candidates shall be declared to have passed the examination in the THIRD Class.

PART – II ENGLISH

ENGLISH: Successful candidates passing the examinations for English and securing the marks (I) 60 percent and above and (ii) 50 percent and above but

below 60 percent in the aggregate shall be declared to have passed the examination in the FIRST and SECOND Class, respectively. All other successful candidates shall be declared to have passed the examination in the THIRD class.

PART – III consisting of CORE SUBJECTS, ALLIED SUBJECTS, PROJECT / ELECTIVE with three courses:

Successful candidates passing the examinations for Core Courses together and securing the marks (I) 60 percent and above (ii) 50 percent and above but below 60 percent in the aggregate of the marks prescribed for the Core courses together shall be declared to have passed the examination in the FIRST and SECOND Class respectively. All other successful candidates shall be declared to have passed the examinations in the Third Class.

PART – IV (consisting of sub items 1 (a), (b) & (c), 2, 3 and 4) as furnished in the Regulations 4 Part-IV supra.

PART – V EXTENSION ACTIVITIES:

Successful Candidate earning of 1 credit SHALL NOT BE taken into consideration for Classification/Ranking/ Distinction.

10. RANKING:

Candidates who pass all the examinations prescribed for the course in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking/ Distinction.

Provided in the case of Candidates who pass all the examinations prescribed for the Course with a break in the First Appearance due to the reasons as furnished in the Regulations. 7 (iii) supra are only eligible for classification.

11. TRANSITORY PROVISION:

Candidates who have undergone the course of study prior to the academic year 2018 – 2019 will be permitted to appear for the examinations under those Regulations for a period of TWO years i.e. up to and inclusive of April/May 2021 Examinations. Thereafter, they will permit to appear for the examination only under the Regulations then in force.

Question Paper Pattern

SECTION – A (30 words)

10 OUT OF 12 - 10 X 2 marks = 20 marks

SECTION – B (200 words)

5 out of 7 - 5 x 5 marks = 25 marks

SECTION – C (500 words)

3 out of 5 - 3x 10 marks = 30 marks

TOTAL = 75 marks

QUESTION PAPER FOR PRACTICALS

The external examiner will prepare a question paper on the spot with the help of the Question Bank supplied by the Controller's office.

APPENDIX – 32 (S)
UNIVERSITY OF MADRAS

SRI SANKARA ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

B.Sc., BIOTECHNOLOGY

(effective from the academic year 2018 – 2019)

SYLLABUS

FIRST SEMESTER

S. No	Course component	Name of course	Inst. hours	Credits	Theory/ Practical (External : Internal)	Max. marks
1	Part I	Language/ Tamil Paper 1	4	3	75 : 25	100
2	Part II	English Paper 1	4	3	75 : 25	100
3	Part III	**Core**: Paper1: Cell biology	6	4	75 : 25	100
4	Part III	**Core**: Paper 2: Practical 1*	6	4	60 : 40	100
5	Part III	**Allied**	6	5	75 : 25	100

		:Paper1: Microbiology				
6	Part IV	**1.a.** Those who have not studied Tamil up to XII std and taken a non-Tamil language under Part – I shall take Tamil comprising of two courses (level will be at 6^{th} std). **b.** Those that have studied Tamil up to XII std and taken a non-Tamil language under Part- I shall take Advanced Tamil comprising of two	2	2	75 : 25	100

		courses. **c.** Others that do not come under a+b can choose non- major elective comprising of two courses.				
7		**2.Skill based subject (Elective):** Soft skill -1	2	3	50 : 50	100
Total Credits						**24**

* Practical examination will be conducted at the end of second semester.

SECOND SEMESTER

S. No	Course component	Name of course	Inst. hours	Credits	Theory/ Practical External : Internal	Max. marks
1	Part I	Language/ Tamil Paper 2	4	3	75 : 25	100
2	Part II	English Paper 2	4	3	75 : 25	100
3	Part III	**Core**: Paper3: Developmental Biology and Genetics	6	4	75 : 25	100
4	Part III	**Core**: Paper 4: Practical 2*	6	4	60 : 40	100
5	Part III	**Allied** :Paper2: Chemistry	6	5	75 : 25	100
6	Part IV	**1. A.** Those who have not studied Tamil				

		up to XII std and taken a non- Tamil language under Part – I shall take Tamil comprising of two courses (level will be at 6th std). **b.** Those that have studied Tamil up to XII std and taken a non-Tamil language under Part- I shall take Advanced Tamil comprising of two courses.	2	2	75 : 25	100

		c. Others that do not come under a+b can choose non-major elective comprising of two courses.				
7		**2. Skill based subject (Elective) :** Soft skill-II	2	3	50 : 50	100
Total Credits						**24**

* Practical examination will be conducted at the end of second semester.

THIRD SEMESTER

Course components	Subject	Inst Hrs.	Credits	Exam Hrs.	Max. Marks		
					Ext. Marks	Int. Marks	Total
Part-I	Language Paper-III	5	3	3	75	25	100
Part-II	English Paper- III	5	3	3	75	25	100
Part III - Core Courses	Paper-V – Immunology	6	4	3	75	25	100
Practical*	Paper- VI Immunology and Biochemistry (Practical)	6	4	3	60	40	100
Allied Subject-II	Paper – I Biochemistry	6	5	3	75	25	100
Part-IV	2. Soft Skill-III	2	3	3	50	50	100
Total Credits							**22**

* Practical examination will be conducted at the end of fourth semester.

FOURTH SEMESTER

Course	Subject	Hrs.	Credits	Exam	Max. Marks

Components					**Ext. Marks**	**Int. Marks**	**Total**
Part-I	Language Paper-IV	6	3	3	75	25	100
Part-II	English Paper-IV	6	3	3	75	25	100
Part III Core Courses	Paper-VII - Animal and Medical Biotechnology	6	4	3	75	25	100
	Paper-VIII – Animal and Medical Biotechnology (Practical)	3	4	3	60	40	100
Allied Subject-II	Paper-II - Biophysics and Biostatistics	5	5	3	75	25	100
Part-IV	2. Soft Skill-IV	2	3	3	50	50	100

3. Environmental Studies		2	2	3	75	25	100
Total Credits							**24**

FIFTH SEMESTER

Course components	**Subject**	**Inst Hrs**	**Credits**	**Exam Hrs.**	**Max. Marks**		
					Ext. Marks	**Int. Marks**	**Total**
Part-III Core Courses	Paper- IX – Plant Biotechnology	6	4	3	75	25	100
	Paper- X - Environmental Biotechnology	6	4	3	75	25	100
	Paper-XI - Bioinformatics	5	4	3	75	25	100

Practical*	Paper- XII - Plant Biotechnology and Environmental Biotechnology	6	4	3	60	40	100
Project (at VI Semester) or Three Electives	Project/Elective –I Methods in Biology	5	5	3	75	25	100
Part-IV 4. Value Education		2	2				
Total Credits						**18/23**	

* Practical examination will be conducted at the end of sixth semester.

SIXTH SEMESTER

Course components	*Subject*	Inst Hrs.	Credits	Exam Hrs.	Max. Marks		
					Ext. Marks	Int. Marks	Total
Part-III Core Courses	Paper- XIII - Genetic Engineering.	5	4	3	75	25	100
	Paper- XIV – Industrial Biotechnology	5	4	3	75	25	100
Practical	Paper-XV - Genetic Engineering and Industrial Biotechnology (Practical).	6	4	3	60	40	100
Project or Three Electives	Project/Elective –II Microbial Biotechnology	6	5	3	75	25	100

	Project/Elective –III Environmental Biotechnology	6	5	3	75	25	100
	Student project	12	15		240 (40-work book, 150-Dissertation + 50-Viva)	60	300
Part-V - Extension Activities		2	1				
Total Credits						**13/23**	

SEMESTER – I

Title of the paper	**Paper 1 - Cell Biology**		
Category : **Part III Core**	Year & Semester First year, Sem 1	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to various biological activities occurring at cellular level		

Unit- I

Introduction to the cell: Cell theory, Prokaryotic and Eukaryotic cell, Differences between animal cell and plant cell. Structure and Functions of Cell wall, Plasma membrane (fluid mosaic model) Cell division: mitosis and meiosis cell cycle. Programmed cell death.

Unit- II

Endoplasmic Reticulum Rough and Smooth- ultra structure. Structure and Functions of Ribosome, Mitochondria, Chloroplast, Nucleus, Chromosomes, Golgi apparatus, Lysosomes and peroxisomes.

Unit- III

Introduction to molecular biology: Central dogma, Nucleic acids, DNA Structure (Watson and Crick model). DNA replication, methods of DNA replication, Enzymes and accessory proteins involved in DNA replication, DNA repair mechanism.

Unit- IV

Prokaryotic transcription-Eukaryotic transcription-RNA polymerase-General and specific transcription factors, post transcriptional modifications, Gene expression (Lac operon concept).

Unit- V

Genetic code; characteristics of genetic code, Translation: Prokaryotic translation-Eukaryotic translation-Mechanism of initiation-elongation and termination, Post translational modifications of proteins.

Text Books:

1. Gupta, P. K. 2015 .Cell and Molecular Biology, 4th edition, Rastogi Publications.
2. Cooper, G.M. 2000. The Cell- A molecular approach, 2nd edition. A.S.M. Press, Washington DC.

Reference Books:

1. David Baltimore.2002.Molecular cell biology4 th edition. W H Freeman & Co publisher

2. Brown, T.A. 2001. Gene Cloning & DNA analysis. Blackwell Science, London.

3. Lodish, H., Berk, A., Zipursky, S.L., Matusudaria, P., Baltimore, D. and Darnell, J., 2000. Molecular Cell Biology, Media Connected, W.H. Freeman and Company, New York.

4. Benjamin Lewis, 2001. Genes VII. Oxford University Press, London.

Title of the paper	**Paper 2 - Practical – 1 Cell Biology and Microbiology**		
Category : **Part III Core**	Year & Semester First year, Sem 1	Credits 4	
Pre- requisites	Knowledge of biology at Higher secondary level		
Objectives of the course	To introduce the student to various laboratory exercises pertaining to cell biology and microbiology.		

(A) Cell Biology: Microscopy- RBC and WBC counting- Enumeration of WBC- Differential leukocyte Count- Salivary gland preparation from Chironomous larva- Mitosis preparation from onion root tip and meiosis

preparation from grasshopper testis- Enumeration of prokaryotic cell- Buccal smear preparation- Cell fractionation (nucleus, mitochondria- Demonstration).

(B) Microbiology: Sterilization techniques: Preparation of media, inoculation techniques – Pour plate, spread plate and dilution techniques. Demonstration of microbial contamination on culture plates. Micrometry- Wet preparation: Hay infusion broth, Hanging drop- Simple staining, Differential staining- Capsule staining- Spore staining- Inoculation techniques: Pour plate- spread plate- Dilution techniques. Biochemical tests for identification of bacteria: - Catalase test- Oxidase test- Urease test- IMVIC test- LAO test- Gelatin liquefaction- Starch Degradation- Carbohydrate fermentation- Viable Bacteria; - morphological identification of Fungi.

Title of the paper	**Allied 1 - Paper 1- Microbiology**		
Category : **Part III Allied**	Year & Semester First year,	Credits 5	

	Sem 1		
Pre- requisites	Knowledge of biology at Higher secondary level		
Objectives of the course	To introduce the student to various aspects of basic microbiology.		

UNIT- I

History and Scope of Microbiology- Anatomy of Prokaryotes and Eukaryotes- Bacteria, Fungi, Algae, Protozoa and Viruses- structure and functions of the cellular components- Growth and nutrition- media and culture.

UNIT- II

Classification of microbes- DNA analysis, Ribosomal RNA analysis- Numerical taxonomy- Molecular taxonomy- methods of microbial identification.

UNIT- III

Environmental Microbiology- role of microorganisms in the productivity of ecosystems- Role of microorganisms in food production; dairy and non-dairy products- fermented foods and alcoholic beverages- production of food (single cell protein), Fuel (ethanol).

UNIT- IV

Medical Microbiology- Pathogenic microbes- Bacterial, Viral, Fungal and Protozoan diseases. Cure, control and prevention- Pharmaceuticals (antibiotics, vaccines etc.),

production of vitamins, organic acids Biofertilizers (BGA), Biopesticides, biopolymers, biosurfactants.

UNIT- V

Industrial use of microbes- fermentation products- bioconversions- products of industrial microbiology- Streptomyces, yeasts (Saccharomyces, Hansenula), Spirulina and Penicillium.

Text Books:

1. Lucy Phillip, 2016. Microbiology: Concepts and Applications. Syrawood Publishing House, USA.
2. Ananthanarayan, R. and Paniker, C.K.J. 2016 A text book of Microbiology. 8th edition. Orient Longman Ltd., Hyderabad.
3. Pelzar, 2000. Microbiology. 5th edition. Tata McGraw Hill., New Delhi.

Reference books:

1. Puvanakrishnan, R, Sivasubramanian, S and Hemalatha, T. 2015. Microbes and enzymes basics and applied, 1st edition MJP Publishers, India
2. Kathleen Park Talaro and Talaro, A. 2012. Foundation in Microbiology, 3rd edition, McGraw-Hill, New York.
3. Daniel Lim, 2002. Microbiology, 2nd edition. McGraw-Hill, New York.

Non-major elective: Plant Physiology

Unit I

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photo protective mechanisms; CO2 fixation-C3, C4 and CAM pathways.

Unit II

Respiration and photorespiration: Glycolysis**,** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway.

Unit III

Nitrogen metabolism: Nitrate and ammonium assimilation; nif genes, amino acid biosynthesis.

Unit IV

Plant hormones: Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

Unit V

Stress physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress.

Text Books:

1. V.K.Jain. 2015.Fundamentals of Plant physiology 8 th edition, S Chand Publisher.

2. S. N. Pandey, B. K. Sinha, 2009.Plant Physiology, 4th Edition, Vikas publishing company, Noida.

3. N.K. Gupta, S. Gupta, 2005. Plant Physiology Oxford & IBH Publishing Company Pvt Ltd, New Delhi.

4. Rajiv Kumar Sinha, 2004. Modern Plant Physiology, Alpha Science International Ltd, England.

5. Janat Shah, 2003.Plant Physiology., New Age International Pvt Ltd, New Delhi.

Reference books:

1. Lincoln Taiz, Eduardo Zeiger. 2014. Plant Physiology and Development.6th edition.

   Sinauer Associates.

2. William G. Hopkins, Norman P. A. Huner .2008. Introduction to plant physiology, 5th Edition. Wiley publishers

Non-major elective: Animal Physiology

Unit I

Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, hemoglobin, immunity, haemostasis.

Unit II

Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

Unit III

Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Unit IV

Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

Unit V

Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Text Books:

1. Surendra Nath Paipuru, 2013. Essentials of Animal Physiology. Lap Lambert Academic Publishing GmbH KG.

2. S. C. Rastogi, 2005. Essentials of Animal Physiology, 3rd Edition, New Age International Pvt Ltd, New Delhi.

Reference books:

1. Richard W. Hill, Gordon A. Wyse, Margaret Anderson, 2012. Animal Physiology. Sinauer Associates Publishers.U.K.
2. Lauralee Sherwood, 2008. Human Physiology from Cells to Systems Cengage, Learning Publishing Company.

SEMESTER – II

Title of the paper	**Core Theory 2- Developmental Biology and Genetics**		
Category : Part III Core Theory	Year & Semester First year, Sem 2	Credits 4	
Pre- requisites	Knowledge of biology at Higher secondary level and cell biology at		

	Bachelors level.
Objectives of the course	To introduce the student to various molecular aspects of developmental biology and genetics

UNIT- I

Gamete cells: Spermatogenesis, Oogenesis, Sperm and oocyte maturation, Cellular regulation – cell cycle control, important signalling pathways in vertebrate development.

UNIT- II

Fertilization: Types of fertilization, Molecular recognition of egg and sperm, fusion and prevention of Polyspermy, rearrangement of egg cytoplasm and activation of egg. Blastulation, Gastrulation, Types of cleavage, Fate Maps, Nieuwkoop center, molecular role of organizer,

UNIT- III

Myogenesis in mammals- growth factors: Mitogens and Oncogenes. Neurogenesis in Drosophila and chick - Regional specification in Drosophila. Embryogenesis- Mammalian homologs in Drosophila ANT-C and BC-X.

UNIT- IV

Mendelian laws of Inheritance - Dominance, segregation, independent assortment, deviation from Mendelian inheritance. Allele, multiple alleles, pseudo allele,

complementation tests. Pedigree analysis, karyotypes, genetic disorders.

UNIT- V

Identification of the DNA as the genetic material. Genetic recombination in bacteria: Conjugation, transduction, and transformation. Transcription, expression and regulation.

Text Books:

1. Monroe Strickberger, W. 2015.Genetics,3rd edition Pearson education ,India
2. Verma, P.S. and Agarwal, V.K. 2010. Genetics, 9th edition, S. Chand Publishers
3. Karvita, B. Ahluwalia, 2010. Genetics. 2nd edition. New Age International Pvt Ltd, New Delhi.
4. Gardener, E.J, Simmons, M.J and Peter Snustad, D.2006.Principles of Genetics, 8th edition. Wiley Publishers.
5. Gilbert, S. 2000. Developmental Biology, 7th edition. Sinaver Associates Inc. Publishers, USA.

Reference Books:

1. Peter Snustand,D and Simmons,M.J. 2011.Genetics, 6th edition John Wiley and sons publication
2. Lewis, R.2001. Human genetics- concepts and application, 4th edition. McGraw Hill.

3. Lodish, H., Berk, A., Zipursky, S.L., Matsudaria, P., Baltimore, D and Darnell, J. 2000. Molecular Cell Biology. Media Connected. W.H. Freeman and Company, New York.

4. Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000. Instant notes in Genetics. Viva books, Ltd.

Title of the paper	**Core Paper 4 - Practical 2 - Developmental Biology and Genetics & Chemistry**		
Category : Part III Core Practical	Year & Semester First year, Semester 2	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to various laboratory exercises in molecular developmental biology and genetics		

Molecular developmental biology and Genetics

1. Observation of sperm from Frog
2. Observation of egg from Frog
3. Observation of living gametes from Grasshopper
4. Observation of living chick embryos 12 hrs development
5. Observation of living chick embryos 24 hrs development
6. Observation of living chick embryos 48 hrs development
7. Observation of living chick embryos 72 hrs development
8. Preparations of culture medium for drosophila.
9. Identification of mutants in Drosophila population
10. Blood grouping
11. Meiosis from grass hopper testis
12. Giant chromosomes from Chironomous larvae

Chemistry Practical

VOLUMETRIC ANALYSIS

· Estimation of Sodium hydroxide using standard Sodium carbonate.

· Estimation of Hydrochloric acid using standard Oxalic acid.

· Estimation of Ferrous sulphate using standard Mohr's salt

· Estimation oxalic acid using standard Ferrous Sulphate.

· Estimation of Potassium permanganate using standard Sodium hydroxide.

· Estimation of Magnesium using EDTA.

· Estimation of Ferrous iron using diphenylamine as internal indicator.

ORGANIC ANALYSIS

Detection of Elements (N, S, Halogens)

To distinguish between aliphatic and aromatic Saturated and unsaturated compounds. Functional group tests for phenol, acids (mono, di) aromatic primary amine, amide, aldehyde & Carbohydrate Glucose. Systematic analysis of organic compounds containing one functional group and characterization by confirmatory test. (Phenol/cresol, cinnamic acid, benzoic acid, phthalic acid, Succinic acid, benzamide, urea, glucose, benzaldehyde & aniline).

REFERENCE

Basic Principles of practical Chemistry: Venkateswaran, Veerasamy & Kulandaivel, S.Chand &Co.

Title of the paper	Allied Theory 2- Chemistry		
Category : Part III Allied Theory	Year & Semester First year, Semester 2	Credits 5	
Pre- requisites	Knowledge of Chemistry at Higher secondary level		
Objectives of the course	To introduce the student to advanced level of Chemistry.		

UNIT- I

Structure of atoms and chemical bonding:

Dalton's Atomic theory- Subatomic particles- concepts of atoms and molecules- General electronic configuration of s,p and d block elements – isotopes, isobars and isotones- shapes of atomic orbitals - periodic table- periodic classification- periodicity, valency. Types of bond - ionic, covalent, coordinate and hydrogen bonding.

UNIT-II

Acids-Bases and Solutions:

Arrhenius concept of acid and bases, proton transfer theory of acid and bases, Lewis concept of acids and bases, concentration of solution, ways of expressing concentrations of solutions – per cent by weight, normality, molarity, molality, mole fraction, pH of solution, pH scale, measurement of pH, buffer solutions, mechanism of buffer action of acid buffer and basic buffer.

UNIT – III

Chemical kinetics and thermodynamics:

Rate – factors influencing rate of reactions - order and molecularity – integrated rate expression for first and zero order reactions – Half life period - Techniques used to study kinetics of reaction – volumetry, polarimetry and manometry. Pseudo first order reaction, methods to determine order of the reaction- Effect of temperature on rate – concept of activation energy – Arrhenius equation. Catalysis – Enzyme catalysis (derivation of Michaelis Menten equation). Terminology of thermodynamics - Types of systems, Reversible, irreversible, isothermal, adiabatic processes, exothermic and endothermic reactions - Spontaneous processes –First law of thermodynamics –Need for the second law - different statements of second law – concepts of Entropy and its significance.

UNIT- IV

F**undamentals of organic chemistry**

Classification of organic compounds -.Hybridization in methane, ethane, acetylene, and benzene .Definition with examples- electrophiles, nucleophiles and free radicals.

Types of reactions: addition, substitution, elimination, condensation and polymerisation. (One example each) Electrophilic substitution reaction in benzene (nitration and sulphonation)

Optical isomerism - symmetry, elements of symmetry - Cause of optical activity, Optical isomers of tartaric acid, Racemisation, Resolution by salt formation method - Geometric isomerism of maleic and fumaric acids. - Keto-enol tautomerism in acetoacetic ester.

UNIT- V

Industrial chemistry:

Hardness of water: temporary and permanent hardness, disadvantages of hard water - Softening of hard water - demineralization process - Zeolite process, and reverse osmosis - Purification of water - for domestic use - use of chlorine, Ozone and UV light. Definitions of pH, TDS, TSS, BOD and COD - determination of BOD and COD. Fuels - Characteristics and Calorific value, Classification, gaseous fuels like water gas, producer gas, and liquefied petroleum gas, gobar gas, compressed natural gas. Fertilizers- Role of NPK fertilizers -urea, Ammonium sulphate, superphosphate, Triple super phosphate, potassium nitrate- manufacture.

Text Books:

1. P.C.Jain and others, 2009. Engineering Chemistry, Dhanpat Rai publishing company, New Delhi.

2. V. Veeraiyan, 2006. Text book of Ancillary

Chemistry, Highmount Publishing house, Chennai.

3. S.Vaithyanathan and Others. 2006. Textbook of Ancillary Chemistry, Priya Publications, Karur.

Reference books:

1. Leroy G. Wade, 2016. Organic Chemistry. Pearson, New Delhi.

2. Gary Wulfsberg, 2016. Inorganic Chemistry, Viva Student Edition, New Delhi.

3. Soni P.L. and Mohan Katyal. 2013. Textbook of Organic Chemistry, Sultan Chand and Company, New Delhi.

4. Puri B.R, Sharma L.R, Pathania M.S. 2006. Principles of Physical Chemistry, Vishal Publishing Co. New Delhi.

Non-major elective (Semester 2): BASICS OF ECOLOGY

Unit I

The Environment: Physical environment; biotic environment; biotic and abiotic

Interactions. Symbiosis. Concept of habitat and niche.

Unit II

Population ecology: Characteristics of a population; population growth curves;

population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured

populations.

Unit III

Community ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Unit IV

Ecological succession: Types; mechanisms; changes involved in succession;

Concept of climax.

Unit V

Ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

Text Books:

1. S. S. Purohit, Ashok Agrawal, 2011. Ecology and Environmental Biology. Agrotech Publishing House, New Delhi.

2. Dash. 2009, Fundamentals of Ecology 3rd Edition Tata Mac Graw Hill Education Pvt Ltd, New Delhi.

3. P. S. Verma, V. K. Agarwal, 2000. Environmental Biology: Principles of Ecology .S. Chand Limited, New Delhi.

Reference Book:

1. J. L. Chapman, M. J. Reiss, 2009. Ecology Principles and Applications 2nd Edition Cambridge Publishing

2. Eugene Pleasants Odum, 2005 Fundamentals of Ecology. Cengage Publishing Company.

Non-major elective: EVOLUTION

Unit I

Emergence of evolutionary thoughts: Lamarck; Darwin– concepts of variation,

adaptation, fitness and natural selection.

Unit II

Origin of molecules: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers.

Unit III

Origin of cells and unicellular evolution: Evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes.

Unit IV

Evolutionary history: The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale.

Unit V

Human evolution: Stages in primate evolution including human.

Text Books:

1. Veer Bala Rastogi. 2014. Organic Evolution. Meddec, Publishing, New Delhi.
2. R. Rajagopalan, 2009, Environment & Ecology, Oxford University Press-New Delhi.
3. P.S.Verma, 2004, Cell Biology, Genetics, Evolution & Ecology (M.E.), 14th Edition. S.Chand Publishing.

Reference Book:

1. Brian K. Hall, Benedikt Hallgrimsson. 2013. Strickberger Evolution Fifth Edition, Jones and Bartlett publishers. New Delhi.

2. Carl Zimmer. 2011 Evolution: The Triumph of an Idea. Arrow books London.

SEMESTER III

Title of the paper	Core Theory 3- Immunology		
Category : Part III Core Theory	Year & Semester Second year, Semester 3	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basic understandings of our immune system.		

UNIT I

Introduction to the immune system: Innate immune response – protective barriers, inflammation. Adaptive immune response- Soluble components of the immune system, lymphocytes, antigen presenting cells. Major histocompatibility complex, Human leukocyte antigens, HLA typing.

UNIT II

Cells and organs of the immune system: Haematopoiesis, Cells involved in the immune response, lymphocytes, mononuclear phagocytes, granulocytes. Primary lymphoid organs, secondary lymphoid organs and tissues, Serum and lymph, Clonal selection of lymphocytes.

UNIT III

Antigen and antibody: Properties of antigen, Haptens, Adjuvants, epitopes. Antigen-antibody interaction. Structure of immunoglobulin, antibody classes and biological activities. Theories of antibody formation. Production and application of monoclonal antibody.

UNIT IV

Cytokines and complement: Properties and biological functions of cytokines. Cytokine related diseases. Complement components; complement activation-classical, alternative and lectin pathway. Membrane attack complex (MAC).

UNIT V

Hypersensitivity and autoimmunity: Hypersensitivity Type I, Type II, Type III, and Type IV. Vaccines- Types of vaccines, DNA vaccines. Autoimmune diseases-organ specific and systemic. Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, Immunological basis of AIDS and cancer.

Text Books:

1. Sunil Kumar, M, K. Sai, K. C. Nathsarma, 2013. Textbook of Immunology. 2 edition, Jaypee Brothers Medical Publisher, New Delhi.

2. B. Annadurai. 2010. A Textbook of Immunology & Immunotechnology, S. Chand Publisher, New Delhi.

3. Nandini Shetty. 2007. Immunology: Introductory

Textbook. Revised 2nd edition. New Age International publishers, Chennai.

Reference Books:

1. Judith A. Owen, Jenni Punt , Sharon A. Stranford. 2013, Kubey Immunology 7th edition W H Freeman & Co (Sd) Publisher.

2. Abbas AK, Lichtman AH, Pillai S. 2007. Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.

3. Delves P, Martin S, Burton D, and Roitt IM. 2006. Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.

Title of the paper	**Core Practical 3 – Immunology and Biochemistry**		
Category : Part III Core Practical	Year & Semester Second year, Semester 3	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basic techniques related to immunology		

Immunology Practical

1. Identification of human blood groups.
2. To separate serum from the blood sample.
3. To identify various immune cells from peripheral blood smear
4. To perform Total Leukocyte Count of the given blood sample.
5. To perform Differential Leukocyte Count of the given blood sample.
6. WIDAL Test
7. ASO Test
8. Rheumatoid arthritis Test
9. Pregnancy Test (HCG)
10. Handling and restraining of laboratory animals
11. Antigen preparation
12. Inoculation routes in laboratory animals
13. Bleeding method in laboratory animals
14. To perform radial immunodiffusion by Mancini method.
15. Double Immunodiffusion Test

16. To perform immunoelectrophoresis.

17. To perform counter current electrophoresis

18. To perform ELISA.

Biochemistry Practical

Volumetric analysis

a. Estimation of ascorbic acid using 2,6 – dichlorophenol indophenol as link solution.

b. Estimation of HCl using Na_2CO_3 as link solution.

c. Estimation of Glycine by formal titration.

d. Estimation of Glucose by Benedict's method.

2. **Qualitative analysis**

Qualitative analysis of carbohydrates- glucose, fructose, galactose, lactose, maltose and sucrose.

3. **Qualitative analysis**

Qualitative analysis of amino acids – arginine, cysteine, tryptophan and tyrosine.

Reference Books

1. Laboratory Handbook of Biochemistry, S.Shanmugam and T. Sathish Kumar, 1st Edition, 2010, PHI Learning Pvt Ltd.
2. Laboratory manual in Bio chemistry, J. Jayaraman, 1st Edition, 2000, New Age International Publisher.

Title of the paper	**Allied Theory 3- Biochemistry**		
Category : Part III Allied Theory	Year & Semester Second year, Semester 3	Credits 5	
Pre- requisites	Knowledge of biology and chemistry at Higher Secondary level		
Objectives of the course	To introduce the student to basics of biochemistry		

Unit I

Structure of atoms, molecules and chemical bonds. Van der Waals, hydrogen bonding. pH, buffer. Structure, Chemistry and properties of Carbohydrates, Lipids, Proteins.

Unit II

Classification of prophyrins, their structure and properties. Structure of metalloprophyrins – haeme and chlorophyll. Vitamins and Hormones.

Unit III

Principles of Bioenergetics, Metabolism of Carbohydrates, fat, proteins, purines, pyrimidines – their biosynthesis and degradation, mechanism of oxidative phosphorylation and its inhibitors, photo phosphorylation.

Unit IV

Enzymes – Nomenclature, Classification, Properties of enzymes, Enzyme Kinetics - Effect of substrate concentration, Effect of pH, Effect of temperature. Isoelectric point, Enzyme Regulation - Feedback Regulation, Allosteric enzymes, Isoenzymes.

Unit V

Diabetes mellitus, Atherosclerosis, In bone errors of metabolism - Glycogen storage disease, phenylketonuria, acute intermittent porphyria, Lipoid congenital adrenal hyperplasia, Gaucher's disease, Lesch-Nyhan syndrome. Serum lipids in diseases with special reference to cholesterol, lipidosis, triglyceridemia, hypo and hypercholesterolemia, Fatty Liver.

Text Books:

1. Nagini S. 2015. Textbook of Biochemistry. 2nd Edition. Scitech Publications Pvt Ltd. India.

2. Victor Rodwell, P. Anthony Weil, Kathleen M. Botham – 2015. Illustrated Biochemistry. 30th Edition**.** McGraw-Hill. Europe.

3. Charlotte W. Pratt, Donald Voet, and Judith G. Voet. 2012. Principles of Biochemistry, 4th Edition. Hoboken, N.J. Wiley; Chichester: John Wiley. New York, United States.

4. Sathyanarayana. U. 2007. Biochemistry. Books and allied Pvt. Ltd. India

Reference Books:

1. Lehninger, A.L., Nelson, D.L and Cox, M.M. 2017. Principles of Biochemistry, 7nd edition. WH Freeman Publishers. New York, United States.

2. Charlotte W. Pratt, Donald Voet, and Judith G. Voet. 2012. Principles of Biochemistry, 4th Edition. Hoboken, N.J. Wiley; Chichester: John Wiley. New York, United States.

FOURTH SEMESTER

Title of the paper	**Core Theory 4- Animal and Medical Biotechnology**		
Category : Part III Core Theory	Year & Semester Second year, Semester 4	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basics of animal biotechnology		

UNIT - I

Basic principles - Animal cell, tissues and organs culture, medium composition, primary culture and maintenance, secondary and continuous cell lines and suspension cultures. Applications cell culture technology in production of animal.

UNIT - II

Structure of sperms and ovum, cryopreservation of sperms and ova of livestock, artificial insemination, super ovulation, in vitro fertilization, culture of embryos, cryopreservation of embryos, embryo transfer, embryo-splitting, embryo sexing, transgenic manipulation of animal embryos.

Unit III

Historical aspects – Medical Biotechnology – Pathogenic microbes – Bacterial, Viral, Fungal and Protozoan disease – diagnosis using modern techniques – probes – Cure, control and prevention. Probes -disease diagnosis - existing and emerging in animal-Monoclonal antibody- Development of MAB as therapeutics. Vaccines: Conventional vaccines, Modern vaccine technologies, genetically improved subunit vaccines, DNA vaccines,

Unit IV

Gene transfer methods in Animals – Microinjection, Embryonic Stem cell gene transfer, Retrovirus, Gene transfer & Antibody engineering- Knockout mice- Gene-editing technology-TALEN

Unit V

Tools in medical biotechnology- Methods of nucleic acid analysis- Polymerase chain reaction, DNA finger printing, Southern blot and Western blot analysis, RAPD, AFLP, RFLP. Nanotechnology and Its Applications to Animal Biotechnology- Genetic engineered fish for human consumption. Ethical and social considerations surrounding animal biotechnology.

Text Books:

1. Ashish Verma, Anchal Singh. 2013. Animal Biotechnology, Models in Discovery and Translation, 1st Edition, Elsevier press.
2. Portner R. 2007. Animal Cell Biotechnology. Humana Press.
3. Ralf Portner, 2007. Animal cell biotechnology: Methods and protocols. 2nd edition, Humana Press, New Jersey
4. Gordon I. 2004. Reproductive Technologies in Farm Animals. 1st Edition, CABI press.

Reference Books

1. Ian Freshney, 2010. Culture of animal cells. 6th edition. Wiley-Blackwell publishers.
2. Leda R. Castilho, Angela Maria Moraes, Elisabeth F.P. Augusto and Michael Butler, 2008.Animal Cell Technology: From Biopharmaceuticals to Gene Therapy, Taylor & Francis Group.
3. Twyman RM, 2003. Advanced Molecular Biology. 3rd Edition, Bios Scientific publishers.

Title of the paper	**Core Practical 4 - Animal and Medical Biotechnology**		
Category : Part III Core Practical	Year & Semester Second year, Semester 4	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basic techniques related to animal biotechnology		

1. Preparation of tissue culture medium and membrane filtration
2. Preparation of single cell suspension from spleen and thymus
3. Primary cell culture
4. Introduction to Animal Cell culture: Procedure for handling cells and medium.
5. Cleaning and sterilization of glassware and plastic tissue culture flasks
6. Preparation of sera for animal cell culture
7. Cell counting

8. Acridine orange/Ethidium bromide staining
9. Macrophage monolayer from PEC and measurement of phagocytic activity
10. Cryopreservation and thawing
11. Measurement of doubling time
12. MTT assay for cell viability and growth
13. Cell fractionation (nucleus, mitochondria- Demonstration).
14. Identify any one of the pathogens form the given specimen
15. Preparation of metaphase chromosomes from animal cells
16. Isolation of genomic DNA

Title of the paper	**Allied Theory 3- Biophysics and Biostatistics**		
Category : Part III Allied Theory	Year & Semester Second year, Semester 4	Credits 5	
Pre- requisites	Knowledge of biology and chemistry at Higher Secondary level		
Objectives of the course	To introduce the student to basics of biophysics and biostatistics		

UNIT-I

Scope and methods of biophysics – levels of molecular organization – detailed structure of protein molecules at primary, secondary, tertiary and quaternary levels.

UNIT-II

Biological macromolecules - physical properties of proteins, three dimensional structure and confirmation using physical methods (principles and applications of electrophoresis, chromatography, viscosity, spectrophotometry, ORD, CD, NMR, ESR to study biomolecules). Analysis of protein, protein interaction and protein – nucleic acid interaction. Structure and chemical nature of polysaccharides.

UNIT-III

Definition - scope of biostatistics - Population and Sample collection, classification, and tabulation of data - graphical and diagrammatic representation - scale diagram - histograms - pie diagrams - frequency polygon - frequency curves.

UNIT-IV

Measures of central tendency - arithmetic mean, median, and mode - calculation of mean, median and mode in series of individual observation, discrete series continuous open - end classes. Measure of dispersion - standard deviation and standard curves.

UNIT V

Probability distributions – Binomial and negative binomial, compound and multinomial distributions – Tests of significance – t tests – F tests – Analysis of variance –

Spread sheets – Data entry – Graphics display – word processes.

Text Books:

1. A.K. Sharma. 2005. Text Book of Biostatistics. House. New Delhi
2. Mahajan. 2006. Methods in Biostatistics. 6th edition. Jaypee brother's publishers, New Delhi.
3. Roland Glaser, 2004. Biophysics, cbspd Publisher

Reference Books:

1. J. Richard and Sundar P. S. S. Rao, 2006. Introduction to Biostatistics and Research Methods 4th Revised edition edition Prentice-Hall of India Pvt.Ltd.
2. Protein structure and molecular properties. Creighton, T.E.2002. W.H. Freeman

   and Company.
3. DNA Science. Micklos, D.A. and Freyes, G.A. 2002. Cold Spring harbour

   Laboratory Press.

SEMESTER – V

Title of the paper	**Core Theory 5- Plant Biotechnology**		
Category : Part III Core Theory	Year & Semester Third year, Semester 5	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basics of plant biotechnology		

UNIT - I

Plant genome organization: Nuclear genome-structure of plant genes, chloroplast and its genome, mitochondria and its genome, cytoplasmic male sterility, Transposable elements.

UNIT - II

Plant growth regulators: Growth hormones-Biosynthesis and physiological effects of auxin, gibberellins, cytokinins, abscisic acid and ethylene.

UNIT - III

Plant tissue culture: culture media, Plant growth regulators, preparation and sterilization of explants. Callus and suspension cultures, protoplast isolation, fusion and

regeneration. Micropropagation, transformation-Direct and Agrobacterium mediated transformation.Ti plasmid.

UNIT – IV

Regulation of gene expression: Inducible control of gene expression-class I Promoters, hormone inducible gene expression, Class II promoters. Phytochrome.

UNIT - V

Transgenic plants: Guidelines for introduction of transgenic plants in the field. Herbicide resistance, pest resistance, disease resistance and stress tolerant plants. Molecular pharming.

Text Books:

1. Krishna G.K.A.Elangovan S.Devika. 2016. Plant Biotechnology, New Visal Publications

2. C.B. Nirmala, G. Rajalakshmi and Chandra Karthick, 2009. 1st Edition. MJP Publishers.

3. B.D. Singh, 2007. Plant Biotechnology. 1st Edition. Kalyani Publishers

4. M. Sudhir, 2000. Applied Biotechnology and plant Genetics. 1st Edition. Dominant Publishers and Distributors.

Reference Books:

1. Adrian Slater, 2011. Plant Biotechnology: The Genetic Manipulation of Plants. 2nd Edition. Oxford University Press.
2. Sant Saran Bhojwani and Prem Kumar Dantu 2013 Plant Tissue culture: An Introductory Text, Springer publisher.
3. H.S Chawla, 2010. Introduction to Plant Biotechnology. 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.

Title of the paper	**Core Theory 6- Environmental Biotechnology**		
Category : Part III Core Theory	Year & Semester Third year, Semester 5	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basics of Environmental Biotechnology		

UNIT - I

Basic Concepts: Ecosystem dynamics and management: Stability and complexity of ecosystems; Energy flow, food chain, food web and tropic levels; Ecological pyramids and recycling, biotic community-concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature.

Unit- II

Environmental Pollution: Water Pollution: sources of pollution and pollutants .Industrial effluents, Domestic wastes, Agrochemical. Heavy metals. Effects of Water pollution, prevention and control of water pollution. Water pollution analysis and monitoring. Soil pollution- sources, effects and its control. Air pollution- sources, air pollutants, effects, control measures. Ozone depletion, global warming.

UNIT -III

Bioremediation and Bio-leaching: Environmental impact of pollution and measurement methods, microbial bioremediation of oil spills. Concepts of bioremediation (in-situ and ex-situ), Bioleaching.

UNIT -IV

Biofertilizers and Biopesticides: Biofertilizers and their importance in crop productivity; Algal and fungal (mycorrhizae) biofertilizers Bacterial biofertilizers (rhizobial, free living N2 fixers and phosphate solublizing bacteria), their significance and practice; Biopesticides: Bacterial (BT pesticides), fungal (Trichoderma).

UNIT -V

Genetic Engineering in Environmental Biotechnology: 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.

Text Books:

1. Indu Shekar Thakur ,2013.Environmental Biotechnology Basic concepts and applications.2nd edition I.K.International Publishing House Pvt.Ltd

2. R.C.Dubey.2004. Text Book of Biotechnology. Schand Publishers, New Delhi.

3. Sathyanarayana. U, 2002. Biochemistry. Books and allied Pvt. Ltd.

Reference Books:

1. Bruce E. Rittmann, Perry. L. McCarty. 2012. Environmental biotechnology. Tata Mcgrew Hill Publisher.
2. Technoglous, G., Burton, F.L. and Stensel, H.D. 2004. Wastewater Engineering – Treatment, Disposal and Reuse. Metcalf and Eddy, Inc., Tata Mc Graw Hill, New Delhi.

Title of the paper	**Core Theory 7- Bioinformatics**

Category : Part III Core Theory	Year & Semester Third year, Semester 5	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basics of bioinformatics		

UNIT I

Biological Databases: Sequence databases – Nucleic Acid sequence Databases: Genbank; Protein Sequence Databases: Swiss Prot, gene prediction rules and software – Human Genome Project

UNIT II

Sequence alignment methods: Pair wise alignment Alignment Algorithms: Needleman – Wunsch Global Alignment Algorithm; Smith – Waterman Local Alignment Algorithm. Drug design / discovery synthesis.

UNIT III

Genes: Oncogenes – proto-oncogene's – Classification of Cancer types: DNA microarrays – Structural genomics - Functional Genomics – Proteomics Comparative Genomics - Phylogeny

UNIT IV

Pair wise Sequence Analysis Tools: BLAST– Steps involved in using BLAST – Interpreting BLAST results; FASTA – Alignment Scores -Multiple Alignment — ClustalW – Phylogenetic Tree

UNIT V

Sequence analysis: (Proteins and Nucleic acids) Proteomics: Proteins analysis – structural comparisons – 2D gel, Mass spec. Genome application – Drug design, Management of diverse chemical libraries.

Text books:

1. Dassanayake S.Ranil, Silva Gunawardene, Y.I.N., 2011, Genomic and Proteomic Techniques. 1st edition, Narosa Publishing House Pvt. Ltd., New Delhi.
2. Thiagarajan, B., Rajalakshmi, .P.A., 2009, Computational Biology. 1st edition, MJP Publishers, Chennai.
3. Lohar S. Prakash, 2009, Bioinformatics. 1st edition, MJP Publishers, Chennai.
4. Bosu Orpita, Simminder Kaur Thukral, 2007, Bioinformatics Databases, Tools and Algorithms. 1st edition, Oxford University Press, New Delhi.
5. Rastogi, S.C., Mendiratta, N., Rastogi, P., 2004, Bioinformatics Methods and Protocols. 1st edition, Prentice-Hall of India Pvt. Ltd. New Delhi.

Reference Books:

1. Mairan Walhout, Marc Vidal, Job Dekker, 2012, Handbook of Systems Biology-Concepts and Insights. 1st Edition, Elsevier publications.

2. Chris Eaton, 2012, Understanding Big Data. 1st edition, Mc-Graw Hill.
3. James A. Marcum, 2009, The conceptual foundations of systems biology- An introduction. 1st edition, Nova Science publishers.
4. David Posada, 2009, Bioinformatics for DNA Sequence Analysis (Methods in Molecular Biology). 1st edition, Humana Press.

Title of the paper	**Core Practical 5- PLANT BIOTECHNOLOGY & ENVIRONMENTAL BIOTECHNOLOGY**		
Category : Part III Core Practical	Year & Semester Third year, Semester 4	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basics of plant biotechnology and industrial biotechnology		

PLANT BIOTECHNOLOGY - Practical

1 Organizing Plant tissue culture Laboratory

2 Preparations of Tissue Culture Media

3 Callus Inductions

4 Shoot tip culture

5 Embryos / Endosperm Culture

6 Somatic Embryogenesis

7 Hardening and Planting in field

8 Isolation of protoplasts

9 Cell suspension culture

10. Micropropagation of Tobacco plant by leaf disc culture

11. Agarose Electrophoresis

15. *Agrobacterium tumefaciens*-mediated plant transformation

16. Direct DNA delivery to plant by Particle Bombardment Demo

17. Isolation of plant genomic DNA

ENVIRONMENTAL BIOTECHNOLOGY - PRACTICAL

1. Detection of coliforms for determination of purity of fresh water.
2. Determination of total dissolved solids of water.
3. Determination of BOD of sewage samples.
4. Determination of COD of sewage samples.
5. Vermicomposting making
6. Microorganisms form polluted environment /Water resources.
7. Microorganisms form polluted environment /Air

8. Estimation of Dissolved Oxygen by Winkler's method
9. Identification of zooplankton and phytoplankton in water sample.

Title of the paper	**Elective Theory 1- Methods in Biology**		
Category : Part III Elective	Year & Semester Third year, Semester 5	Credits 5	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basic methods applied in the field of biology		

UNIT 1

Separation of Biomolecules: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods for proteins; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels.

UNIT 2

Histochemical and immunotechniques: Detection of molecules using ELISA, RIA, western blot,

immunoprecipitation, flow cytometry and immunofluorescence microscopy.

UNIT 3

Biophysical methods: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, protein structure determination using X-ray diffraction.

UNIT 4

Microscopic techniques: Light microscopy, resolving powers of different microscopes, Phase contrast, inverted microscopy, scanning and transmission microscopes. Different fixation and staining techniques for light microscopy and electron microscopy, freeze-etch and freeze-fracture methods for EM. Radiolabelling and detection.

UNIT 5

Research Design -Basic principles, Meaning, Need and features of good design, important concepts. Types of research designs. Development of a research plan - Exploration, Description, Diagnosis, Experimentation. Hypothesis -Null and alternate hypothesis and testing of hypothesis. Writing Skills; Selection of topic, thesis statement, developing the thesis.

Text Books:

1. Ekwal Imam. 2015. Basics of Research Methodology. New India Publishing Agency, New Delhi.

2. K. Wilson, J. Walker. 2010. Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, London.

3. R. K. Sharma, S.P.S. Sangha. 2008. Basic Techniques in Biochemistry and Molecular Biology. I K International Publishing House Pvt. Ltd, New Delhi.

Reference Books:

1. Lehninger, A.L., Nelson, D.L and Cox, M.M. 2017. Principles of Biochemistry, 7th edition. WH Freeman Publishers.

2. Stryer, L. 1999. Biochemistry, 4th edition. W.H.Freeman & Company, New York.

3. Zubey, G.L. 1998. Biochemistry, 4th edition. McGraw-Hill.

4. Voet, D.and Voet, J.G.1995. Biochemistry, 2nd edition. John Willey and Sons, Inc.

SEMESTER - VI

Title of the paper	**Core Theory 9- Genetic Engineering**

Category : Part III Core Theory	Year & Semester Third year, Semester 6	Credits 4	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basics of genetic engineering		

UNIT - I

Introduction to Genetic Engineering, Restriction enzymes. Cloning vector, Plasmids & Phage Vectors, Cosmids, Phasmids, advanced vectors, artificial chromosomes BACs, YACs and PACs.

UNIT - II

Recombinant technology: gene cloning – Selection and screening for recombinants RFLP, AFLP, RAPD, DNA finger printing, Microarray and DNA sequencing.

UNIT - III

Polymerase chain reaction, DNA sequencing, Antisense technology, Whole genome sequencing, Chromosome walking, jumping. Human genetic disease, Ligase chain reaction, Site directed mutagenesis, Principles of Electrophoresis and blotting techniques.

UNIT - IV

Expression systems -Inducible expression system, Prokaryotic expression systems, Eukaryotic expression systems- applications: Production of protein from cloned genes.

UNIT - V

Gene transfer in bacteria, plant and animal cells, Electroporation, particle bombardment and Lipofection, Gene cloning and manipulations.

Text Books:

1. T.A. Brown, 2010. Gene cloning and DNA analysis: An introduction, 6th edition, Wiley-Blackwell.
2. Sandy B. Primrose and Richard Twyman, 2006. Principles of Gene Manipulation and genomics, 7th edition, Wiley-Blackwell.
3. Bernard R. Glick and Jack J. 2003. Molecular Biotechnology: Principles and Applications of recombinant DNA, Pesternak 3rd Edition, American Society for Microbiology.
4. Brown, T.A, 2002. Genomes, 2nd Edition, Wiley-Liss.
5. Old RW and Primrose SB, 2001. Principles of gene manipulation, 6th Edition, Blackwell Scientific Publications.
6. Kreuzee and Massey, 2001. Recombinant DNA & Biotechnology, A, 1st Edition, ASM Press.

Reference Books:

1. Thiel, 2002. Biotechnology DNA to Protein: A laboratory Project, 1st Edition, and Tata McGraw-Hill.
2. Ring, C.J.A. and Blair, E.D, 2001. Genetically Engineered viruses: Development and application, 1st Edition, and Bios Scientific publishers.
3. Davidson, E.H, 2001. Genomic regulatory systems: Development and evaluation, 1st Edition, 2001 and Academic press.
4. Jognand, S.N, 2000. Gene Biotechnology, Edition1 Himalaya publishers.
5. Lewin, 2009. Genes X, 10th edition, Jones & Barlett Publishers

Title of the paper	**Core Theory 10- Industrial Biotechnology**		
Category : Part III Core Theory	Year & Semester Third year, Semester 6	Credits 4	
Pre- requisites	Knowledge of Biology at Higher Secondary level		
Objectives of the course	To introduce the student to basics of fermentation technology		

UNIT-I

Media for Industrial Fermentation: Types of media, composition of media – carbon sources, nitrogen sources, vitamins and growth factors, mineral, inducers, precursors and inhibitors. Aerobic and anaerobic fermentation processes and their application in the field of biotechnology industry.

UNIT-II

Bioreactors: Introduction to bioreactors, Batch and Fed-batch bioreactors, Continuous bioreactors; solid state and submerged; photo bioreactors Sterilization of bioreactors; Design of Bioreactors.

UNIT-III

Industrial Production: Alcohol (Ethanol, Beer, Wine) Acids (citric), Solvents-(glycerol) Antibiotics (penicillin, tetracycline), Aminoacids (lysine, glutamic acid), Single Cell Protein (algae/fungi). Use of microbes in mineral beneficiation and oil recovery.

UNIT-IV

Introduction to bioseparation: Primary recovery process: Cell disruption methods. Cell lysis and Flocculation: Osmotic and mechanical methods of lysis. Filtration and sedimentation.

UNIT-V

Extraction Principles: Liquid-liquid extraction, aqueous two phase extraction, drying. Principles and operation of vacuum

dryer, shelf dryer, rotary dryer, freezer and spray dryer, formulation methods.

Text Book:

1. Puvanakrishnan, R, Sivasubramanian, S and Hemalatha, T. 2015. Microbes and enzymes basics and applied: 1st edition MJP Publishers, India.
2. Mathuriya S. Abhilasha. 2009. Industrial Biotechnology, 1st edition ANE Books publisher.

Reference Books:

1. Min-tze Liong, 2011.Bioprocess Sciences and Technology. Nova Science Pub Inc.
2. L.Shuler, Fikret Kargi. 2003. Bioprocess Engineering: Michael and PHI publishers.
3. R.G. Harrison,P.Todd, SR.Rudge and D.P. Petrides.2003. Bioseparation science and engineering: John Wiley and sons.

Title of the paper	**Core Practical 7- Genetic Engineering & Industrial Biotechnology**		
Category : Part III Core Theory	Year & Semester Third year,	Credits 4	

	Semester 6		
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basics of fermentation technology		

GENETIC ENGINEERING

Extraction and estimation of intracellular proteins from E. Coli – Lowry's Method – Production of competent cells for transformation – Bacterial transformation – Isolation of genomic DNA – Extraction and estimation of RNA – Restriction Digestion of DNA – Absorption spectra of Nucleic acid – Estimation of DNA by Diphenyl amine method – Melting temperature of DNA, Agarose gel electrophoresis – SDS – PAGE – Agrobacterium mediated gene transfer – Isolation of plasmid DNA – Screening of Recombinants- Southern hybridization (DEMO) – Western Blotting (DEMO) – DNA amplification – PCR (DEMO).

INDUSTRIAL BIOTECHNOLOGY

1. Production, recovery and assay of citric acid by *Aspergillus niger*.

2. Biological assay of antibiotic.

3. Screening of Antibiotic producing microorganisms from soil by crowded plate

Technique.

4. Production, recovery of Amylase.

5. Assay of amylase.

6. Production of Bio insecticides by using *B.thuringenesis.*

7. Estimation of milk sugar by Benedict's method.

8. Qualitative analysis of milk sample by Methylene Blue Reduction Time Test.

9. Enumeration of bacteria in milk by Standard Plate Count.

10. Determination of efficiency of pasteurization of milk by alkaline phosphatase test.

11. Isolation of lactic acid bacteria from the curd sample.

12. Isolation of lipolytic microorganisms from butter.

13. Isolation of spoilage microorganisms from spoiled vegetables/fruits.

Title of the paper	**Elective Theory 2 - Microbial**

	Biotechnology		
Category : Part III Elective	Year & Semester Third year, Semester 5	Credits 5	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basic methods applied in the field of biology		

UNIT I

History and scope of microbial biotechnology, microbial diversity and its use, cultivation and preservation of microorganisms in small scale in Fermentor, bioreactors, immobilized cells and microbial polysaccharides- Microbial Biomass.

UNIT II

Production of microbial enzymes and applications, production of organic solvents- single cell proteins.

UNIT III

Production of beverages, beer, wine, microbes in banking- production of baker yeast and milk products.

UNIT IV

Biofertilizers and Biopesticides: Biomass from carbohydrates, higher alkanes, methanol. Biofertilizers – manufacture, formulation and utilization. Biopesticides – Bacteria, virus and fungi.

UNIT V

Bioremediation: Microbes in mining, ore leaching, oil recovery, waste water treatment, biodegradation of non cellulose and cellulosic wastes for environmental conservation.

Text Books:

1. L.E.J.R.Casida.2016.Industrial Microbiology. New age international publishers.
2. Puvanakrishnan.R, Sivasubramanium.S and Hemalatha.T.2015. Microbes and enzymes basics and applied, 1st edition MJP Publishers, India.
3. A.H.Patel.2005Industrial Microbiology. Mac Millan India Ltd NewDelhi.

Reference Books:

1. W.Clarke.2016.Biotechnology: Industrial Microbiology A text book.CBS Publisher.
2. Principles of Fermentation technology by P.F. Stanbury, and A.Whitakor (2013). Pergamum Press Elsevier science Ltd.

3. M.S.Abhilasha.2009.Industrial Biotechnology. ANE books publisher.

Title of the paper	**Elective Theory 3 - Environmental Biotechnology**		
Category : Part III Elective	Year & Semester Third year, Semester 5	Credits 5	
Pre- requisites	Knowledge of biology at Higher Secondary level		
Objectives of the course	To introduce the student to basic methods applied in the field of biology		

UNIT I

Biofilm Kinetics: Soluble microbial products and inert biomass. Reactors: Reactors types – A batch reactor – A continuous- flow stirred- tank reactor with effluent recycle

– A plug – flow reactor – A Plug flow reactor with effluent recycles – Reactors with recycle of settled cells.

UNIT II

Linking stoichiometric equations to mass balance equations – Engineering design of reactors – Reactors in series. Reactor configurations – Special factors for the design of anaerobic sludge digesters.

UNIT III

Denitrification: Physiology of denitrifying bacteria – Tertiary denitrification – One – sludge denitrification – Drinking water treatment: Anaerobic treatment by methanogenesis – Uses for methanogenic treatment.

UNIT IV

Detoxification of Hazardous chemicals: Factors causing molecular recalcitrance – Biodegradations of problem environmental contaminants – Bioremediation of problem environmental contaminants – Bioremediation: Engineering strategies for Evaluating bioremediation.

UNIT V

Sewage and waste treatment: Pollution monitoring, control and remediation (petroleum industry, paper industry, chemical industry etc).

Text books:

1. Viswanath Buddolla, 2016. Environmental Biotechnology: Basic Concepts and Applications, Alpha Science International Ltd.
2. Bhattacharyya and Rintu Banerjee, 2011. Environmental Biotechnology, 2nd Revised edition, I K International Publishing House Pvt. Ltd.

Reference books:

1. K.Allen, 2016. Environmental Biotechnology, CBS; 1st Edition. CBS Publishers.
2. Moo-Young, M., Anderson, W.A., Chakrabarty, A.M., 2010. Environmental Biotechnology: Principles and applications. 1st Edition, Springer.
3. Gareth M. Evans, Judith C. Furlong, 2003. Environmental Biotechnology: Theory and Application.

Title of the paper	**Project Instead of Elective 1-3 in V and VI Semesters**		
Category : **Part III** **Project**	Year & Semester Third year, Semester 6	Credits 15	
Pre- requisites	Knowledge of biology at UG LEVEL		
Objectives of the course	To introduce research concept and execute their ideas through project.		