B. Sc. Biotechnology

Syllabus

AFFILIATED COLLEGES

Program Code: 22R

2020 – 2021 onwards

BHARATHIAR UNIVERSITY

**(A State University, Accredited with "A" Grade by NAAC,
Ranked 13th among Indian Universities by MHRD-NIRF,
World Ranking : Times - 801-1000, Shanghai - 901-1000, URAP - 982)**

Coimbatore - 641 046, Tamil Nadu, India

Program Educational Objectives (PEOs)	
The **B.Sc., Biotechnology** program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Have enormous opportunities to become an effective researcher in the field of Life sciences.
PEO2	Acquire skills to face Various Government competitive exams viz., TNPSC, UPSC and SSC etc.,
PEO3	Become socially responsible with morel and intellectuals.
PEO4	Become an entrepreneur and product developer.
PEO5	Graduates will empower skills to meet the global challenges through current teaching learning methodologies.

1

Program Specific Outcomes (PSOs)

After the successful completion of B.Sc., Biotechnology program, the students are expected to

PSO1	Graduates acquire Problem solving ability- solving social issues and engineering problems
PSO2	Graduates will develop interest in lifelong learning
PSO3	Graduates develop an ability to design and conduct experiments
PSO4	Graduates will be enriched with skill based practical which aid them to become self employed
PSO5	Graduates will obtain requisite knowledge on the structure, function and applications of living organisms and thereby explore it in academia and industry

2

Program Outcomes (POs)	
On successful completion of the B. Sc. Biotechnology program,	
PO1	The students should be able to demonstrate proficiency in basic science and fundamental biotechnological tools
PO2	The graduates could understand the working principles of advanced biological sciences
PO3	The graduates acquire employability skills in the field of Pharma, food and agricultural industries
PO4	The graduates get motivated towards deep learning, higher studies and research in life sciences
PO5	The graduates develop health and environment awareness towards social responsibility

3

BHARATHIAR UNIVERSITY : : COIMBATORE 641 046
B.Sc Biotechnology Curriculum (Affiliated Colleges)
(For the students admitted during the academic year 2020 – 21 onwards)

Part	Sub code	Study Components	Course title	Ins.hrs/ week	Examinations				Credit
					Dur/Hrs	CIA	Marks	Total Marks	
		Semester I							
I	11T/11H/11F	Language – I		6	3	25	75	100	4
II	12E	English – I		6	3	25	75	100	4
III	13A	Core Paper I - Cell biology		5	3	25	75	100	4
	13B	Core Paper II – Bioinstrumentation		4	3	25	75	100	4
		Practical I (Cell Biology, Bioinstrumentation and Microbiology)		3	-	-	-	-	-
	1AA	Allied A: Paper I : Basic Mathematics		4	3	20	55	75	3
IV	1FA	Environmental Studies #		2	3	-	50	50	2
		Semester II							
I	21T/21H/21F	Language – II		6	3	25	75	100	4
II	22E	English – II		6	3	25	75	100	4
III	23A	Core Paper III – Microbiology		5	3	25	75	100	4
	23P	Core Practical I (Cell Biology, Bioinstrumentation and Microbiology)		4	3	40	60	100	4
	2AH	Allied A : Chemistry		4	3	20	55	75	3
	2PH	Allied Practical (Chemistry)		3	3	20	30	50	2
IV	2FB	Value Education – Human Rights #		2	3	-	50	50	2
		Semester III							
I	31T/31H/31F	Language – III		6	3	25	75	100	4
II	32E	English – III		6	3	25	75	100	4
III	33A	Core Paper IV – Biochemistry		4	3	25	75	100	4
	33B	Core Paper V- Genetics		4	3	25	75	100	4
		Core Practical II (Genetics & Biochemistry)		2	-	-	-	-	-
	3AA	Allied B: Paper I – Computer applications I : Introduction to computers		3	3	20	55	75	3
IV	3ZA	Skill based Subject 1 - Human Physiology		3	3	20	55	75	3
	3FB/3FC	Tamil @ / Advanced Tamil# (OR) Non-major elective - I (Yoga for Human Excellence# / Women's Rights#/ Constitution of India #)		2	3	50		50	2

		Semester IV						
I	41T/41H/41F	Language – IV	6	3	25	75	100	4
II	42E	English – IV	6	3	25	75	100	4
III	43A	Core Paper VI- Molecular Genetics	4	3	25	75	100	4
	43P	Core Practical – II (Genetics & Biochemistry)	3	3	40	60	100	4
	4AA	Allied B : Paper II – Computer applications II- 'C' and Python programming	4	3	20	55	75	3
	43Q	Allied Practical (Computer applications I & II)	2	3	20	30	50	2
IV	4ZB	Skill based Subject 2 -Human Pathology	3	3	20	55	75	3
	4FB/4FE	Tamil @ /Advanced Tamil # (OR) Non-major elective -II (General Awareness#)	2	3	50		50	2
		Semester V						
III	53A	Core paper VII Plant & Animal Biotechnology	4	3	25	75	100	4
	53B	Core Paper VIII Immunology	4	3	25	75	100	4
	53C	Core Paper IX Environmental Biotechnology	4	3	25	75	100	4
	53D	Core Paper X Recombinant DNA Technology	4	3	25	75	100	4
		Core Practical III Immunology and Plant Tissue Culture	4	-	-	-	-	-
		Core Practical IV Microbial Biotechnology & rDNA technology	3	-	-	-	-	-
	5EA/5EB/5EC	Elective 1	4	3	25	75	100	4
IV	5ZC	Skill based Subject 3 Diagnostic Tools	3	3	20	55	75	3
		Semester VI						
III	63A	Core Paper XI – Microbial Biotechnology	5	3	25	75	100	4
	63P	Core Practical III- Immunology and Plant Tissue Culture	6	6	40	60	100	4
	63Q	Core Practical IV Microbial Biotechnology & rDNA technology	6	6	40	60	100	4
	6EA/6EB/6EC	Elective – II	5	3	20	55	75	3
	6ED/6EE/6EF	Elective – III	5	3	20	55	75	3
IV	6ZD	Skill Based Subject 4 – Pharmacology	3	3	20	55	75	3
V	67A	Extension Activities/Internship training (Research Institute/ Industry) @	-	-	50	-	50	2
		Total					3500	140

First Semester

6

Course code	13A	**SEMESTER I: CELL BIOLOGY**	L	T	P	C
Core		**CORE PAPER: I**	5		-	4
Pre-requisite		Students should have studied basic science at school level	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of this course :

- Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
- Students will understand how these cellular components are used to generate and utilize energy in cells
- Students will understand the cellular components underlying mitotic cell division
- On successful completion of the subject the student should have understood the Structural features, Organelles and the cellular mechanisms.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Design the model of a cell.	K6
2	Differentiate the structure of prokaryotic and eukaryotic cell.	K2
3	Explain the organization of Genes and chromosomes, chromosome morphology and its aberrations	K2
4	Compare and contrast the events of cell cycle and its regulation	K4
5	Explain the communications of cells with other cells and to the environment.	K2
6	To know the cell organelles and locate its parts along with functions	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Basics of Cells**	**10 hours**

Cell as a basic unit: discovery of the cells, classification of cell types, development of cell theory, early chemical investigation in cell biology. Prokaryotic and Eukaryotic cell organization.

Unit:2	**Mechanisms of Cell Transport**	**15 hours**

Cell transport phenomenon: membrane architecture. Active, Passive, diffusion and osmosis. Chemistry of carbohydrates, lipids, proteins and nucleic acids.

Unit:3	**Cytoplasmic Compartments of The Cell**	**15 hours**

Structure and function of cytoplasmic compartments of the cell: ribosome and protein synthesis, energy flow through mitochondrion, chloroplast and photosynthesis, Golgi apparatus, lysozymes and micro bodies, endoplasmic reticulum, vacuoles, peroxysomes, lysozymes and Nuclear compartment. Heterochromatin and euchromatin, polytene chromosomes.

Unit:4	**Cell Division**	**13 hours**

Cell division in prokaryotes and eukaryotes: Cell cycle, mitosis, meiosis, crossing over and characteristics of cancer. Apoptosis, Stem cell, Prions.

Unit:5	Specialized Cells and Interaction	15 hours
Integrative and specialized cellular events, cell-cell signalling, specialized cells nerve cells, sperm cells, microfilaments, microtubules, muscle cells. Cells of vision, Nucleocytoplasmic interaction, cell cloning.		

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**70 hours**

Text Book(s)

1	Molecular cell biology, Lodish, Baltimore, Scientific American books, 1994
2	Essential Cell Biology-4th edition - Bruce Alberts et al., 2014
3	Molecular and cell biology, Stephen L Wolfe, Wordsworth Publishing company 1993

Reference Books

1	Robertis, D., 1987. Cell and molecular biology.
2	De Robertis ED, Nowinski WW, Saez FA. Cell biology. Philadelphia: Saunders; 1975
3	Pollard TD, Earnshaw WC, Lippincott-Schwartz J, Johnson G. Cell Biology E-Book. Elsevier Health Sciences; 2016 Nov 1.
4	Alberts B, Bray D, Hopkin K, Johnson AD, Lewis J, Raff M, Roberts K, Walter P. Essential cell biology. Garland Science; 2013 Oct 15.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://study.com/academy/lesson/symbiotic-relationships-mutualism-commensalism-amensalism.html

https://www.khanacademy.org/science/biology/ecology/intro-to-ecosystems/a/energy-flow-primary-productivity

Course Designed By: Dr. P. Ruban, Asst. Professor, Dept. of Biotechnology, SNMV College of Arts and Science, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	S	M	M	S	M
CO3	S	M	M	S	M
CO4	S	M	M	S	M
CO5	S	M	M	S	M

*S-Strong; M-Medium; L-Low

Course code	13B	**BIOINSTRUMENTATION**	**L**	**T**	**P**	**C**
Core		**CORE PAPER: II**	**4**		**-**	**4**
Pre-requisite		Students should have studied the principles of analytical instruments	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of this course :

- The student should have understood the analytical techniques in the field of Biotechnology

- To make the students to understand the basic principles of Bioanalytical instruments

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate the basics of instrumentation by analysis	K4
2	Exemplify the structure of atoms and molecules by using the principles of spectroscopy	K1
3	Evaluate by Separating and Purifying the components	K5
4	understand the need and applications of imaging techniques	K3
5	categorize the working principle and applications of fluorescence and radiation based techniques	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Basics instruments**	**12 hours**

pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator.

Unit:2	**Spectroscopic Techniques**	**10 hours**

Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy

Unit:3	**Chromatographic and Electrophoresis Techniques**	**12 hours**

Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC.
Electrophoresis Techniques: Starch Gel, AGE, PAGE.

Unit:4	**Imaging techniques**	**12 hours**

Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan radioisotopes.

Unit:5	**Fluorescence and radiation based techniques**	**12 hours**

Spectrofluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.

9

Unit:6	Contemporary Issues	2 hours
	Expert lectures, online seminars – webinars	
	Total Lecture hours	**60 hours**

Reference Books	
1	Introductory Practical Biochemistry – S. K. Sawhney and Randhir Singh. Narosa Publishing House
2	Principles of Applied Biomedical Instrumentation- Gedder A and L. E. Balsar,John Wiley and Sons.
3	Modern Experimental Biochemistry 2nd Edition- Boyer, Rodney F.Benjamin and Cummins

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.google.com/search?client=firefox-b-d&q=Spectroscopy

https://study.com/academy/lesson/medical-imaging-techniques-types-uses.html

https://www.erswhitebook.org/chapters/principles-of-respiratory-investigation/imaging-techniques/

Designed By: Dr. V. Senthilkumar, Associate Professor, Dept. of Biotechnology Palanisamy College of Arts, Perundurai.

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	L
CO2	S	M	S	S	L
CO3	S	M	S	S	L
CO4	S	M	S	S	S
CO5	S	M	S	S	S

*S-Strong; M-Medium; L-Low

10

Course code	23P	LAB IN CELL BIOLOGY, BIOINSTRUMENTATION AND MICROBIOLOGY	L	T	P	C
Core		PRACTICAL I			3 in sem 1 & 4 in sem 2	4
Pre-requisite		Students must know about basic knowledge about basic science and school level. Two hours laboratory each week for Odd semester four hours laboratory each week for even semester	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:

- To introduce an fundamentals of cell biology and microbiology techniques
- To teach students the basic techniques and instrument principles in biotechnology
- To give hands on microbiology and cell biology experiments

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Be aware of the laboratory rules and regulations.	K1
2	Understand the importance, evolution and diversity of cells and preparation of buffers	K2
3	Learns to visualize the cells by employing different types of microscopes	K2
4	Bring in the concepts of microbial culturing techniques.	K4
5	Analysis of phenotypic characterization of known and unknown microbes and basic instruments	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Cell biology and Bioinstrumentation	Hours
Laboratory rules and regulations	3
Handling of Microscopy	3
Introduction to Buffer	3
Preparation of Buffer- Phosphate	3
Preparation of Buffer Acetate	3
Preparation of Buffer Tris	3
Determination of OD using - Colorimeter,	3
Determination of OD using Spectrophotometer	3
Determination of OD using pH	3
Total Hours	27
Microbiology	**Hours**
Media preparation and sterilization	4
Enumeration of microorganism Spread and Pour	4
Pure culture technique – Streaking techniques	4
Measurement of growth of bacteria	4

Staining of microorganisms – Gram		4
Staining of microorganisms- negative		4
Staining of microorganisms- acid fast,		4
Fungal spore staining LCB		3
IMVIC test		4
Antibiotic sensitivity test		4
Permanent Slide preparation		3
Hanging Drop Technique		3
	Total hours	**27+45 hours**

Text Book(s)	
1.	Ruban. P. Basic Biotechniques. 1st Edition. Notion press. 2020
2.	Cappuccino, James G., and Natalie Sherman. "Microbiology: a laboratory manual." (2005).
Reference Books	
1.	Benson HJ. Microbiological applications: a laboratory manual in general microbiology. WCB/McGraw-Hill; 1998.
2.	Cullimore DR. Practical manual of groundwater microbiology. CRC Press; 2007 Dec 17.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
https://www.azolifesciences.com/article/What-is-a-pH-Meter-and-How-Does-it-Work.aspx	
Designed By: Dr. P. Ruban, Asst. Professor, Dept. of Biotechnology, SNMV College of Arts and Science, Coimbatore	

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	M	S	M	M
CO3	S	S	S	M	L
CO4	S	S	S	M	S
CO5	M	S	S	M	M

*S-Strong; M-Medium; L-Low

Course code	1AA	SEMESTER I: BASIC MATHEMATICS	L	T	P	C
Allied		ALLIED A : Paper I :	4		-	3
Pre-requisite		Students should have the basic understanding of Algebra, Matrix, Differentiation, and Integration & Central Tendency.	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course :

- Students will understand the Binomial Series, Logarithmic Series & Summation of the Series.
- Students will understand the types of Matrices, Inverse of the Matrix, Eigen values & Vectors, Simultaneous Linear Equations.
- Students will understand about Differentiation & Integration.
- Students will gain knowledge about Central Tendency & Correlation.

Expected Course Outcomes:	
On the successful completion of the course, student will be able to:	
1	Student can understand, apply & analyze about binomial, exponential, logarithmic & summation series.	K2,K3,K4
2	Students can apply the inverse matrix problem in cryptography.	K3
3	Remember & Understand about differentiation.	K1, K2
4	Understand the integration by parts.	K2
5	Students can apply the Central Tendency in real life.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Series		12 hours

Binomial, Exponential and Logarthmic series (Statement only) – Applications to summation of series only.

Unit:2	Matrix		10 hours

Quadratic Equation – Matrices – Determinant of a matrix – Inverse of a matrix – Characteristic equation of a matrix – Eigen values – Solutions of simultaneous linear equations in three variables using matrices.

Unit:3	Differentiation		12 hours

Differentiation of algebraic – Exponential logarithmic and trigonometric functions – physical interpretations of derivatives with reference of velocity and acceleration – Application of differentiation of maxima and minima (simple problems)

Unit:4	Integration		12 hours

Partial differentiation (Simple problems) – Integration of simple algebraic, exponential and trigonometric functions – substitution method – Integration by parts.

Unit:5	Central Tendency & Correlation		12 hours

Measures of central tendency – Mean, Median, Mode - Measure of dispersion – Quartile deviation

13

- Mean deviation - Standard deviation - Corelation – Karl pearson's coefficient of correlation – rank correlation.

Unit :6	Contemporary issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	60 hours

Reference Books

1	Calculus – Volume I – T.K.Manickavasagam Pillai and others.
2	Calculus – Volume II – T.K.Manickavasagam Pillai and others.
3	Algebra – T.K. Manickavasagam Pillai and others.
4	Statistical Methods – S.P.Gupta.

Related Online Contents [Websites]

https://youtu.be/1plMO7ChXMU

https://youtu.be/MSTSBW8LPRM

https://youtu.be/XrGM0OANzaE

https://youtu.be/mOlgB_BmF2s

Course Designed By: Mr. T. Prabakaran, Asst. Professor, Dept. of Mathematics, Nandha Arts and Science College, Erode-52.

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	S	L
CO2	S	M	M	S	L
CO3	S	M	M	S	L
CO4	S	M	M	S	L
CO5	S	M	S	S	L

*S-Strong; M-Medium; L-Low

14

Second Semester

Course code	23A	SEMESTER II: MICROBIOLOGY	L	T	P	C
Core		CORE PAPER III	5		-	4
Pre-requisite		Students should have knowledge about the microbes and its uses	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of this course are :
1. To appreciate the efforts of the Scientists for the development of Microbiology and Microscopes.
2. To equip the students with the real knowledge of working with different types of Microbes.
3. To understand the variety of microorganisms and to analyse their true potential.

Expected Course Outcomes:

	On the successful completion of the course, student will be able to:	
1	Remember and recall the historical events which paved the development of different types of microscopes.	K1
2	Understand and differentiate the different types of microbes.	K2
3	Analyze the media composition and grow the desired microbe.	K3
4	Apply the knowledge to enumerate the microorganisms from natural environment.	K4
5	Evaluate the success of understanding the viruses.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Microscope and its Types	14-- hours

Definition and scope of microbiology - A general account on microbial diversity. Basic principles in microscopy, Types of microscopes- light, dark, phase contrast, fluorescent and electron microscope- (Transmission and Scanning electron).

Unit:2	Microbes and their Reproduction.	13-- hours

A detailed account of General structure, growth and reproduction of Bacteria, fungi and Virus. Economic and industrial importance of yeast and moulds.

Unit:3	Media and Culture Techniques	15-- hours

Microbiological Media: Types, preparation, methods of sterilization; enumeration of microorganisms in soil, water and air; isolation of microorganisms from Environment and infected tissue; Techniques of pure culture, maintenance and Preservation; Staining: stains and types of staining;

Unit:4	Microbes and its associations	14-- hours

Physiology and biochemistry of microbes- Photo-autotrophs, Chemo-autotrophs, Parasitism, Saprophytism, Mutualism and Symbiosis, Commensalisms, endozoic microbes.

Unit:5	Metabolism And Viruses	12-- hours

Nitrogen metabolism including Nitrogen fixation (Symbiotic and asymbiotic), Lipid metabolism,

16

Secondary metabolism, microbial pathogens of plants (TMV, Gemini virus), animals (Yersinia pestis, rabies) and humans (HIV, HSV), Role of microbes in biogeochemical cycles.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**70 hours**

Text Book(s)

1	Pelczar, JR. M. J. (1993). Microbiology: Concepts and Applications. McGraw-Hill. Inc.
2	Prescott, L.M., Harley, J.P and Klein, D. A. Brown (2019). Microbiology. 11th edition , Mc Graw publishers.
3	Stanier, R. Y., Ingraham, J. I., Wheelis, M. I. and Painter, P. R. (2005). General Microbiology. Macmillan Press Ltd. Hampshire.

Reference Books

1	Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M. and Stahl, D. A. (2017). Brock Biology of Microorganisms. 15th edition. Pearson.
2	Tortora, G. J., Funke, B. R. and Case, C. L. (2016). Microbiology: An introduction. 12th Edition, Pearson.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Introduction to Microbiology-MOOC
2	General Microbiology-SWAYAM
3	NPTEL- Microbiology Course
4	https://www.microscopeworld.com/p-3658-types-of-microscopes.aspx
5	https://micro.magnet.fsu.edu/cells/bacteriacell.html
6	https://www.biotopics.co.uk/microbes/tech1.html
7	https://courses.lumenlearning.com/microbiology/chapter/introduction-to-microbial-biochemistry/
8	https://en.wikipedia.org/wiki/Pathogen

Designed By: S.Priscilla Helen Christy, Asst Professor, C.M.S College of Science and Commerce.Coimbatore.

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	S
CO2	S	S	S	L	M
CO3	S	S	S	S	S
CO4	S	M	S	S	S
CO5	S	S	L	M	S

*S-Strong; M-Medium; L-Low

Course code	2AH	Semester II: Allied A: CHEMISTRY	L	T	P	C
Allied			4		-	3
Pre-requisite		Students should have studied the basics of chemistry	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course:

- Students will understand the basics of bonding
- Students could gain knowledge on chemistry in day today life

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the importance of bonding and order	K1 & K2
2	Apply the gained knowledge in analyzing the water parameters	K3
3	Analyse the adulteration in food	K4
4	Evaluate the role of agricultural, pharmaceutical and textile chemistry	K5
5	Think innovatively to solve the environmental issues	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Inorganic chemistry	10 hours

Chemical bonding: Molecular orbital theory, bonding, antibonding and non-bonding orbitals. Molecular orbitals. MO configuration of H_2, N_2, O_2, F_2. Bond order.

Covalent bond: orbital overlap, hybridization, geometry of organic molecules- CH_4, C_2H_4, and C_2H_2.

Unit:2	Environmental chemistry	14 hours

Concept and scope of environmental Chemistry-Nomenclature: Pollutant, contaminant, receptor, sink, pathways of a pollutant.

Water – Sources of water, qualities of potable water, soft and hard water, methods of removal of hardness- water pollution- dissolved oxygen, chemical oxygen demand (COD), biochemical oxygen demand (BOD)-Environmental segments.

Atmosphere: Composition and structure of atmosphere, particles, ions and radicals in the atmosphere, Air Pollution: Air Pollutants, e.g. carbon monoxide, nitrogen oxides, hydrocarbons, oxides of sulfur, photochemical smog, acid rain and particulates.

Unit:3	Food chemistry	10 hours

Food and Nutrition – Carbohydrates, Proteins, Fats, Vitamins and Minerals –definition, classification and their importance as food constituents- Balanced diet- Calorie. Food Adulteration- types and detection methods.

Unit:4	Pharmaceutical chemistry	12 hours

Medicinally important Inorganic compounds: Compounds of Aluminium, Phosphorous, Arsenic,

18

Iron and Mercury.

Sulphonamide: mechanism and action of sulpha drugs- preparation and uses of sulphanilamide sulphadiazine & sulphapyridine.

Analgesics-definition and actions-narcotic and non narcotic-morphine, Heroin. Antipyretic analgesics- preparation and uses - methyl salicylate, aspirin & paracetamol

Unit:5	Agricultural and textile chemistry	12 hours

Fertilizers: Effect of Nitrogen, potassium and phosphorous on plant growth – commercial method of preparation of urea, triple superphosphate. Complex fertilizers and mixed fertilizers – their manufacture and composition. Secondary nutrients – micronutrients – their function in plants.

Dyes: azo and triphenylmethane dyes- Preapration one example-Methyl Orange, Malachite green.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	60 hours

Text Book(s)

1	*Applied Chemistry*, Krishnamurthy N., Jayasubramanian K and Vallinayagam, Prentice Hall of India, New Delhi (1990).
2	Chemistry, Raymond Chang, McGraw-Hill; 10th Edition (2007)
3	Medicinal Chemistry, Ashutosh kar, New Age International, 1992. 5.
4	A text book of pharmaceutical chemistry, Jayashree ghosh, S. Chand, 1997.
5	*A text book of Pharmaceutical Chemistry*- Jeyashre Ghosh, , Tata McGraw Hill Publishing, New Delhi (1993).
6	*Chemistry in Everyday Life*, Gem Mathew G.D., Vishal Publishing (2014).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

SWAYAM: https://onlinecourses.swayam2.ac.in/cec20_ag10/preview

SWAYAM: https://onlinecourses.swayam2.ac.in/cec20_lb05/preview

Designed by Mr. K. Karthik, Assistant Professor, Dept. of Chemistry, Nandha Arts and Science College,Erode-52

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	M	M	M	S
CO3	S	M	M	M	S
CO4	S	M	S	M	S
CO5	S	M	M	M	S

*S-Strong; M-Medium; L-Low

19

Course code	2PH	Semester : II: ALLIED CHEMISTRY PRACTICAL	L	T	P	C
Allied		**Allied Practical**	-	-	3	2
Pre-requisite		Students must know about basic knowledge on volumetric analysis and solution preparation	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of this course are:

- To learn about the estimation of unknown solution from known solution
- To gain knowledge on identification of functional group of given compound

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the practical skills in chemistry	K2
2	Acquire skills in handling of chemicals	K2
3	Calculate the normality of a given solution	K3
4	Analyse the functional groups of the given compound	K4
5	Evaluate the parameters of water	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

VOLUMETRIC ANALYSIS	**Hours**
Estimation of sodium hydroxide using standard sodium carbonate.	3
Estimation of hydrochloric acid- standard oxalic acid.	3
Estimation of ferrous sulphate- standard Mohr salt solution.	3
Estimation of Total Hardness of water	3
Estimation of available chlorine in the given sample of bleaching powder.	3
ORGANIC ANALYSIS: systematic analysis	
Detection of Elements (N, S, Halogens).	3
To distinguish between aliphatic and Aromatic.	3
To distinguish between saturated and unsaturated.	3
Functional group tests for phenols, acids (mono and di), aromatic primary amine, amide, diamide, carbohydrate.	3
Detection of Elements (N, S, Halogens).	3
Total hours	**30**

Text Book(s)

1.	Basic principles of Practical chemistry, V. Venkateswran, R.Veerasmy and A.R. Kulandavelu- Sultan Chand and Sons, Second edition,1997.

20

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
https://www.youtube.com/watch?v=7bmQkQW8bbs
https://www.youtube.com/watch?v=NqK3-dM_D7Q
Designed by Mr. K. Karthik, Assistant Professor, Dept. of Chemistry, Nandha Arts and Science College,Erode-52

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	S	M
CO2	S	M	L	S	M
CO3	S	M	L	S	M
CO4	S	M	L	S	M
CO5	S	M	L	S	M

*S-Strong; M-Medium; L-Low

21

Third Semester

22

Course code	33A	SEMESTER III : BIOCHEMISTRY	L	T	P	C
Core		CORE PAPER: IV	4		-	4
Pre-requisite		Students should have studied about environmental science in previous semester and school level	Syllabus Version		2020-2021	

Course Objectives:

- On successful completion of the subject the student should have understood: Basic Structure and metabolism of Biomolecules.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the significance of Biochemistry.	K1
2	Describe the chemistry of carbohydrates, lipids, proteins and amino acids.	K2
3	Understand the basics of enzymes.	K1
4	Describe the classification and structural organization of proteins	K3
5	The students will understand about the structure and function of nucleosides and nucleotides.	K5
6	Basic knowledge of structure and functions of major bio-molecules	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	BIOMOLECULES	12 hours

Structure of atoms and biomolecules: Atomic theory, Valency, Atomic weight, Molecular weight, Molarity. Chemical Bonding - Electrostatic, Covalent, Ionic and Vander waals, Structure of water molecules, properties and ionization of Water, pH and buffers. Laws of Thermodynamics.

Unit:2	ENZYMES	12 hours

Enzymes and co-enzymes, IUB classification and nomenclature of enzymes, regulation of enzyme activity, active sites, activators and inhibitors; Isoenzymes, allosteric enzymes.

Unit:3	CARBOHYDRATES	12 hours

Definition, Nomenclature, Classifications and Structures of sugars. Structural features of polysaccharides. Glycolysis, TCA cycle, Glycogen breakdown and synthesis, Gluconeogenesis, Bioconversion of pentoses and hexoses,

Unit:4	LIPIDS	12 hours

Definition, Nomenclature, Classifications and Structure of lipids, Metabolism of lipids: Fatty acid biosynthesis and oxidations. Amino acids and peptides – classifications, Structural Organization of protein (primary, secondary, tertiary and Quaternary), Functions of proteins.

Unit:5	NUCLEIC ACIDS	10 hours

Definition, Nomenclature, Classifications and Structure of nucleic acids, Biosynthesis and

23

degradation of nucleic acids (purines and pyrimidines) Integration of metabolism and regulations.		
Unit:6		**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Reference Books

1	Boyer.R., (2002) Concepts in Biochemistry 2nd ed. Brooks / Cole publishing company New York.
2	David L. Nelson and M. Cox (2003) Lehninger's Principles of Biochemistry, 3rd Ed, Worth publication New York
3	Voet and Voet (1995) Fundamentals of Biochemistry, 2nd Edition, John Wiley and sons inc., New York.
4	Geoffery L Zubay (1995) Principles of Biochemistry, WCB publishers, London
5	Murrey RK., D.K. Granner, P.A. Mayers and V.W. Rodwell, (2003) Harper's Biochemistry, Prentice –Hall Int, Boston 6. Outlines of Biochemistry Conn &Stumph.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://study.com/academy/lesson/symbiotic-relationships-mutualism-commensalism-amensalism.html

https://www.khanacademy.org/science/biology/ecology/intro-to-ecosystems/a/energy-flow-primary-productivity

Course Designed By: M.Raghunath, Asst. Professor, Dept. of Biotechnology, KSG College of Arts and Science , Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	M	S	M	M
CO3	S	L	M	M	M
CO4	S	L	M	M	L
CO5	M	L	M	M	M

*S-Strong; M-Medium; L-Low

24

Course code	33B	GENETICS	L	T	P	C
Core		Core Paper V	4			4
Pre-requisite		Students must have knowledge about Genetics	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:
- Understand on Historical introduction to Genetics and genetic materials
- Understanding the concept and principles of genetics exchanges and
- Its expression in host and to provide an idea about gene regulations and its control.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Obtain acquaintance on historical overview of microbial genetics and genetic materials	K3
2	Comprehend the concept of replication of genetic materials	K2
3	Understand about regulation of gene expression and mutation	K1
4	Demonstrate the genetic exchange mechanism in microorganisms	K6
5	Gain knowledge on Mutation	K5
6	Grasp the Basic of genetics and their role	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Basics of Genetics	12 hours

History of Genetics - Mendelian Principles, Segregation, Independent Assortment, Dominance. Multiple alleles, Incomplete dominance, Over dominance and co dominance.

Unit:2	Genetic Linkage and Mapping	12 hours

Epistasis, lethal genes. Sex determination and sex linkage in diploids, linkage and crossing over, gene mapping. Chromosomal theory of inheritance, maternal effects.

Unit:3	Chromosomal Variation	12 hours

Chromosomal variation in number, Changes in Chromosomal structure, Genetics of Heamoglobin, Transposable elements in prokaryotes and eukaryotes.

Unit:4	Genetic Structure	10 hours

Structure of chromosome, fine structure of Gene, cistron, recon, Structure of Eukaryotic gene, Experimental evidence for DNA as the genetic material, cytoplasmic genetic systems- mitochondria and chloroplast DNA.

Unit:5	Population genetics	12 hours

Genetic control of Development in Drosophila. Population genetics, calculating gene frequency, factors affecting gene frequency. Pedigree analysis and genetic counselling.

25

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Book(s)	
1	Daniel, L. Hartl., W. Elizabeth and Jones. (2001). Genetics-Analysis of Genes and Genomes, Jones and Bartlett publishers, UK.
2	David Frifelder. (1990). Microbial Genetics, Narosa publishing house, New Delhi.
3	Gardner, E.J., Simmons, M.J., and Snustad, D.P. (2006). Principles of Genetics. John Wiley & sons.
Reference Books	
1	Groombridge, B (Ed.) 1992. Global Biodiversity – Status of the Earth's Living Resources. Chapman & Hall, London.
2	UNEP, 1995, Global Biodiversity Assessment, Cambridge Univ. Press, Cambridge.
3	Virchow, D. 1998. Conservation & Genetic Resources, Springer – Verlag, Berlin
4	Gary K.Meffe& .Ronald Carroll, C.1994. Principles of Conservation Biology, SinauerAssociates, Inc., Massachusetts.
5	Clarke, G.L. 1954, Elements of ecology, John Wiley & sons. N.Y
6	Rastogi, V.B. and M.S. Jayaraj, 1989. Animal ecology and distribution of 10. Animals, Kedamath Ramnath.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
https://www.khanacademy.org/science/biology/classical-genetics/chromosomal-basis-of-genetics/a/linkage-mapping	
https://study.com/academy/lesson/genetic-structure-of-human-populations-definition-lesson-quiz.html	
Designed By: Dr. N. Saranya, Asst. Professor, Nehru Arts and Science College, Coimbatore	

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	S
CO2	S	M	L	L	M
CO3	S	M	M	L	M
CO4	S	M	L	L	M
CO5	S	M	M	L	S

*S-Strong; M-Medium; L-Low

26

Course code	43P	LAB IN GENETICS AND BIOCHEMISTRY	L	T	P	C
Core		CORE PRACTICAL II (GENETICS & BIOCHEMISTRY)	-	-	2 in sem 3 & 3 in sem 4	4
Pre-requisite		Students must be equipped with the basic knowledge of Genetics and concepts of Biochemistry from their previous semester	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:

- To teach students the concept of Mitosis and visualize the sex chromatin under the microscope.
- To give hands on experience in quantification of important biological constituents of cell.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Successfully quantify the important biological constituents of cell.	K5
2	Analyze the sex chromatin present in different cells.	K4
3	Examine and evaluate the stages of Mitosis.	K5
4	Develop the skills of DNA isolation technique	K2
5	Could able to separate and interpret the mixture of components	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

BIOCHEMISTRY	Hours
Paper Chromatography (Preparation of reagents and performance of Paper chromatography).	2+2
Estimation of Protein - Lowry's method.(Preparation of reagents and estimation of protein)	2+2
Estimation of DNA (Preparation of reagents , estimation and calculation)	2+2
Estimation of RNA by Orcinol method (Preparation of reagents , estimation and calculation)	2+2
Estimation of Sugars by Anthrone method (Preparation of reagents, performance and calculation)	2+2
Estimation of total free amino acids (Preparation of reagents ,performance and calculation)	2+2
Estimation of Lipids (Preparation of reagents ,lipid estimation and calculation)	2+2
Analysis of Oils- Iodine Number- Saponification Value -Acid Number. (Preparation of reagents and determination)	2+2
Quantification of Vitamin C. (Preparation of reagents and performance)	2+2
Total Hours	36
GENETICS	**3 Hrs/Week**
Isolation of Genomic DNA From Blood	3
Agarose Gel Electrophoresis	3

27

Observation of Bands		3
Mitotic Preparation - Onion Root Tip		3
Study of Prophase		3
Study of Metaphase		3
Study of Anaphase		3
Study of Telophase		3
Buccal Smear Preparation		3
Examination of Sex Chromatin		3
	Total Lecture hours	**36+ 30 hours**

Text Book(s)

1.	Jayaraman, J. (2011). **Laboratory Manual in Biochemistry.** Wiley Eastern Limited.
2.	Sadasivam, S. and Manickam, A. (2018). **Biochemical Methods.** 3rd Edition. New Age International Ltd Publishers, New Delhi.
3.	Wilson, K. and Walker, J. (2010). **Principles and techniques of Biochemistry and Molecular Biology**. 7th Edition. Cambridge University Press.
4.	Plummer, D. T. (2017). **An Introduction to Practical Biochemistry**. 3rd Edition. McGraw Hill Education.

Reference Books

1.	Sadasivam, S. and Manickam, A. (2018). **Biochemical Methods.** 3rd Edition. New Age International Ltd Publishers, New Delhi.
2.	Sri Jayachamarajendra (2018)/ pdf. **Cell Biology and Genetics Lab.**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

www.slideshare.net/TapeshwarYadav1/clinical, www.niddk.nih.gov/research-funding/at-niddk/labs.

Designed By: S. Priscilla Helen Christy, Asst. Professor, C.M.S College of Science and Commerce, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	M	M	M
CO3	S	S	S	M	M
CO4	S	S	S	S	M
CO5	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	3AA	Allied B : Computer Applications- I :	L	T	P	C
Allied		**INTRODUCTION TO COMPUTER**	3		-	3
Pre-requisite		Students should have known the basics of computer	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of this course are to:

1. To Develop their skills, the necessary for office automation industry oriented applications
2. To develop the basic skills required to write network ports

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Use basic fundamental utilities which are required again and again on daily basis to work on operating system.	K6
2	Configure important services to connect ports.	K2
3	To inculcate the basic knowledge on Computer Networks and technologies	K2
4	To impart strong knowledge on spreadsheet application in biological data analytics	K4
5	Enable to know about basic presentation graphical representation of data.	K2
6	Make understand the types of Internet and its usage in industry	K1

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Windows and ports**	**10 hours**

Windows: Definition of Operating System, Functions of OS, types of OS. Desktop icons and their functions: My computer, My documents, My Network Place, Recycle Bin, Files, Folder, Local Disk Drive, CD/DVD Drive, Pen Drive.

Ports: PS/2 keyboard and mouse port, USB OTG, Ethernet port, serial port, parallel port, HDMI port, VGA port, display port, USB A-Type, USB B-Type, USB C-Type, Type A Mini and micro port, Type B Micro.

Unit:2	**Basics of Networks and MS word**	**8 hours**

Basics of Networks: LAN, WAN, MAN, Wireless, Home Networks, Connection-oriented and connectionless services, DNS – E-mail.

MS Word: Features, creating, saving and opening documents in word, interface, toolbars, ruler, menus, keyboard shortcut keys, Editing, previewing, printing and formatting a document, advanced features of MS Word, find and replace.

Unit:3	**Spreadsheet**	**8 hours**

Spreadsheet: Creating worksheet, entering and editing text, Saving, modifying worksheet, range selection, copying and moving data, inserting and deleting rows and columns, naming Worksheet. Setting Formula: Finding total in a column or row, mathematical operations like addition, subtraction, multiplication, division using formulas. Printing worksheet, Creating charts, Pivot tables.

29

Unit:4	PowerPoint	8 hours
PowerPoint: Basic of power point, creating and editing slides, formatting slides, Master slides, Templates, coloring text and objects, Transitions, heading slides, using clip art gallery, chart creations, managing files.		
Unit:5	**Internet of Things and Development of India in IOT**	8 hours
Internet of Things: Introduction, Definition & characteristics of IOT, IOT in everyday life, Internet of everything. IOT Applications: Intelligent Traffic systems, Smart Parking, Smart cities and location sharing, Smart Agriculture, IOT in education. **Development of India in IOT**: Solar Plant System, ATM chip card system , IOT in health care industry, IOT in rural empowerment. Challenges in IOT: Big Data Management, Connectivity challenges.		
Unit:6	**Contemporary Issues**	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	44 hours

Text Book(s)	
1	Joyce Cox & Polly Urban, Quick Course in Microsoft Office-GOLGOTIA Publications.
2	Arshdeep Bahga, Vijay Madisetti: Internet of Things-A hands on Approach Authors, Universities press.
Reference Books	
1	Srinivasa K.G., Siddesh G.M.,Hanumantha Raju R., "Internet of Things" Cengage Learning India pvt. Ltd (2018)
2	R.K. Taxali, PC Software for Windows Made Simple,Tata McGrawHill Publishing Company,1998.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Word : https://www.youtube.com/watch?v=d1cm4frzNEQ

Excel : https://www.youtube.com/watch?v=rwbho0CgEAE

PowerPoint : https://www.youtube.com/watch?v=8ovm_qUX7yE

IOT : https://www.youtube.com/watch?v=UrwbeOIlc68

Designed By Dr. S. Prasath, Assistant Professor and Coordinator, Centre for E-Learning and Development, Nandha Arts and Science College, Erode

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	L
CO2	S	S	M	S	L
CO3	S	M	M	S	L
CO4	S	M	M	S	L
CO5	S	M	M	S	L
*S-Strong; M-Medium; L-Low					

30

Course code	3ZA	Subject Title: HUMAN PHYSIOLOGY	L	T	P	C
Core		**Skill Based Subject 1**	3		-	3
Pre-requisite		Students must have studied about Human Physiology in previous semester/ school level	**Syllabus Version**		2020-2021	

Course Objectives: To understand various organs of human, their physiological activities and the disorders

The main objectives of this course are to:

understood the various systems in human body and their activities

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	understand various systems in human body.	K2
2	Know the activities of various organs.	K1
3	apply terminologies applicable to pathology and describe the courses and natural progress of human disease.	K3
4	outline the current research in disease-specific disciplines and what is currently known about treatment options for various human diseases.	K4
5	know about Kidney functions and disorders.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	**Skeletal Muscles and Nervous System**	**15 hours**

Muscle- skeletal muscles – composition – functions and properties of plain (smooth) and cardiac muscles – electromyography, Nervous System – organization – basic functions of synapses and transmitter substances – sensory receptors – sense of hearing – taste and smell. Special senses – optics of vision – function of retina –cortical and brain stem control of motor function. cerebrospinal and brain metabolism

Unit:2	**Blood & Body Fluid**	**14 hours**

Blood & Body Fluid – blood cell –Haematosis – determination of coagulation – plasma proteins – platelets – leucocytes. Bone marrow – functions of tissue fluid – Lymph nodes Cardio Vascular System – Heart as pump – rhythmic excitation – electrocardiogram.

Respiratory System- pulmonary ventilation – pulmonary circulation – gaseous exchange - O_2 and CO_2 transport in blood and body fluids – mechanism of breathing – ventilation

31

Unit:3	Digestive system	14 hours

Digestive System – digestive tract – gastrointestinal function – motility– secretory functions of alimentary tract – digestion and absorption. Excretion – functions of kidney – renal associated mechanisms - extra cellular and intracellular fluids – osmolality.

Micturition– skin – sweat Endocrines – pituitary hormones and their control by hypothalamus – thyroid metabolic hormones – adreno-cortical hormones – insulin, glucagon's and Diabetes mellitus – Gonadotrophic hormones –testosterone – oestrogen.

Unit: IV Contemporary issues	2 hours
Expert lectures, online seminars – webinars	
Total Lecture hours	**45 hours**

Text Book(s)

1	Chatterjee, **Human physiology**, Medical Allied Agency, Kolkatta, 11th Edition, 2016.

Reference Books

1	Gary A. Thiodeare& Kevin T Patton, **Anthony's Text book of Anatomy and Physiology**, Moshi Year Book, New York, 2nd Edition, 2008.
2	Jan Koolman and Klaus-Heinrich Roehm, **Color Atlas of Biochemistry**, Thieme Publications, 2nd Edition, 2010.
3	Colleen M. Smith, Allan D. Marks and Michael A. Lieberman, **Marks' Basic Medical Biochemistry: A Clinical Approach**, Lippincott Williams and Wilkins, 2nd Edition, 2009.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.cliffsnotes.com/study-guides/anatomy-and-physiology

https://www.studocu.com › Athabasca University › Human Anatomy and Physiology

Designed By: Dr. N. Saranya, Asst. Professor, Nehru Arts and Science College, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	M	L	S	S

*S-Strong; M-Medium; L-Low

Fourth Semester

33

Course code	43A	Semester IV: MOLECULAR GENETICS	L	T	P	C
Skill Based		CORE PAPER: VI	4		-	4
Pre-requisite		Students must know about basic knowledge about molecular genetics/basic science in their previous semester and school level	Syllabus Version		2020-2021	

Course Objectives:

- The focus will be on understanding central principles and fundamental mechanisms for the organization, replication, expression, variation, and evolution of the genetic material, as well on methods for molecular genetic analyses and gene technology.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To remember the Organization of genome.	K1
2	To understand Structure and function of DNA.	K2
3	To describe the transcriptional regulation in prokaryotes.	K2
4	To analyze the operon concept-lac operon.	K4
5	Evaluate the post translational modifications and folding of newly assembled polypeptides.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	GENOME STRUCTURE, FUNCTION	12 hours

Organization of genome – Structure and function of DNA and RNA. Experiment to prove semiconservative mode of replication. DNA replication in prokaryotes and eukaryotes. Types-unidirectional, bidirectional and theta model replication. Enzymology of replication.

Unit:2	GENE EXPRESSION	12 hours

Gene as the unit of expression- Co linearity, Transcription, post transcriptional modifications (mRNA, tRNA, rRNA), transcriptional regulation in prokaryotes (operon concept-lacoperon), inhibitors of transcription. Elucidation of genetic code.

Unit:3	TRANSLATION	10 hours

Translation of protein – post translational modifications and folding of newly assembled polypeptides, translational regulations, signal sequences and protein export.

Unit:4	GENE MUTATION	12 hours

Gene mutation – Biochemical basis of mutations – types of mutations- spontaneous and induced mutations; Ames test for mutation; DNA damage – types of DNA repair mechanisms – photo reactivation excision repair, post replication recombinant repair, SOS repair.

Unit:5	GENETIC RECOMBINATION	12 hours

Recombination - Homologous and non-homologous recombination, including transposition, site

34

specific recombination. Genetic exchange – bacterial transformation, transduction, conjugation and their mapping.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Reference Books

1	Basic Genetics by D.L. Hartl 1991, Jones &Bartett publications.
2	Microbial Genetics, Friefelder 1987 – Jones &Bartnett publications
3	Molecular Biology of the gene 4th edition by Watson et al, The Benjamin / Cummings co
4	Molecular Cell Biology by Lodish 1994, Baltimore Scientific American Brocks

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://medicine.umich.edu/dept/human-genetics/genome-structure-function-0

https://www.yourgenome.org/facts/what-is-gene-expression

https://en.wikipedia.org/wiki/Translation_(biology)

https://en.wikipedia.org/wiki/Mutation

https://www.nature.com/scitable/topicpage/genetic-recombination-514/

Designed By: M.Raghunath, Asst. Professor, Dept. of Biotechnology, KSG College of Arts and Science, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	M	S
CO3	S	S	S	M	S
CO4	S	S	L	M	S
CO5	S	M	L	M	S

*S-Strong; M-Medium; L-Low

Course code	4AA	**Allied B :** **Computer Applications- II:**	L	T	P	C
Allied		**'C' AND PYTHON PROGRAMMING**	**4**		**-**	**3**
Pre-requisite		Students should have known the basics of computer	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of this course are :

- To learn about the fundamentals of C programming and Python language concepts.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the students have the programming ability in C Language.	K6
2	Ability to write C Programming for logical concepts.	K2
3	Ability to design and write application to manipulate coding logics for biological concepts.	K2
4	Develop their own applications to analysis with data.	K4
5	To inculcate knowledge on basic Python programming skills.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Computer Algorithms and Fundamentals in C**	**10 hours**

Computer Algorithms:

Basics of Algorithms- Pseudo code-Flowchart-Stack-Queues.

Fundamentals in C:

History of C- Basic Structure of a C program- Simple C Program- Character set - C tokens - Keywords - Identifiers - Constants – Variables – Data Types -Declaration of Variable - Assigning Values to Variables –Initialization.

Unit:2	**Operators and Expressions: Arrays**	**14 hours**

Operators and Expressions:

Arithmetic operators – relational operators – logical operators – assignment operators – increment and decrement operators – conditional operators – special operators – arithmetic expression – evaluation of expression – Precedence of arithmetic operators – type conversion in expression – operator precedence and associativity – mathematical functions.

Arrays:

Introduction – One dimensional array – declaration of array – Initiating on two and multidimensional arrays.

Unit:3	**Decision Making , Branching and looping**	**10 hours**

Decision Making and Branching:

Introduction to if, if...else, nesting of if ...else statements- else if ladder – The switch statement, The ?: Operator – The goto Statement.

Decision Making and Looping:

Introduction - while loop –do loop –do while lopp –for loop –Nested Loops–break–continue–goto–exit–return.

36

Unit:4	Python	12 hours

Python:

About python, features of python, python set up, fundamentals of python, values and data types, variables, key word, identifier of python, quotations, indentation, multi line statement, input-output and import function in python, advantages and disadvantages of python.

Unit:5		12 hours

Fruitful functions in python:

Defining a function, function call, types of function, python function arguments, composition, python recursion and python lambda function.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**60 hours**

Text Book(s)

1	Computer Programming In C: V.Rajaraman (PHI Publication)
2	Mark Summerfield. ―Programming in Python 3: A Complete introduction to the PythonLanguage, Addison-Wesley Professional, 2009.
3	Martin C. Brown, ―PYTHON: The Complete Reference‖, McGraw-Hill, 2001.
4	Fred L. Drake, Guido Van Russom, "An Introduction to Python", Network Theory Limited.
5	Dr.A.Kannan andDr.L.Sai Ramesh Problem solving and Python Programming, United Global Publisher Pvt.Ltd.,Chennai,2018.

Reference Books

1	Programming in ANSI C by E. Balagurusamy
2	Programming in C by Ashok N. Kamthane First Indian Print 2004
3	Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist''`, 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016
4	Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python, Revised and updated for Python 3.2, Network Theory Ltd., 2011.
5	Wesley J Chun, ―Core Python Applications Programming, Prentice Hall, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://nptel.ac.in/content/storage2/106/104/106104128/MP4/mod01lec05.mp4

https://nptel.ac.in/content/storage2/106/104/106104128/MP4/mod01lec06.mp4

https://www.youtube.com/watch?v=wp9elxZzypg

Designed By Dr. S. Prasath, Assistant Professor and Coordinator, Centre for E-Learning and Development, Nandha Arts and Science College, Erode

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	L
CO2	M	M	S	S	L
CO3	M	M	S	S	L
CO4	M	M	S	S	L
CO5	M	M	S	S	L

*S-Strong; M-Medium; L-Low

38

Course code	43Q	SEMESTER IV: ALLIED PRACTICAL	L	T	P	C
Allied		COMPUTER APPLICATIONS I & II	-		2	2
Pre-requisite		Students must know about basic knowledge on volumetric analysis and solution preparation	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are:

- To impart fundamentals concepts in basic programming skills for students

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the practical skills in office oriented applications	K2
2	Acquire skills in handling internet	K2
3	Write programs which employs basic concepts of C	K3
4	Ability to develop C Programming that allows applications to make efficient skills	K4
5	Write programs which employs basic concepts of python for biological purpose	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

	Hours
To compose, send a mail, forward a mail and to reply for a mail.	2
To send a mail to a large number of recipients using cc and bcc options.	2
To search a thing using a search engine and to upload your resume with any one job portal.	2
Create a excel program for Student mark list.	2
Create a power point presentation for anyone topic in biotechnology with minimum 10 slides.	2
Write a C program to find the sum, average, standard deviation for a given set of numbers.	2
Write a C program to generate n prime numbers.	2
Write a C program to generate Fibonacci series.	2
Write a C program to sort the given set of numbers in ascending order.	2
Write a python program that displays the following information: Your name, Full address, Mobile number, College name, Course subjects.	2
Write a python program to make a simple calculator	2
Write a python program to find the largest three integers using if-else and conditional operator.	2

39

	Total hours		**24**

Text Book(s)	
1.	R.K. Taxali, PC Software for Windows Made Simple,Tata McGrawHill Publishing Company,1998.
2.	Programming in C by Ashok N. Kamthane First Indian Print 2004
3.	Dr.A.Kannan andDr.L.Sai Ramesh Problem solving and Python Programming, United Global Publisher Pvt.Ltd.,Chennai,2018.
4.	Wesley J Chun, ―Core Python Applications Programming, Prentice Hall, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.youtube.com/watch?v=HC13M8FGlNc

https://www.youtube.com/watch?v=O1_zgmUINi8

https://nptel.ac.in/content/storage2/106/104/106104128/MP4/mod01lec05.mp4

https://nptel.ac.in/content/storage2/106/104/106104128/MP4/mod01lec06.mp4

Designed By Dr. S. Prasath, Assistant Professor and Coordinator, Centre for E-Learning and Development, Nandha Arts and Science College, Erode

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	L
CO2	S	S	S	S	L
CO3	S	S	L	S	L
CO4	S	S	L	S	L
CO5	S	S	L	S	L

*S-Strong; M-Medium; L-Low

Course code	4ZB	HUMAN PATHOLOGY	L	T	P	C
Core		Skill Based Subject 2	3			3
Pre-requisite		Students must know about the basics of physiology and disease	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:
- Know about the concept of pathology
- Understand the metabolic disorders and complications involved.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Distinguish the metabolic disorders in human being	K4
2	Explain the basic nature of diseases and their causes	K2
3	Apply knowledge of pathology in disease diagnosis and management	K3
4	Acquire knowledge to maintain the healthy body	K1
5	Evaluate the condition of body to prevent the diseases.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Kidney disorder	13 hours

Disorders of Kidney: acute renal failure, chronic renal failure, proteinuria and nephritic syndrome and urinary calculi. Disorders of Liver: Hepatitis, acute liver failure, Cirrhosis. Gilbert's, Crigler-Najjar, Dubin-Johnson, Jaundice, and Rotor.

Unit:2	Metabolic disorder	15 hours

Diabetes mellitus - Etiology and pathogenesis, diagnosis and management. Diabetes in pregnancy.

Disorders of Plasma proteins and enzymes: Hypoalbuminaemia, hypogammaglobulinaemia, hypergammaglobulinaemia. Alkaline phosphatase, Creatine kinase.

Types of hyperlipidaemias. Lipoprotein deficiency-abetalipproteinaemia. Diseases of Heart- Myocardial infarction, Heart failure and Hypertension.

Unit:3	Hormonal disorder and cancer	15 hours

Disorders of hormones: Acromegaly and gigantism, Cushing's disease, Conn's syndrome, congenital adrenal hyperplasia (CAH).

Hyperthyroidism, hypothyroidism, goiter and thyroid cancer.

Metabolic aspects of cancer: Metabolic complications of prostate and lung cancer

Tumour markers: α- Fetoprotein (AFP), Carcinoembryonic antigen (CEA), Para

proteins, Human chorionic gonadotrophin (hCG), markers of prostatic cancer, enzymes as tumour markers and Carbohydrate antigen (CA) markers.

Unit:4	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**45 hours**

Text Book(s)

1	An Illustrated color text of Clinical Biochemistry by Allen Gaw, Robert A.Cowan, illustrated by Robert Britton (1999, second edition, Churchill Living stone press).

Reference Books

1	Color Atlas of Biochemistry (second edition, Thieme Publications, revised and enlarged) by Jan Koolman and Klaus-Heinrich Roehm.
2	Marks' Basic Medical Biochemistry: A Clinical Approach (2nd Edition), by Colleen M. Smith, Allan D. Marks and Michael A. Lieberman.
3	Medical Microbiology by Jawetz.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.cancer.gov/about-cancer/diagnosis-staging/diagnosis/tumor-markers-fact-sheet

https://ocw.mit.edu/courses/health-sciences-and-technology/hst-035-principle-and-practice-of-human-pathology-spring-2003/lecture-notes/introduction_2003.pdf

SWAYAM: Cancer fundamentals: https://onlinecourses.swayam2.ac.in/aic20_ge02/preview

MOOC: https://www.mooc-list.com/course/clinical-epidemiology-coursera

MOOC: https://www.mooc-list.com/course/science-medicines-futurelearn

Designed by Mr. P.DHEEBAN SHANKAR, Asst. Professor, Dept. of Biotechnology, Nandha Arts and Science College,Erode-52,TN

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	M	S
CO3	S	S	S	M	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Fifth

Semester

Course code	53A	Semester V: PLANT AND ANIMAL BIOTECHNOLOGY	L	T	P	C
Core		Core paper VII	4		-	4
Pre-requisite		Students should have the basic understanding of Plant and Animal products	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:
- Understood usage of Plant and Animal products and exploitation of them in Biotechnology.
- Knowledge on Crop development and Callus culture
- Biotechnological applications of plants, Animal tissue culture, Animal products, production & improvement of them.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand scientific and technical skills on plants and animal study	K1
2	Know about animal products	K1
3	Acquire knowledge on limitations and challenges in animal cell tissue culture.	K2
4	Know the applications of Plant and animal Biotechnology.	K3
5	Learn the preservative methods of cells	K4
6	Evaluate and discuss public and ethical concerns over the use of animal Biotechnology.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Cell and Tissue culture	12 hours

Introduction to cell and tissue culture, Plant tissue culture media (composition, types and preparation), plant hormones and growth regulators in tissue culture, Preparation of suitable explants for organogenesis. Micropropagation on large scale, somatic embryogenesis, protoplast culture and somatic hybridization, Anther, pollen and ovary culture for production of haploid plants.

Unit:2	Cell culture methods	12 hours

Cell culture methods for the secondary metabolite production, somaclonal variation and its significance, Cryopreservation, Plant transformation techniques - Agrobacterium mediated gene transfer – Mechanism of DNA transfer, general features of TI and RI plasmids and their use as vectors, role of virulence genes, reporter genes, designing of expression vectors, use of 35S and other promoters, reporter genes.

Unit:3	Animal cell cultures	12 hours

Animal cell cultures: Culture media – composition and preparation, Balanced salt solution – and simple growth medium, Role of CO_2, serum and protein-free defined media and their applications; Culturing and maintenance of different animal cell lines (Primary and established cell lines). Characterization of cultured cell, measurement of viability, cyto – toxicity and

44

growth parameters. Stem cell cultures, embryonic stem cell and their application, cell culture-based vaccines, apoptosis.

Unit:4	Transgenic animals	12 hours

Transgenic animals: Method of obtaining transgenic animals using fertilized eggs and embryonic blastocyst cell, importance of transgenic animals – increased productivity of domestic animals, improved desired characters of domestic animals, production of recombinant gene products and proteins for pharmaceutical use. Animal models for tackling human diseases (Gene knock out in mice models).

Unit:5	Animal cloning	10 hours

Transgenic silkworms, Animal cloning: Methods of cloning in animal system – Rat, Sheep, Pig; importance of cloning – Gene therapy and cell mediated therapy. Ethical issues in Animal Biotechnology.

Unit:6	Contemporary Issues	2 hours
	Expert lectures, online seminars – webinars	
	Total Lecture hours	**60 hours**

Text Book(s)

1	Mather and Barnes, **Methods in Cell Biology**, Academic Press, 1998.
2	Butler, **Mammalian Cell Biotechnology: A Practical Approach**, Oxford UNI Press, 1991.
3	Chawla, **Introduction to Plant Biotechnology**, Oxford and IBH Publishers, 2nd Edition, 2003

45

Reference Books	
1	Plant genetic engineering, Dodds J.H.
2	Plant molecule biology, Grierson and S.V.Convey
3	Molecular biotechnology, Principle and applications of recombinant DNA technology, Bernard R. Glick.
4	Plant Biotechnology-Monica Hughes.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
Coursera: https://www.coursera.org/learn/patenting-bio-ipr
https://www.coursera.org/search?query=plant%20biotechnology&=
SWAYAM: https://onlinecourses.nptel.ac.in/noc20_bt42/preview
Course Designed By: Dr.Saranya, Asst. Professor, Dept. of Biotechnology, Nehru Arts and Science College, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	M	M	S	S
CO3	S	S	S	S	M
CO4	S	S	S	S	M
CO5	S	M	S	S	M

*S-Strong; M-Medium; L-Low
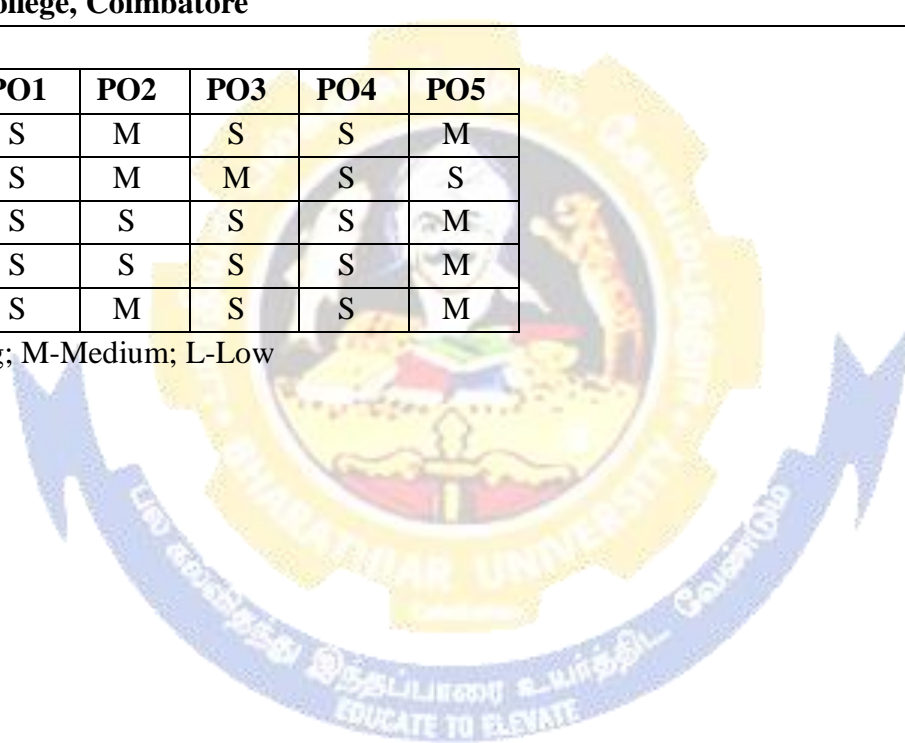
Course code	53B	IMMUNOLOGY	L	T	P	C
Core		CORE PAPER: VIII	4			4
Pre-requisite		Students should have studied about immune system in previous semester and school level	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:

- This course presents the basic defense mechanism of animals
- To make the student to understood the concept immunology
- On successful completion of the subject the student should have understood: Immunity, Antigen, Antibody, Cells of immune system and their function and regulations

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know about the history of Immunology	K1
2	Compare and contrast innate and adaptive immunity	K2
3	Design a model of Immunoglobulin/Antibodies	K6
4	Describe which cell types and organs present in the immune response.	K2
5	Illustrate various mechanisms that regulate immune responses and maintain tolerance	K3
6	Exemplify the adverse effect of immune system including Allergy, hypersensitivity and autoimmunity	K2
7	Apply basic techniques for identifying antigen antibody interactions	K3
8	Explain the stages of transplantation responses	K2
9	Describe the immunological response against tumor and blood transfusion	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Basics of Immunology and Immune System	12 hours

Introduction- Historical Development in Immunology. Immunity- Humoral and Cell mediated response, Primary and Secondary immune response. Cells involved in immune response. Innate and Acquired Immunity. Mechanisms of defense.

Unit:2	Components of Immune Cells	12 hours

Antigen- Types and classifications. Antibody – Structure, Types, properties and their biological functions, poly clonal sera, Monoclonal antibody. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Lymphocytes traffic and regulation. CD Molecules.

Unit:3	Antigen and Antibody Process	10 hours

Hematopoiesis and development of B and T lymphocytes. Immunoglobulin Gene expression B cell and T cell activation. MHC molecules Response of B cells to antigens. Plasma Cells, Memory Cells.

Unit:4	Immunological Reaction and Disorder's	12 hours

47

Complement – activation and regulation. Cytokines- structure and functions, Interferon and interleukins. Immuno regulation: Tolerance. Suppression, Autoimmunity and hypersensitivity reactions. Primary and secondary Immuno deficiency disorders.

Unit:5	Antigen Antibody Reaction	12 hours

Transplantation, HLA Typing; Mechanism of Graft rejection. Tumor immunology. Immuno surveillance- mechanisms. Antigen – Antibody Interactions. Immunodiffussion and Immunoelectrophoresis. Principle and Applications of RIA, ELISA, Fluorescent Antibody techniques.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	60 hours

Text Book(s)

1	Immunology – Kuby., J - 5th Edition

Reference Books

1	Immunology – Tizard
2	Immunology – Ivan M. Roitt – Third Edition
3	Immunobiology – Janeway and Travers – 5th Edition
4	Basic Biotechniques. Ruban P. 1st Edition. Notion press

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.nature.com/ni/video

https://www.cell.com/immunity/home

https://www.wpunj.edu/sec/vsec/science_courses/bio/BIOimmuANIM.html

https://www.youtube.com/watch?v=K09xzIQ8zsg

Course Designed By: Dr. P. Ruban, Assistant Professor, Dept. of Biotechnology, SNMV College of Arts and Science, Coimbatore.

Cos	PO1	PO2	PO3	PO4	PO5
CO1	L	L	L	L	L
CO2	M	M	M	M	S
CO3	S	S	S	S	M
CO4	S	M	M	M	M
CO5	S	S	S	M	M

*S-Strong; M-Medium; L-Low

48

Course code	53C	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
Core		CORE PAPER: IX	4		-	4
Pre-requisite		Students should have studied about environmental science in previous semester and school level	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:

- To reveal the current status and basics of environmental condition
- To make the students to understand the concepts of ecology and conservation of environment
- To provide knowledge of current perspectives in ecological issues

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Classify microbes according to energy source and carbon source and evaluate energy outcome of the energy metabolism according to electron acceptor and electron donor usage	K1
2	Describe suitable methods for characterizing the activity, function, diversity, and composition of microbial communities	K2
3	Explain the microbial processes and growth requirements underlying the activated sludge process, nitrification, Denitrification, enhanced phosphorus removal, and anaerobic digestion	K1
4	Describe the most commonly applied disinfection methods, and the steps typically involved in drinking water treatment process train	K3
5	Evaluate the potential for biodegradation of organic pollutants, taking microbial and physical/chemical environments, as well as the chemical structure of the compound itself, into consideration	K5
6	Describe biotechnological solutions to address environmental issues including pollution, mineral resource winning, renewable energy and water recycling.	K4
7	Describe existing and emerging technologies that are important in the area of environmental biotechnology	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Basics of Environmental components and Relationship	12 hours

Scope – Branches of ecology – Abiotic factors – water – soil – temperature – light. Biotic factors – Animal relationship – symbiosis – commensalisms – mutualism –Antagonism – Antibiosis – Parasitism – Predation – competition.

Unit:2	Ecosystem and Their Cycles	12 hours

Ecosystem –Definition –structure – pond ecosystem – primary production –secondary production – food chain – food web – trophic levels – energy flow – pyramid of biomass–

pyramid of energy. Biogeochemical cycle: Nitrogen and Phosphorous.

Unit:3	Types of Pollution and Threats	12 hours

Pollution – types – sources – effects – Air-water – land – Noise – Thermal – Pesticide – Radioactive – green house effect, ozone and its importance – global warming – Acid rain– Bio accumulation. Biological control. Hazard management and environmental monitoring.

Unit:4	Biodiversity and Sewage Treatments	10 hours

Biodiversity –Types of Biodiversity, Hotspots, Values of Biodiversity. Sewage Treatment System – Characteristics, Primary, secondary and tertiary treatment. Environmental education.

Unit:5	Disaster Management	12 hours

Disaster Management: Natural disaster, Earth quake, Bomb treat, Hazardous material spill/ release, Campus Shooting, Terrorist incidence, health emergency.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**60 hours**

Text Book(s)		
1	Odum, E.P. 1971. Fundamentals of Ecology. W.B.Saunders company, Philadelphia	
2	Sharma, P.D. 1990. Ecology and environment. Rsatogi publications, Meerut.	
3	Verma P.S. and V.K. Agarwal. 1996. Principles of Ecology S.Chand. & co., New Delhi.	

50

Reference Books	
1	Groombridge, B (Ed.) 1992. Global Biodiversity – Status of the Earth's Living Resources. Chapman & Hall, London.
2	UNEP, 1995, Global Biodiversity Assessment, Cambridge Univ. Press, Cambridge.
3	Virchow, D. 1998. Conservation & Genetic Resources, Springer – Verlag, Berlin
4	Gary K.Meffe& .Ronald Carroll, C.1994. Principles of Conservation Biology, SinauerAssociates, Inc., Massachusetts.
5	Clarke, G.L. 1954, Elements of ecology, John Wiley & sons. N.Y
6	Rastogi, V.B. and M.S. Jayaraj, 1989. Animal ecology and distribution of 10. Animals, KedamathRamnath.
7	Southwick, C.H. 1976. Ecology and the quality of environment D.Van.Nostrand Co.,

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
https://study.com/academy/lesson/symbiotic-relationships-mutualism-commensalism-amensalism.html
https://www.khanacademy.org/science/biology/ecology/intro-to-ecosystems/a/energy-flow-primary-productivity
Designed By: Dr. P. Ruban, Asst. Professor, Dept. of Biotechnology, SNMV College of Arts and Science, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	L	M
CO2	S	S	M	M	L
CO3	S	S	S	M	M
CO4	S	S	L	S	S
CO5	S	S	M	S	L

*S-Strong; M-Medium; L-Low

51

Course code	53D	RECOMBINANT DNA TECHNOLOGY	L	T	P	C
Core		**CORE PAPER: X**	**4**			**4**
Pre-requisite		A Basic knowledge on Genetics ,Tools and techniques of Molecular Biology	**Syllabus Version**		2020-2021	

Course Objectives:
The main objectives of this course are to:

1. To gain knowledge about the importance of gene manipulation and gene transfer technologies
2. To learn the concept of vectors and expression systems and methods of selection
3. To understand and describe the concept of Hybridization technique

Expected Course Outcomes:	
On the successful completion of the course, student will be able to:	
1	Acquaint with the vocabulary involved in molecular cloning strategies and techniques used to probe DNA for specific genes of interest	K1
2	Apprehend with the tools and techniques in rDNA technology and types of Vectors	K2
3	Relate the role of restriction and modifying enzymes in recombinant DNA technology	K3
4	Explore the techniques involved in construction of genomic DNA library and cDNA library	K4
5	Design the protocols for analyzing gene transfer methods and to explore knowledge on hybridization based markers	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Plasmid and its types**	10 hours

Plasmids –Types of Plasmids (F, R and Col), Properties Of Plasmid, Plasmid Compatibility, Copy Number Control. E.Coli Vectors- pBR322 And Their Derivatives, pUC Vectors And Their Derivatives, BAC. Cloning In Bacillus And Streptomyces.

Unit:2	**Vectors**	12 hours

Molecular Biology of Lambda and Lambda Vectors, Cosmid, Phagemid, M13. Yeast Vectors – YIP, YEP, YRP and YAC. Inducible Promoters, Selectable Markers And Expression Vectors.

Unit:3	**Restriction enzymes**	12 hours

 Restriction and Modification Systems of Bacteria. Restriction Enzyme, DNA Polymerases, RNA Polymerase, Taq Polymerase, DNA Ligase, Methylase, Polynucleotide Kinase, Alkaline Phosphatase, Reverse Transcriptase, DNaseI, S1nuclease, RnaseH, Terminal Deoxynucleotidyl Transferase.

Unit:4	**Viral vectors**	12 hours

Animal Vectors- SV40 Vectors, Retero Viral and Baculo Viral Vectors, Shuttle Vectors. Plant Vectors - Ti Plasmid as Gene Vector, Caulimo Viruses, Gemini Viruses, Transposable Elements as Vectors Construction of cDNA and Genomic DNA Libraries.

52

Unit:5	Probes and techniques	12 hours

Probes - Probe Construction and Labelling. Introduction of Cloned Genes into Cell – Transformation, Transduction, Particle Bombardment, Liposome Mediation, Electroporation and Cocultivation. Identification of Recombinant DNA. Hybridization Techniques-Southern, Western and Northern Blotting, Chromosome Walking and Jumping. DNA Sequencing, Microarray. RFLP Maps, RAPD Markers, PCR, Antisense Technology, Terminator Gene Technology, DNA Finger Printing.

Unit:6	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	60 hours

Text Book(s)

1	Principles of gene manipulation and genomics. 2016 .S.B. Primrose and R.M. Twyman
2	Gene Cloning and DNA Analysis: An Introduction .2010. Terry Brown

Reference Books

1	Genes to clones. Ernst. L. Winnacker, (2003), 2nd edition, Panima publishing corporation, NewDelhi.
2	James. D. Watson (2001) Recombinant DNA technology, 2nd edition, WH Freeman and company, New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	**SWAYAM** - Genetic Engineering: Theory And Application By Prof. Vishal Trivedi	IIT Guwahati in the current MOOCs course
2	**NPTEL** Certification course - Gene Therapy by Sachin Kumar https://nptel.ac.in/courses/102/103/102103041/
3	**Coursera** Certification course -Vaccines

Designed By: Dr. Maleeka Begum, Associate Professor, Dept. of Biotechnology, Sri Ramakrishna College of Arts and Science, Coimbatore

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO3	S	S	S	S	M
CO3	S	S	S	M	M
CO4	S	S	S	S	S
CO5	S	S	S	M	M

*S-Strong; M-Medium; L-Low

53

Course code	5ZC	DIAGNOSTIC TOOLS	L	T	P	C
Skill Based		Skill Based-Subject 3	3			3
Pre-requisite		Students should have learnt about physiology and pathology	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of the course is to :

    Make the students to understood the concept of diagnostic methods and to know examination of Blood , Urine and CSF

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Compare and contrast the various blood and urine parameter analysis	K1
2	Understand the techniques to diagnose the abnormality in health	K2
3	Acquire a basic understanding about the components in blood to be checked	K2
4	Analyze the fundamental principles of advanced molecular techniques	K4
5	Evaluate the pros and cons of advanced techniques	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Blood parameters	15 hours

    Blood examination – anticoagulant, hemoglobin, RBC, Packed cell volume, ESR, WBC total, differential normal and abnormal hematopathies – anemia, bone marrow smear, leukemia and myelodysplastic syndromes, diagnostic significance of PB smear.

Unit:2	Urine, CSF and Parasite analysis	14 hours

    Urine analysis – collection – physical, chemical and microscopic examination of urine – CSF, Parasite analysis

Unit:3	Diagnostic Tools	14hours

    Biochemical analysis of Blood, Blood banking, Transplantation, AIDS, Lab safety, ELISA, RIA, FACS, PCR, Computers in lab.

Unit:4	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	45 hours

Text Book(s)

1	Handbook of medical lab technology – Ed; V.H.Talib
2	Clinical Chemistry by Willium J.Marshall (Fifth edition
3	An Illustrated color text of Clinical Biochemistry by Allen Gaw
4	Marks' Basic Medical Biochemistry: A Clinical Approach (2nd Edition) by Colleen M. Smith, Allan D. Marks and Michael A. Lieberman.

Reference Books

1	Medical Microbiology by Jawetz.

54

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
https://www.healthline.com/health/blood-tests
https://www.youtube.com/watch?v=d8w5SICzzxc
https://www.medicinenet.com/urinalysis/article.htm
https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-sequencing-pcr-electrophoresis/a/polymerase-chain-reaction-pcr
Course Designed By: **Mr. P.DHEEBAN SHANKAR, Asst. Professor, Dept. of Biotechnology, Nandha Arts and Science College,Erode-52,TN**

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	S	M	S	S
CO5	S	L	M	S	S

*S-Strong; M-Medium; L-Low

Sixth

Semester

56

Course code	63A	Semester VI: MICROBIAL BIOTECHNOLOGY		L	T	P	C
Core		CORE: XI		4		-	4
Pre-requisite		A basic knowledge in microbes and their benefits		Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:
1. Understood the applications of Microbes
2. Know about Fermentation, Microbial products, Vaccine and antibiotics.

Expected Course Outcomes:

On successful completion of the course, student will be able to:

1	Narrate the scope and economics of Microbial Biotechnology	K1
2	Understand the need of microbial products for the mankind	K2
3	Examine the learned techniques in production of industrially important products	K3
4	Think about the innovativeness in the production of new beneficial metabolites	K6
5	Apply the IPR law to real problems and also learn patenting for creative products	K3 & K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1		10 hours

Microbial Biotechnology: Scope and application-horizons of microbial Technology, public concern about the microbial biotechnology and Economics of microbial biotechnology.

Unit:2		12 hours

Microbes: Living factories for macromolecules-Production of proteins in Bacteria and yeast; recombinant and synthetic vaccines; microbial insecticides (*Bacillus thuringiensis, B.sphaericus, B.papilliae and Baculo*-Viruses); microbial enzymes application in starch processing , textile designing, detergents, cheese making; polysaccharides and polyesters.

Unit:3	Microorganisms in fermentation	12 hours

Microorganisms in fermentation-Ethanol from feed stocks to fermentable Sugars, from sugars to alcholos, clostridial fermentation, lactic acid fermentation, acetic acid production and industrial production of various milk products.

Unit:4	Metabolites from microorganisms	12 hours

Metabolites from microorganisms-amino acids; antibiotics-antibacterial agents (lactams, tetracyclines, peptides, amino glycosides), antifungal agents, anti-tumor antibodies.

Unit:5	Biofertilizers and IPR	12 hours

Production of biofertilizers (nitrogen fixing Bacteria, single cell protein, mycorrizha and phosphate solubilizing Bacteria).Introduction to intellectual property and intellectual

property rights (IPR) - types: patents, copy rights, trade marks, design rights and geographical indications.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**60 hours**

Text Book(s)

1	Preve *et al*. 1987. Fundamentals of Biotechnology. VCH Publ.
2	Stanbury, P.F. Whittaker, A, Hall, S.J. 1995. Principles of fermentation technology. Butterworth Heinemann.
3	Stainer, R.Y. Ingraham, J.L., Wheelis, M.L. and Painter, P.R. 1987. General Microbiology. Macmillan Co.
4	Lancini, G. Parenti, F. and Gallo, G.G. 1995. Antibiotics-A Multidisciplinary Approach. Plenum Press, New York.

Reference Books

1	Prescott, L.M. Harley, J.P. and Klein, D.A. 1999. Microbiology. McGraw Hill Co.
2	Glazer, A.N. and Nikaido, H. 1995. Microbial biotechnology. W.H.Freeman & Co.,New York
3	Gunasekaran.P. 1995. Laboratory manual in microbiology. New Age International Limited. New Delhi.
4	Glick, B.R. and Pasternak, J.J. 1998. Molecular Biotechnology. Washington D.C. ASM Press.
5	Encyclopedia of Microbiology. 1992. Vols.1-4. Academic Press.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	SWAYAM: https://onlinecourses.swayam2.ac.in/cec20_ag09/preview (Food Microbiology)
2	SWAYAM: https://onlinecourses.nptel.ac.in/noc20_hs55/preview (Patenting for engineer and scientists)
3	SWAYAM: https://onlinecourses.nptel.ac.in/noc20_hs54/preview (Patent draft for beginners)
4	https://www.biologydiscussion.com/fertilizers/production-of-various-bio-fertilizers-microbiology/66873
5	https://www.google.com/search?client=firefox-b-d&q=Microorganisms+in+fermentation

Course Designed By: **Mr. P.DHEEBAN SHANKAR, Asst. Professor, Dept. of Biotechnology, Nandha Arts and Science College,Erode-52,TN**

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	L	M	M	L
CO3	S	M	M	M	S
CO3	S	M	S	S	S
CO4	S	S	M	M	M
CO5	S	S	M	M	M

*S-Strong; M-Medium; L-Low

Course code	63P	LAB IN IMMUNOLOGY AND PLANT TISSUE CULTURE	L	T	P	C
Core		PRACTICAL III	-	-	4 in Sem 5 & 6 in sem 6	4
Pre-requisite		Students must know about basic knowledge in immune system in their previous semester and school level. Four hours laboratory each week for Odd semester six hours laboratory each week for even semester	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:

- To teach students the latest techniques and principles in Immunology and Plant Tissue Culture
- To give hands on experience in immunological techniques and Plant Tissue Culture

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the practical skills in Immunology	K2
2	Acquire skills in plant tissue culture	K2
3	Defining the fundamental concepts of immunology, disease diagnosis and Plant tissue culture techniques	K3
4	Developing and applying the recent technology involved in diagnostic techniques of immunology and Plant cell culture	K4
5	Examining and analyzing the results involved in immune techniques and Plant tissue Culture	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Immunology	Hours
Method of immunization and bleeding	2
Preparation of Anti bodies	2
Antigen-antibody reactions -Single radial Immuno diffusion	2
Double Immuno diffusion	2
Rocket Immuno diffusion	2
Blood grouping	2
Preparation of serum from blood	2
WIDAL	2
ASO	2
CRP	2
ELISA/Dot ELISA- Demonstration	2
Total Hours	22
Plant Tissue Culture	**Hours**
Plant Tissue Culture Media Preparation	6
In vitro germination o f seeds	6

59

Callus induction and differentiation	2
Embryo Culture	2
Somatic embryogenesis	4
Isolation and fusion of protoplast	6
Artificial seed production	2
Meristem culture	2
Micropropagation	4
Qualitative analysis of alkaloids, flavonoids, saponins, tannins and phenolic Compounds	4
Total hours	**22+38 hours**

Text Book(s)

1.	Ruban.P. Basic Biotechniques. 1st Edition. Notion press. 2020
2.	Nagar Santosh, AdhavMadhavi. Practical Book of Biotechnology & Plant Tissue Culture. 2010.
3.	HirenkumarSherathiya.Practical manual for Plant Tissue Culture.2013
4.	Aparna Pareek, L K Pareek. Plant Tissue Cultural Manual.2013

Reference Books

1.	Ruban.P. Basic Biotechniques. 1st Edition. Notion press. 2020

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.youtube.com/playlist?list=PLrAEgIY86I6wYIgx3iE-KvyaRFzwuuixr

Designed By: Dr. P. Ruban, Asst. Professor, Dept. of Biotechnology, SNMV College of Arts and Science, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5	
CO1	S	M	S	S	M	
CO2	S	M	S	S	M	
CO3	S	M	S	L	M	
CO4	S	M	S	M	M	
CO5	S	S	S	S	L	*S-Strong; M-Medium; L-Low

60

Course code	63Q	LAB IN MICROBIAL BIOTECHNOLOGY AND rDNA TECHNOLOGY	L	T	P	C
Core		**PRACTICAL IV**		-	3 in sem 5 & 6 in sem 6	4
Pre-requisite		Basic knowledge in tools and techniques of Cell Biology, Genetics and Biochemistry	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of the course is to facilitate:

The Students to gain sound technical knowledge and hands on practical skills in various aspects of Microbial Biotechnology and rDNA Technology

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire an overview about the fundamentals of Bioprocess Technology and r-DNA technology tools and their application in agriculture, medicine and biodiversity conservation.	K1
2	Acquire expertise in isolation of Plasmids and DNA and to validate the steps involved in isolation process	K2
3	Gain confidence to apply the knowledge in pursuing bioprocess and DNA techniques at pilot scale for biotechnological application	K3
4	Analyse, interpret gene amplification and identify copies to integrate transgene by PCR and Southern blot analysis.	K4
5	Demonstrate the practical experience to begin a career in Biotech as well as well as in R and D research laboratories for advanced research.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Experiments in Lab in Microbial Biotechnology and rDNA Technology	Hours
1. Fermentor design and working principles – (Demo)	3
2. Production and assay of extra cellular enzyme –protease – submerged	3
3. Wine Production	3
4. Ethanol production and calculate the percentage of alcohol	3
5. SCP – Production	3
6. Isolation of genomic DNA – bacteria	5
7. Isolation of genomic DNA – Plant	5
8. Isolation of genomic DNA – Animal	5
9. Agarose Gel Electrophoresis	5
10. Isolation of Plasmid DNA	5
11. Restriction digestion	5

61

12. Ligation		3
13. Transformation		5
14. SDS-PAGE		5
15. Western blotting – Demo		5
16. Southern blotting – Demo		5
17. PCR – Demo		4
	Total Lecture hours	**72 Hours**

Text Book(s)

1	Practical Manual on Fermentation Technology by S. Kulandaivel & S. Janarthanan . Kindle Edition I K International Publishing House 2012
2	Molecular Biology Lab Manual, Julie B. Wolf, Department of Biological Sciences, UMBC IHC World ife Science Products and services
3	Cell And Molecular Biology: A Lab Manual Kindle Edition by K. V. Chaitanya (Author) Publisher: PHI

Reference Books

1	Molecular Biology: A Laboratory Manual. S.K. Gakhar, Monika Miglani, Ashwani Kumar Wiley India
2	Industrial Microbiology : A Laboratory Manual – by Mathur,N.AbeBooks

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.slideshare.net/sardar1109/practical-manual-on-molecular-biology-and-genetic-engineeringrecombinant-dna-technology
2	Experimental Biotechnology - Course – Swayam - swayam.gov.in › nd1_noc20_bt31 - INDUSTRIES SUPPORT : Biocon https://www.biocon.com/

Designed By: Dr. Maleeka Begum, Associate Professor, Dept. of Biotechnology, Sri Ramakrishna College of Arts and Science, Coimbatore

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO3	S	S	S	S	M
CO3	S	S	S	S	M
CO4	S	S	S	S	M
CO5	S	S	S	S	M

 *S-Strong; M-Medium; L-Low
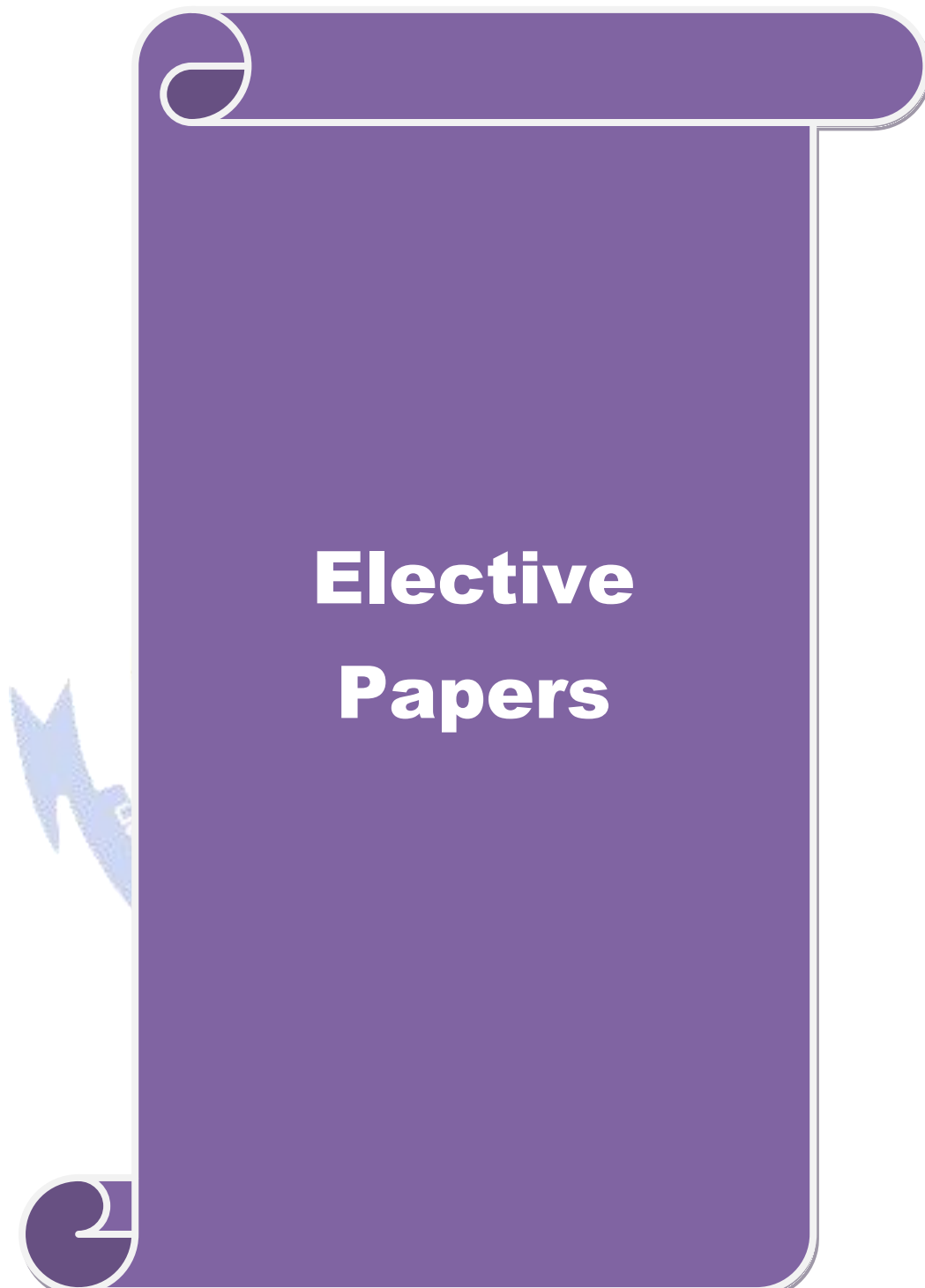
Course code	6ZD	PHARMACOLOGY	L	T	P	C
Skill Based		**Skill Based-Subject 4**	3			3
Pre-requisite		Students must know about basic knowledge about immunology/basic science in their previous semester and school level	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of this course are to:

- To make the student to understood the concept therapy.
- This Pharmacology is the study of inherited variation in drug response.
- To understand the basic steps in the drug research, toxicological, pre-clinical and clinical studies

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Compare and contrast the specific pharmacology of the major classes of drugs, important distinctions among members of each class	K1
2	Understand the medicinal and pharmaceutical importance of drug compounds	K2
3	Students acquire a basic understanding about the drug research.	K2
4	Analyze the fundamental principles of pharmacokinetics and pharmacodynamics.	K4
5	Evaluate the risks and benefits, in relation to the organ systems they affect, and the diseases for which they are used therapeutically.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	**Basics of Pharmacology**	15 hours

Pharmacology – origins and antecedents – Pharmacology in the 20th century – Drugs – Sources, dosage forms and routes of administration. Absorption, factors modifying drug absorption, distribution, metabolism – Phase I, II reactions, action of cytochrome P450

Unit:2	**Mode of Drug Reaction in Immune system and Immuno-Assay**	14 hours

Targets for drug action, receptor proteins, ion channel and drug targets, control of receptor expression, assay of drug potency: Chemical, bioassay and immunoassay-Drug tolerance and drug dependence. Principles of basic Pharmacokinetics, Adverse response to drugs, drug intolerance, drug allergy, tachyphylaxis, drug abuse, vaccination against infection, factors modifying drug action and effect.

Unit:3	**Mechanisms and Antimicrobial Drugs Against Various Diseases**	14 hours

Mechanism of action of drugs used in therapy of Respiratory systems – cough, bronchial asthma, pulmonary tuberculosis Cancer chemotherapy. Antimicrobial drugs – sulfonamide, trimethoprim, penicillins, aminoglycosides and bacterial resistance. Thyroid and anti thyroid drugs, insulin and anti diabetic drugs, anti fertility and ovulation inducing drugs.

63

Unit:4	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**45 hours**

Text Book(s)	
1	Basic and Clinical Pharmacology, Prentice Hall, International, katzung, B.G.
2	Clinical Pharmacology. Scientific book agency, Laurence, D.R and Bennet P.N.
3	Drug Interaction, Kven Stockley, Hamsten.
4	Pharmacology – 5th edition – H.P.Rang, M.M.Dale, J.M.Ritter, P.K.Moore
5	The Pharmacology, Volume I and II – Goodman and Gillman
Reference Books	
1	Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.
2	Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.
3	Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.
4	ShominiParashar, Deepa GoelIPR, Biosafety and Bioethics Pearson India 2013
5	Bioethics &Biosaftey By Sateesh Mk (2008), Ik Publishers
6	Pharmacology and Pharmacotherapeutics – R.S.Satoskar, S.D. Bhandhakam and S.S. Alinapure
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
https://www.youtube.com/watch?v=1FUhRj7xpS8	
https://www.youtube.com/watch?v=z4EZpQK9t34	
https://study.com/academy/course/introduction-to-pharmacology.html	
https://www.youtube.com/watch?v=--sqCGRij40	
Designed By: Dr. P. Ruban, Asst. Professor, Dept. of Biotechnology, SNMV College of Arts and Science, Coimbatore	

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	S	M	M	S	S
CO3	S	S	S	S	S
CO4	S	M	S	S	S
CO5	S	M	M	S	S

*S-Strong; M-Medium; L-Low

64

Elective

Papers

65

Course code	5EA	AGRICULTURAL BIOTECHNOLOGY	L	T	P	C
Elective		ELECTIVE - I (A)	4			4
Pre-requisite		Students should have studied about basic science school level.	Syllabus Version		2020-2021	

Course Objectives:

The main objective of the course is to

- understand the relationship between society and science and the justification for biotechnological manipulation of plants, animals, and microorganisms.
- acquire knowledge about the range of approaches to manipulate and improve plants, animals and microorganisms.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Explain the growth and historical perspective of agricultural biotechnology.	K1
2	The students will be provided with a firm understanding in the principles and application of agriculture biotechnology.	K2
3	Understand the importance of biofertilizers	K2
4	Analyse the current practices and production of biofertilizers.	K4
5	Create new practices in production of biofertilizers.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	AGRICULTURE BIOTECHNOLOGY RISKS AND APPLICATIONS	20 hours

Biotechnology in agriculture, growth and historical perspective of agricultural biotechnology. Agriculture biotechnology – Risks and applications. Transgenic plants resistance to biotic and abiotic stress. transgenic plants in crop improvement. Advantages and applications of transgenic plants.

Unit:2	TRANSGENIC PLANTS	20 hours

Transgenic plants in quality modifications – Starch, Oil, Protein, Golden Rice, Suppression of endogenous gene, Male sterilization. Plants derived vaccines, flower modification and colour.Targetting transgenic product to chloroplast and mitochondria.

Unit:3	BIOFERTILIZERS IMPORTANCE	18 hours

Importance of Biofertilizers in agriculture (Rhizobium,Azotobacter, Mycorrhiza, Actinorhiza) advantages and current status,vermiculture, composting, current practices and production of biofertilizers.

Unit:4	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**60 hours**

Reference Books

1	Biotechnology fundamental and application (4th edition) - S.S.Purohit.
2	Plant Biotechnology – B.D.Singh
3	Plants, Genes and agriculture by Maartein, J.Christpeels, David E.Sdava.
4	Crop Biotechnology by P.R.Yadav, Rajiv Tyagi.
5	Plant Biotechnology by Chawla. Gendel,
6	Steven M. et al (eds.) Agricultural Bioethics: Implications of Agricultural Biotechnology. Ames
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
https://www.iatp.org/sites/default/files/Applications_of_Biotechnology_to_Crops_Benefit.htm	
https://en.wikipedia.org/wiki/Genetically_modified_plant	
https://en.wikipedia.org/wiki/Biofertilizer	
Designed By: M.Raghunath, Asst. Professor, Dept. of Biotechnology, KSG College of Arts and Science,Coimbatore.	

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	L	L	L	L
CO2	M	S	M	M	M
CO3	S	M	M	S	S
CO4	S	M	M	S	S
CO5	S	S	S	S	S

*S-Strong; M-Medium; L-Low

67

Course code	5EB	BIOREMEDIATION	L	T	P	C
Elective		ELECTIVE - I (B)	4			4
Pre-requisite		This course is open to students having background in Science at school level and previous semesters.	Syllabus Version		2020-2021	

Course Objectives:

- Demonstrate an understanding of the nature and importance of bioremediation. Understand the influence of contaminant characteristics to bioremediation.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Explain the definition of bioremediation.	K1
2	To Understand the bioreactors for remedial processes.	K2
3	To describe the various phytoremediation processes.	K2
4	To Create biotechniques for air pollution.	K6
5	To Analyze Biodegradation of xenobiotics.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	BIOREMEDIATION	10 hours

Bioremediation: Definition - constraints and priorities of bioremediation. Bioaugmentation; bioreactors for remedial processes, types of bioremediation- in situ & ex situ.
Bioremediation of heavy metals: Microorganisms for ore concentration and leaching. Reclamation of mine sweepings - Biosorption and bioleaching. Heavy metal elimination from sewage water and effluents – Biotechnological approaches.

Unit:2	PHYTOREMEDIATION	20 hours

Phytoremediation –Definition, various phytoremediation processes, example of phytoextractrion from soil, hyper accumulators and biotic interaction. Mycoremediation: Definition, Rhizofiltration, Mycorrhizal associations, Mycofiltration.

Unit:3	XENOBIOTIC COMPOUNDS	18 hours

Xenobiotic compounds: Recalcitrance – hazardous wastes – disposal of radioactive wastes. Biodegradation of xenobiotics - Biological detoxification; Biodegradation of DDT, BHC and malathion in soil, plants and insects. Biotechnological methods for hazardous waste management. Biotechniques for air pollution abatement and odor control: Deodorization process, application.

Unit:4	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	60 hours

Reference Books

68

1	Environmental Science & Technology- Stanley E. Manahan
2	Introduction to Environmental Biotechnology- A K Chatterjii
3	Environmental Biotechnology- S N Jogdand

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://en.wikipedia.org/wiki/Bioremediation

https://www.sciencedirect.com/topics/earth-and-planetary-sciences/phytoremediation

https://www.biologydiscussion.com/microbiology-2/bioremediation/xenobiotic-compounds-meaning-hazards-and-biodegradation/55625

Designed By: Mr. M. Raghunath, Asst. Professor, Dept. of Biotechnology, KSG College of Arts and Science,Coimbatore.

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	L	M	M
CO2	S	M	L	M	M
CO3	S	M	M	M	M
CO4	S	S	M	M	L
CO5	S	S	L	L	L

*S-Strong; M-Medium; L-Low

69

Course code	5EC	INTRODUCTION TO BIOINFORMATICS	L	T	P	C
Elective		ELECTIVE – I (C)	4			4
Pre-requisite		Students must have basic knowledge on computer and biomolecules.	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are :
- To teach about organizing vast reams of Molecular Biology data in an efficient manner
- To make understand the tools development that aid in maintaining molecular data

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate the concepts in computational Biology	K1
2	Understand the interrelationship between Biology, Computer and mathematics	K2
3	Apply the knowledge on existing software effectively to extract information from large databases and to use those information in computer modeling	K3
4	Analyze the molecular data using insilico tools	K4
5	Think critically and get motivated to do higher studies to develop evaluation skills in bioinformatics	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Introduction to Bioinformatics	20 hours

Introduction and history of bioinformatics – Internet, World Wide Web, Web browser, EMB net, NCBI. File transfer protocol. Database browsers and search engines. Introduction to MS access, making queries, Designing forms and Report design

Unit:2	Databases	20 hours

Database- Definition, DBMS, Biological Databases – FASTA, Blast, Genbank, DNA sequence databases, Protein databases. Entry formats, carbohydrate databases, Enzyme databases, Pathway databases. Relational database model. Theory on RDBMS. SQL.

Unit:3	Application of Bioinformatics	18 hours

Application aspects – gene prediction, target searching – drug designing – E- cell, phylogenetic analysis, PERL, Chemoinformatics.

Unit:4	Contemporary Issues	2 hours
	Expert lectures, online seminars – webinars	
	Total Lecture hours	**60 hours**

Text Book(s)

1	Bioinformatics for the beginners K.Mani & N.vijayaraj
2	Proteomics- Pennigton & Dunn (2002) Viva books publishers, New Delhi

70

3	Bioinformatics- A practical guide to the analysis of genes & protein 2nd ED Andreas, Baxevanis and Francis Ouellette.
4	The internet (1999) Christian Crumlish. BPB publications.
Reference Books	
1	Introduction to Bioinformatics T.K.Altwood, D. J. Parry-smith (2004).Pearson Education

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.mooc-list.com/course/whole-genome-sequencing-bacterial-genomes-tools-and-applications-coursera

https://www.mooc-list.com/course/vvedenie-v-bioinformatiku-introduction-bioinformatics-coursera

https://www.mooc-list.com/course/bioinformatic-methods-ii-coursera

https://www.coursera.org/learn/bioinformatics-pku

Designed By: **Mr. P.DHEEBAN SHANKAR, Asst. Professor, Dept. of Biotechnology, Nandha Arts and Science College,Erode-52,TN**

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	L
CO2	S	M	S	M	L
CO3	S	S	S	S	L
CO4	S	S	S	M	M
CO5	S	S	S	M	L

*S-Strong; M-Medium; L-Low

71

Course code	6EA	MEDICAL BIOTECHNOLOGY	L	T	P	C
Elective		**ELECTIVE - II (A)**	**5**		**-**	**3**
Pre-requisite		Students must know about basic knowledge about Medical Biotechnology /basic science in their previous semester and school level.	**Syllabus Version**		2020-2021	

Course Objectives:

- Deep understanding of advantages and hazards of microbial world. Advanced knowledge for growth and control micro organisms for wealth production.
- To give students a solid foundation in biology and chemistry.
- To develop analytical and critical thinking skills in biological phenomena through scientific methods.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	To remember the role of biotechnology in healthcare.	K1
2	To understand the worldwide market and work in medical biotechnology.	K2
3	To describe the pharming for human proteins and neutraceuticals.	K2
4	To analyze the diagnosis and prediction of disorders.	K4
5	Evaluate the recent developments in medical biotechnology.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	MEDICAL BIOTECHNOLOGY TOOLS	25 hours

Tools of Medical Biotechnology – Biotechnological revolutions- Genomics, combinatorial chemistry, insight into basic biology-Areas of application, Diagnosis and prediction of disorders, Limits and approaches.

Unit:2	MEDICAL BIOTECHNOLOGY ROLE	22 hours

Role of biotechnology in healthcare. Worldwide market and work in medical biotechnology. Vaccine Production-New developments. Biosensors in clinical diagnosis, chiral technology, monoclonal antibodies for immunotherapy.

Unit:3	MEDICAL BIOTECHNOLOGY APPLICATION	23 hours

Recent developments in medical biotechnology –Pharming for human proteins and nutraceuticals. Tissue engineering and therapeutic cloning, Application of nanotechnology in biomedical sciences- Green anaosubstances, gene delivery, drug delivery. Nanotechnology in replacing defective cells.

Unit:4	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**72 hours**

Reference Books

1	Fundamentals of medical biotechnology by Aparna Rajagopalan, Ukaaz publications.

72

2	Medical biotechnology by S.N.Jogdand, Himalaya publications.
3	Medical Microbiology- Mackie and Mc Cartney

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.toppr.com/guides/biology/biotechnology-principles-and-process/tools-of-biotechnology/

https://byjus.com/biology/application-biotechnology-medicine/

https://www.slideshare.net/aiswaryababunaishu/applications-of-medical-biotechnology

Designed By: M.Raghunath, Assistant Professor, KSG College of Arts and Science, Coimbatore.

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	S
CO2	S	S	M	M	S
CO3	S	S	S	S	S
CO4	S	S	S	M	S
CO5	S	S	S	L	L

*S-Strong; M-Medium; L-Low

73

Course code	6EB	BIOTECHNOLOGICAL APPROACH FOR WASTE WATER TREATMENT	L	T	P	C
Elective		Elective II (B)	5			3
Pre-requisite		Students must know about basic knowledge about waste water /basic science in their previous semester and school level	Syllabus Version		2020-2021	

Course Objectives:
Students will gain knowledge on waste water treatment and its procedure.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire skills on handling domestic and industrial waste water	K1
2	Understand the different levels of waste water treatment	K2
3	Become employable in ETP lab and pollution control board	K3
4	Analyze the parameters before and after treating waste water	K3
5	Apply knowledge in designing effluent treatment plant for the dyeing industries	K4, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Introduction to waste water treatment	25 hours

Historical introduction to water and waste water environment. Domestic and industrial waste water flow rate and characteristics. Design of waste water network, waste water treatment process. Waste water pretreatment – screenings, grit channels, filtration and equalization, primary treatment-chemically enhanced primary sedimentation, sludge quantity from primary settlings.

Unit:2	Wastewater Treatment	22 hours

Secondary Treatment – Biological treatment of waste water, secondary treatment systems, filtration, sludge settlement parameters. Nitrification and denitrification. Activated sludge systems – Complete mix, plug flow reactors, attached growth systems. Nutrient removal – Biological nutrient removal. Nitrification combined biological phosphorus and nitrogen removal.

Unit:3	Wastewater Process	23 hours

Secondary classification, advanced treatment process – Granular media filtration, Absorption, Chemical treatment, Air stripping and ammonia removal. Waste water disinfectant. Diffuses from waste water – plume flow, design. Treatment of waste water in Food processing, Paper, Sugar and Leather industry.

Unit : 4		2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Text book of environmental biotechnology by Pradeep Kumar Mohaptra.
2	Environmental Biotechnology by Alan.Scragg.
3	Industry Microbiology by Patel.

Reference Books

74

1	Environmental Engineering by Gernardhily.
2	Biotechnology fundamentals and application by S.S.Purohit
3	Waste Water Engineering Treatment and Disposal and Reuse by Metcalf and Eddy.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	

SWAYAM: https://onlinecourses.nptel.ac.in/noc20_ce57/preview
SWAYAM: https://onlinecourses.swayam2.ac.in/nou20_ag12/preview
SWAYAM : https://onlinecourses.swayam2.ac.in/cec20_ge24/preview
https://www.safewater.org/fact-sheets-1/2017/1/23/wastewater-treatment
https://www.veoliawatertechnologies.co.uk/technologies/filtration-water-treatment
Designed By: Dr. N. Saranya, Assistant Professor, Nehru Arts and Science College, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	M	M	M	M
CO2	M	S	M	M	M
CO3	M	M	S	S	S
CO4	M	S	S	S	S
CO5	M	S	L	L	M

*S-Strong; M-Medium; L-Low

75

Course code	6EC	GENOMICS	L	T	P	C
Elective		ELECTIVE – II (C)	5		-	3
Pre-requisite		Students must have basic knowledge on Biological databases	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:
- Understand the genome organization, function and comparative study with other organisms
- Acquire knowledge on genome sequencing and mutation study

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain information on next generation sequencing tools and next generation mapping portals	K1
2	Understand the stages of genes expression, genome projects and genomic databases	K2
3	Acquire skills in managing and processing Omics data	K3
4	Obtain and analyse information and data relating to genes using specific organism databases	K4
5	Validate appropriate knowledge and skills in the area of Biological sciences	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Introduction to genome databases	25 hours

Introduction to genome databases - database search - Algorithms issues in databases search - sequence database search - FASTA - BLAST – Types of genomic databases and uses: Polymorphic markers, Cytogenic Maps, LINE, SINE- Amino acid substitution matrices PAM and BLOSUM.

Unit:2	Gene therapy, gene expression and Sequencing	22 hours

Gene Therapy: Concept and Principles of Gene Therapy. Principles of gene Expression - Genome Mapping –physical and genetic mapping techniques, Human Genome Project - Genomes of other organisms. Shotgun DNA sequencing - Sequence assembly - Gene predictions - Molecular prediction with DNA strings.

Unit:3	Genome analyzing Tools	23 hours

Genomic resources, Gene structure and DNA sequences. EST comparison, gene hunting. Expression analysis- SAGE, cDNA library, ORF prediction, Microarray – DNA sequencing and sequence alignment: RFLP, SNP, RAPD, Application of Comparative Genomics.

Unit:4	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**72 hours**

76

	Text Book(s)
1	Introduction to bioinformatics by Dr. Mani and Dr. Vijayaraj.
2	Bioinformatics by Parry and Smith.
3	Genomes 3 by T. A. Brown.
4	Introduction to bioinformatics by Dr. Mani and Dr. Vijayaraj.
	Reference Books
1	Bioinformatics by David Mount.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.coursera.org/learn/genomics-research

https://www.coursera.org/learn/comparing-genomes

https://www.mooc-list.com/course/whole-genome-sequencing-bacterial-genomes-tools-and-applications-coursera

SWAYAM: https://onlinecourses.nptel.ac.in/noc20_bt19/preview   (Proteogenomics)

SWAYAM: https://onlinecourses.nptel.ac.in/noc20_bt40/preview   (Functional genomics)

Designed By: **Mr. P.DHEEBAN SHANKAR, Asst. Professor, Dept. of Biotechnology, Nandha Arts and Science College,Erode-52,TN**

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	M
CO2	S	S	M	M	M
CO3	S	S	S	M	M
CO4	S	S	M	M	M
CO5	S	S	S	L	M

*S-Strong; M-Medium; L-Low

77

Course code	6ED	INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
Elective		ELECTIVE - III (A)	5		-	3
Pre-requisite		This course is open to students having background in Science at school level and previous semesters.	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are:

- To make the students learn about the fermentation, fermentor and production fermented foods

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Increase their understanding that industrial biotechnology is based on using machines to control the growth of microorganisms	K2
2	Acquire basic theoretical skills on operating fermentor under various parameters	K3
3	Exemplify the production of alcoholic beverages and organic acids	K3
4	Analyze the potential business opportunities in fermentation-based biotechnology	K4
5	Become innovative in search of new microbes for microbial product production	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Fermenter	25 hours

Fermenter- batch and continuous fermenter, general design of a stirred tank fermenter, sterilization and maintenance of sterile conditions, preparation of inoculum. Types of fermentation- solid state fermentation- tray and drum, and submerged fermentation- batch and fed batch Media used for industrial fermentation.

Unit:2	Microbial production and product recovery	22 hours

Microbial production and product recovery - Alcoholic beverage- wine and beer Production of vinegar from alcohol, production of vitamin-B 12, production of organic acid- lactic acid and glutamate.

Unit:3	Fermented dairy products	23 hours

Fermented dairy products- microorganisms involved in fermentation, yogurt, curds, sour cream, cheese paneer, pickles, idly, single cell protein.

Unit:4	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Mather and Barnes, **Methods in Cell Biology**, Academic Press, 1998.
2	Butler, **Mammalian Cell Biotechnology: A Practical Approach**, Oxford UNI Press, 1991.
3	Chawla, **Introduction to Plant Biotechnology**, Oxford and IBH Publishers, 2nd Edition, 2003

Reference Books

1.	Industrial Microbiology, Prescot and Dunn,
2.	Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Marituna,F., The Nature Press, Macmillan Publ.Ltd.
3.	Biochemical Engineering Fundamentals, Bailey &Olis.MGH.
4.	Text book of Biotechnology – Plant Biotechnology and industrial biotechnologyby
5.	S.B. Sullia, G. Siva Kumar Swami, P.A. Sastry- United publishers

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
SWAYAM: https://onlinecourses.nptel.ac.in/noc20_bt21/preview (Industrial Biotechnology)
https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/product-recovery
https://dairyprocessinghandbook.tetrapak.com/chapter/fermented-milk-products
Designed By: Dr. N. Saranya , Asst. Professor, Nehru Arts and Science College, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	M	S	S	M
CO3	S	M	S	S	S
CO4	S	S	S	S	S
CO5	S	S	M	S	M

*S-Strong; M-Medium; L-Low

Course code	6EE	BIOETHICS & BIOSAFETY	L	T	P	C
Elective III		Elective III (B)	5	-		3
Pre-requisite		This course is open to students having background in Science at school level and previous semesters.	Syllabus Version		2020-2021	

Course Objectives:

The main objectives of this course are to:

- The course has been designed to sensitize students about the significance of biotechnological products and awareness of genetically engineered organisms
- To know the general biosafety rules and different biosafety levels.
- The course further aims to make students aware about the ethical issues involving biological material.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Distinguish knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations.	K1
2	Analyze ethical aspects related to biological, biomedical, health care and biotechnology research	K4
3	Awareness education on genetically engineered organism	K2
4	Evaluate the levels and their impact on Environment	K5
5	Understand the Ethics in clinical trials and Good Clinical Practices	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Basics of Ethics in Biotechnology	25 hours

Definition of ethics and Bioethics, Ethics in Biotechnology-positive and negative effects with classical examples – Rice with Vitamin A, No-till Agriculture, cotton without insecticide, reduced need for fertilizer, biological pest control, slow ripening fruits and controlled ripening, fast growing trees and fishes.

Awareness education on genetically engineered organism. Transgenic instability, gene flow, resistance/ tolerance of target organism, increase weedlessness, risks and uncertainty associated with Biotechnology.

Unit:2	Impact of Environmental Containments and GLP	22 hours

Containment levels and their impact on Environment- Containment- definition, types of containment, summary of recommended Biosafety levels for infectious agents, detail checklist – premises and lab equipment, Animal facilities, environment. Gene technology laboratory.

GLP and Bioethics- introduction, national Good Laboratory Practices (GLP), the GLP authority functions, Good Laboratory Practices- necessity, aspiration and responsibility.

Unit:3	Ethics In Clinical Trials and Good Clinical Practices in Biotechnology	23 hours

Ethics in clinical trials and Good Clinical Practices (GCP) – Definition of clinical trials and GCP, general information about clinical trials, need to conduct clinical trials, faces of clinical trials, institutional set ups for conducting clinical trials, ethics in clinical Biotechnology.

Unit:4	Contemporary Issues	2 hours
Expert lectures, online seminars – webinars		

	Total hours	72 hours

Text Book(s)

1	Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, India
2	M K Sateesh. Bioethics and Biosafety. Kindle Edition
3	Safety Assessment by Thomas, J.A., Fuch, R.L. (2002), Academic Press

Reference Books

1	Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.
2	Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.
3	Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.
4	ShominiParashar, Deepa GoelIPR, Biosafety and Bioethics Pearson India 2013
5	Bioethics &Biosaftey By Sateesh Mk (2008), Ik Publishers

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.longdom.org/open-access/biosafety-issues-of-genetically-modified-organisms-2167-0331.1000e150.pdf

https://journals.sagepub.com/doi/pdf/10.1177/153567601301800404

https://www.who.int/tdr/publications/documents/glp-handbook.pdf

https://www.who.int/medicines/areas/quality_safety/safety_efficacy/gcp1.pdf

Designed By: Dr. P. Ruban, Asst. Professor, Dept. of Biotechnology, SNMV College of Arts and Science, Coimbatore

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	M	S	S	S
CO3	S	S	M	S	S
CO4	S	S	M	L	S
CO5	S	M	M	M	S

*S-Strong; M-Medium; L-Low

81

Course code	6EF	PROTEOMICS	L	T	P	C
Elective		**ELECTIVE – III (C)**	5			3
Pre-requisite		Students must have basic knowledge on protein databases	**Syllabus Version**		2020-2021	

Course Objectives:

The main objectives of this course are to:
- Understand the protein databases and interactions
- Gain knowledge on qualitative and quantitative proteomics

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquire skills on protein databases and their retrieval	K1
2	Able to interpret the protein interactions	K3
3	Identify and investigate the structure of protein	K4
4	Know the Evaluation of mass of the protein	K5
5	Develop analytical skills in identifying new proteins thereby interpreting with databases	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Protein databases	23 hours

Protein databases: CATH, SCOP, FSSP, SARF, MMDB. Protein structure and comparison, Blocks, Class, Domain, Fold, Profile, Motif and PSSM.

Unit:2	Structural Proteomics	22 hours

Structural Proteomics: Experimental Techniques for Protein Structure Elucidation, X-ray Crystallography, 2-D Electrophoresis- Sample preparation, pH gradient- MALDI-TOF, Electroplot, Protein Microarray and Bioseparation.

Unit:3	Metabolomics	25 hours

Metabolomics: Understanding the Metabolic Pathways of Microbes, metabolic pathway databases-KEGG. Structure prediction, active site determination, neural networks. Protein – protein interaction, protein – DNA interaction. Enzyme – Substrate interaction. Applications of Proteomics: Plant breeding and Biomedical.

Unit:4	Contemporary Issues	2 hours

Expert lectures, online seminars – webinars

	Total Lecture hours	**72 hours**

Text Book(s)

1	Proteomics- Pennigton & Dunn (2002) Viva books publishers, New Delhi
2	Bioinformatics- A practical guide to the analysis of Genes & Protein 2nd ED Andreas, Baxevanis and Francis Ouellette.

Reference Books
1   Bioinformatics by David Mount.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
SWAYAM: https://onlinecourses.nptel.ac.in/noc20_bt20/preview (Introduction to proteomics)
https://www.sciencedirect.com/topics/medicine-and-dentistry/metabolomics
http://www.premierbiosoft.com/tech_notes/mass-spectrometry.html
https://www.sciencedirect.com/topics/neuroscience/two-dimensional-gel-electrophoresis
Designed By: **Mr. P.DHEEBAN SHANKAR, Asst. Professor, Dept. of Biotechnology, Nandha Arts and Science College,Erode-52,TN**

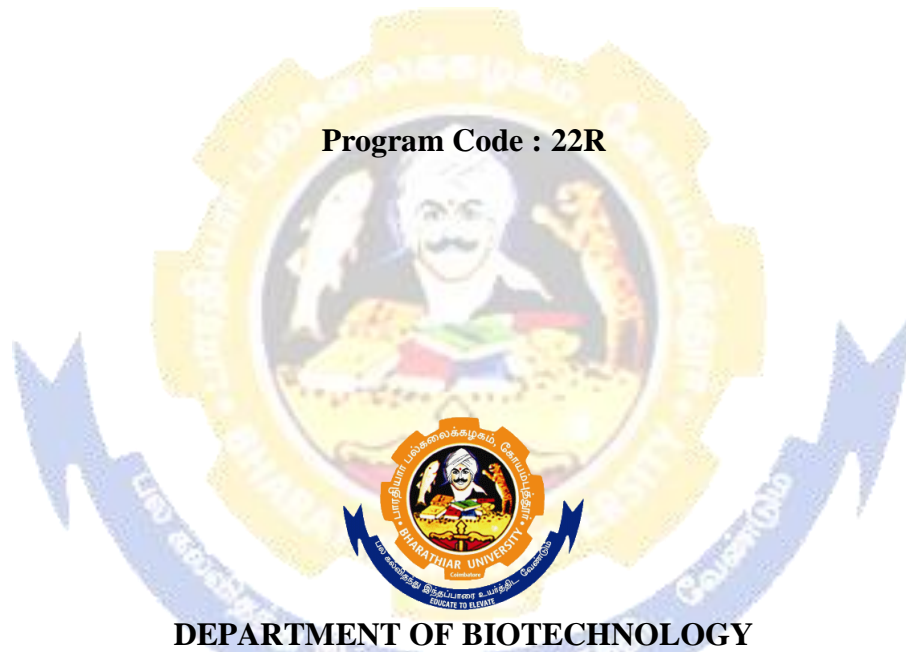| Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	M
CO2	S	S	M	M	M
CO3	S	M	M	M	M
CO4	S	M	M	M	M
CO5	S	M	M	M	S

*S-Strong; M-Medium; L-Low
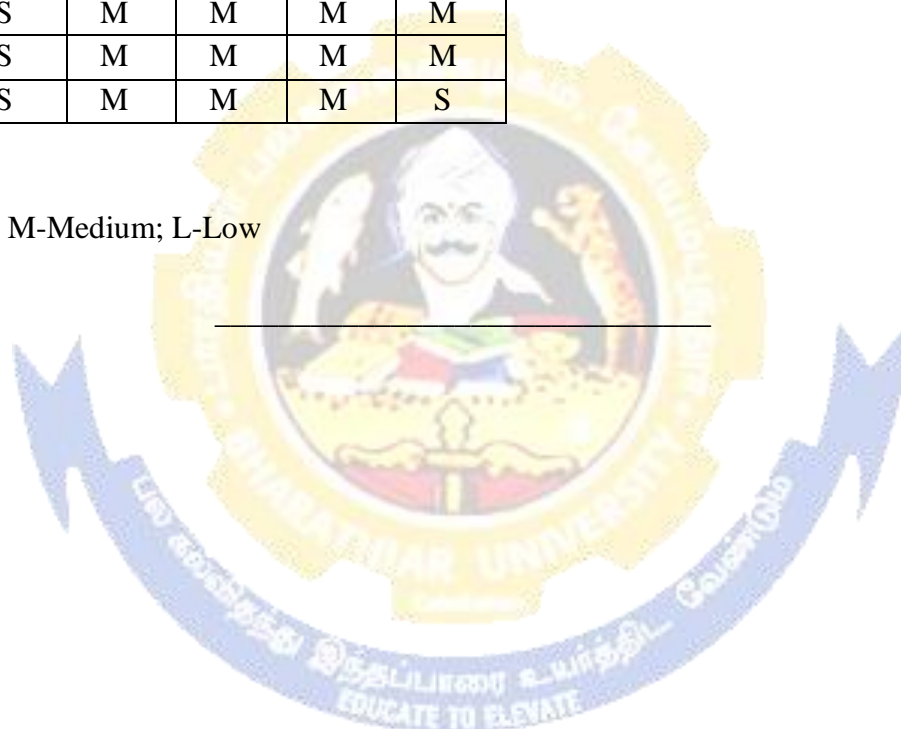
ANNEXURES

B.Sc. Biotechnology
Affiliated Colleges of Bharathiar University

Syllabus
(With effect from 2020-2021)

Program Code : 22R

DEPARTMENT OF BIOTECHNOLOGY
BHARATHIAR UNIVERSITY
(A State University, Accredited with "A" Grade by NAAC and
13th Rank among Indian Universities by MHRD-NIRF)
**Coimbatore 641 046, INDIA**

85

BHARATHIAR UNIVERSITY, COIMBATORE- 641046
DEPARTMENT OF BIOTECHNOLOGY

VISION

To proffer outcome-based education in terms of developing eminent skills and intellectuals with highly competent in fundamental and applied aspects of biology and nourish confidence to become employable and survival in the society.

MISSION

Contribute quality teaching and learning by modern pedagogy with enhancements in practical and entrepreneurial skills enabling the students on empowered knowledge to meet global standard in biotechnology and to encounter the current and future requirements of biotechnological industries.

86
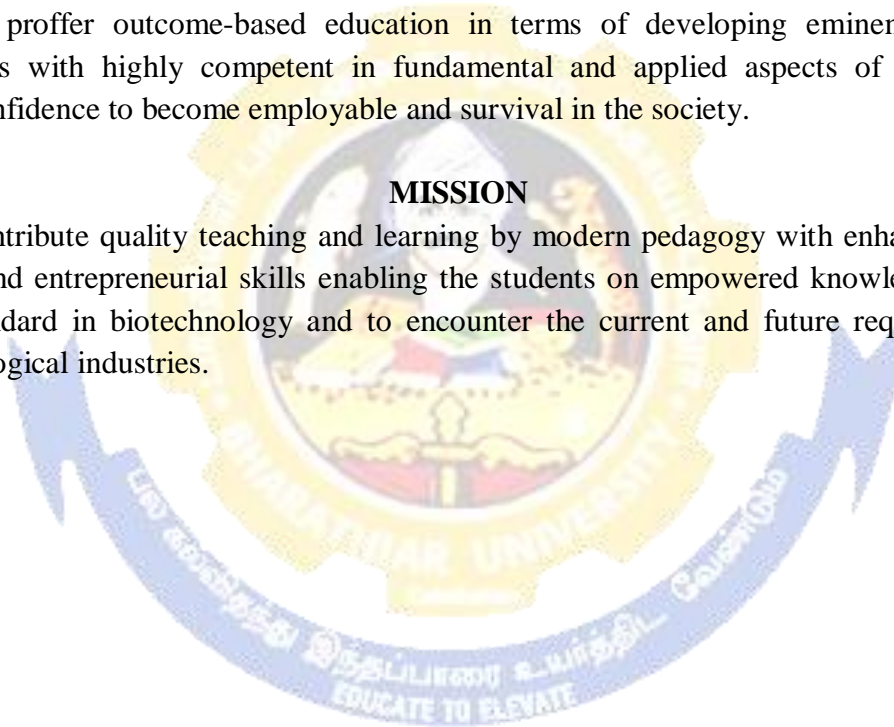
		Value added courses/ Job oriented Certificate courses	Optional
		UGC-SWAYAM online /MOOC's courses	Optional

Note : Subject code to be cross verified especially for allied Maths and Computer Courses

@ No University Examinations. Only Continuous Internal Assessment (CIA) #   No Continuous Internal Assessment (CIA). Only University Examinations.

List of Elective papers* (Colleges can choose any one of the paper as elective)		
Elective – I	A	Agricultural Biotechnology
	B	Bioremediation
	C	Introduction to Bioinformatics
Elective – II	A	Medical Biotechnology
	B	Biotechnological approach for waste water treatment
	C	Genomics
Elective – III	A	Industrial Biotechnology
	B	Bioethics & Biosafety
	C	Proteomics

*Elective papers as listed above or any other new elective can be added based on the need, which can be approved by the University authorities.