



AVS

COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)

Attur Main Road, Ramalingapuram, Salem - 106.

(Recognized under section 2(f) & 12(B) of UGC Act 1956 and
Accredited by NAAC with 'A' Grade)

(Co - Educational Institution | Affiliated to Periyar University, Salem
ISO 9001 : 2015 Certified Institution)

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Syllabus for

B. Sc BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM –

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK

(CBCS – LOCF)

(Applicable to the Candidates admitted from 2023-24 onwards)



VISION

- To attain excellence in the field of education by creating competent scholars with a touch of human values.

MISSION

- To accomplish eminence in the academic domain.
- To provide updated infrastructure.
- To educate value based education.
- To impart skills through efficient training programs.
- To cultivate culture and tradition with discipline and determination.



REGULATIONS

1. Eligibility for Admission:

To get admission in a UG biotech course, an aspirant should have passed Grade XII with at least 50% in aggregate in five subjects and must have studied Physics, Biology, Mathematics shall be Eligible for admission into B.Sc., course in Biotechnology.

2. Duration:

The course for the degree of Bachelor of Science shall consist of three academic years divided into six semesters.

3. Eligibility for award of degree:

Any student who has earned his/her undergraduate degree in BSc in any specialization with a Minimum of 50% marks passed examinations.

4. Course of Study:

Biotechnology is a multidisciplinary field that deals with the usage of biological processes for Solving problems and making eco-friendly products. Biotechnology is a field of Biological Science and Technology, candidates are taught various subjects such as Chemistry, Biology and Information Technology.

5. Scheme of Examination:

Regular class tests will be held in all subjects in the month of November.

Mid-term Examination will be held in all subjects in the month of November.

The Test Examination of Part – I candidates will be held in the month of March.

Students must appear and qualify Test/Selection Examination, failing that they would not be allowed to appear in the University Examination.

For students of the second and third year the same scheme of evolution will be followed.

6. Passing Rules:

In case of a subject involving practical work a candidate must obtain 33% marks in theory and 33% marks in practical separately in addition to 33% marks in aggregate in order to qualify in that subject

i) Theory

Written Examination for each subject is conducted for 60 marks with duration of 3 hours.

Students have to secure a minimum of 24 marks (40%) out of 60 in End Semester Examination and a total of 40(CIA+ESA) marks out of 100 marks to pass in every subject.



ii) Practical

Practical Examination for each subject is conducted for 30 marks with duration of 3 Hours. Students have to secure a minimum of 12 marks (40%) out of 30 in End Semester Practical Examination and a total of 20(CIA+ESA) marks out of 50 marks to pass in every subject.

Programme Outcomes (POs)	
On successful completion of the B. Sc Biotechnology	
PO1	Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study
PO2	Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
PO4	Critical thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development
PO5	Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
PO6	Analytical reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing 3 viewpoints.
PO7	Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experimenter investigation
PO8	Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team
PO9	Reflective thinking: Critical sensibility to lived experiences, with self awareness and

	reflexivity of both self and society.
PO10	Self-directed learning: Ability to work independently, identifies appropriate resources required for a project, and manages a project through to completion.

Program Specific Outcomes (PSOs)

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

PSO1	Disciplinary Knowledge: Understand the fundamental principles, concepts, and theories related to biotechnology. Also, exhibit proficiency in performing experiments in the laboratory.
PSO2	Critical Thinking: Analyze complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively.
PSO3	Problem Solving: Employ theoretical concepts and critical reasoning 5 ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities.
PSO4	Analytical & Scientific Reasoning: Apply scientific methods, collect and analyze data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models
PSO5	Research related skills: Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects.
PSO6	Self-directed & Lifelong Learning: Set learning goals, manage their own learning, reflect on their learning, adapt to new contexts, seek out new knowledge, collaborate with others and to continuously improve their skills and knowledge, through ongoing learning and professional development, and contribute to the growth and development of their field.



Programme Educational Objectives (PEOs)

The B. Sc Biotechnology programme describes accomplishments that graduates are expected to attain within five to seven years after graduation.

PEO1	To impart advanced theoretical and practical knowledge in Biotechnology and allied fields.
PEO2	To provide domain knowledge and expertise for successful career in academics, research and industry.
PEO3	To develop ethically and socially responsible professionals with leadership and entrepreneurship skills
PEO4	To provide skills of observations and drawing logical inferences from the scientific experiments.
PEO5	To develop a working knowledge of biotechnology product and processes.


CREDIT DISTRIBUTION FOR 3 YEARS B. Sc BIOTECHNOLOGY PROGRAMME

3–Year UG Programme			
Credits Distribution			
		No. of Papers	Credits
Part I	Tamil (3Credits)	4	12
Part II	English(3Credits)	4	12
Part III	Core Courses (4Credits)	15	68
	Elective Courses: Generic Discipline Specific(3Credits)	8	24
Total			116
Part IV	NME(2 Credits)	2	4
	Skill Enhancement Courses	5	9
	Skill Enhancement Courses	1	2
	Professional Competency Skill Enhancement Course	1	2
	EVS(2Credits)	1	2
	Value Education(2Credits)	1	2
Total			21
Summer internship			2
Part V	Extension Activity(NSS/ NCC/Physical Education)		1
Total Credits for the UG Programme			140

**CONSOLIDATED SEMESTER WISE AND COMPONENT WISE CREDIT
DISTRIBUTION FOR 3 YEARS B. SC BIOTECHNOLOGY PROGRAMME**

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	3	6	4	2	23
Part V	-	-	-	-	-	1	1
Total	23	23	22	25	26	21	140

*Part I, II and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programmes and the other components IV and V have to be completed during the duration of the programmes as per the norms, to be eligible for obtaining the UG degree.

METHOD OF EVALUATION

Evaluation	Components	Marks
Internal Evaluation	Continuous Internal Assessment Test	15
	Assignments	3
	Class Participation	2
	Distribution of marks for Attendance (in percentage) 96 – 100: 5 Marks 91 – 95: 4 Marks 86 – 90: 3 Marks 81 – 85: 2 Marks	5
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks

Note: 1.UG Programmes- A candidate must score minimum 10 marks in Internal and 30 marks in External Evaluation.

2. PG Programmes- A candidate must score minimum 13 marks in Internal and 38 marks in External Evaluation.

CONTINUOUS INTERNAL ASSESSMENT

Categorizing Outcome Assessment Levels Using Bloom's Taxonomy

level	Cognitive Domain	Description
K1	Remember	It is the ability to remember the previously learned concepts or ideas.
K2	Understand	The learner explains concepts or ideas.
K3	Apply	The learner uses existing knowledge in new contexts.
K4	Analyze	The learner is expected to draw relations among ideas and to compare and contrast.
K5	Evaluate	The learner makes judgments based on sound analysis.
K6	Create	The learner creates something unique or original.

Question Paper Blue Print for Continuous Internal Assessment- I& II

Duration: 2 Hours		Maximum: 50 marks					
Section	K level						Marks
	K1	K2	K3	K4	K5	K6	
A (no choice)	10						10 X 1 =10
B (no choice)		1	1				2 X 5 =10
C (either or choice)				3			3 x 10 = 30
Total							50 marks

Note: K4 and K5 levels will be assessed in the Model Examination whereas K5 and K6 Levels will be assessed in the End Semester Examinations.

Question Paper Blue Print for Continuous Internal Assessment- I

Time: 2 Hours

Total Marks: 50 Marks

Minimum Pass: 20 Marks

Unit	Section - A	Section - B	Section - C
I	Q.N. 1, 2, 3, 4, 5	Q.N. 11	Q.N. 13 A, 13 B
I or II	-	-	Q.N. 14 A, 14 B
II	Q.N. 6, 7, 8, 9, 10	Q.N. 12	Q.N. 15 A, 15 B

SECTION – A (10 X 1 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – C (3 X 10 = 30 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)

Question Paper Blue Print for Continuous Internal Assessment- II

Time: 2 Hours

Total Marks: 50 Marks

Minimum Pass: 20 Marks

Unit	Section - A	Section - B	Section - C
III	Q.N. 1, 2, 3, 4, 5	Q.N. 11	Q.N. 13 A, 13 B
III or IV	-	-	Q.N. 14 A, 14 B
IV	Q.N. 6, 7, 8, 9, 10	Q.N. 12	Q.N. 15 A, 15 B

SECTION – A (10 X 1 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ALL THE QUESTIONS

SECTION – C (3 X 10 = 30 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)

Question Paper Blue Print for Model Examination & End Semester Examination

Duration: 3 Hours		Maximum: 75 marks						
Section	K level						Marks	
	K1	K2	K3	K4	K5	K6		
A (no choice, three questions from each unit)		15						15 X 1 =15
B (choice, one question from each unit)			1	1				2 X 5 =10
C (either choice & questions each unit) or two from	<i>Courses with K4 as the highest cognitive level</i>				4	1		5 x 10 = 50
	<i>Course with K5 as the highest cognitive level wherein three K4 questions and two K5 questions are compulsory.</i>				3	2		
	<i>Course with K6 as the highest cognitive level wherein two questions each on K4, K5 and one question on K6 are compulsory.</i>				2	2	1	
Total								75 marks



Question Paper Blue Print for Model Examination & End Semester Examination

Time: 2 Hours

Total Marks: 75 Marks

Minimum Pass: 30 Marks

Unit	Section - A	Section - B	Section - C
I	Q.N. 1, 2, 3	Q.N. 16	Q.N. 21 A, 21 B
II	Q.N. 4, 5, 6	Q.N. 17	Q.N. 22 A, 22 B
III	Q.N. 7, 8, 9	Q.N. 18	Q.N. 23 A, 23 B
IV	Q.N. 10, 11, 12	Q.N. 19	Q.N. 24 A, 24 B
V	Q.N. 13, 14, 15	Q.N. 20	Q.N. 25 A, 25 B

SECTION – A (15 X 1 = 15 Marks)

ANSWER ALL THE QUESTIONS

SECTION – B (2 X 5 = 10 Marks)

ANSWER ANY TWO QUESTIONS

SECTION – C (5 X 10 = 50 Marks)

ANSWER ALL THE QUESTIONS (Either or Choice)



Question Paper Blue Print for Model Practical Examination & End Semester Examination (Practical)

Time: 3 Hours

Total Marks: 60 Marks

Minimum Pass: 24 Marks

Practical Marks	Maximum Mark	Minimum Mark
Internal	40	16
External	60	24
Total	100	40

Evaluation for End Semester Examinations (Practical)

Record	10 marks
Formula with expansion	05 marks
Observation with data	20 marks
Viva-voce	05 marks
Calculation	15 marks
Result with units	05 marks
TOTAL	60 MARKS

*Submission of record with due certification is a must for external practical examinations.

**A student should complete all requires experiments to get 10 marks for the record.

Scheme of Examination for B. Sc Biotechnology

First Year – Semester - I

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UFTA01	Podhu Tamil-I	6	3	25	75	100
II	23UFEN01	General English - I	6	3	25	75	100
III	23UBTCT01	Core I - Cell and Developmental Biology	4	4	25	75	100
	23UBTCT02	Core II - Molecular biology	3	3	25	75	100
	23UBTDE01	Elective Dicipline I - Biological chemistry	3	3	25	75	100
	23UBTCP01	Core practical I - Cell and Molecular Developmental Biology and biological chemistry	4	3	40	60	100
IV	23UBTFC01	Skill Enhancement - Mushroom cultivation technology	2	2	25	75	100
	23UTANE01	Non Major Elective Course - Pechukalai Thiran	2	2	25	75	100
Total			30	23	215	585	800

* Non major elective: Choose any one from the other department

First Year – Semester - II

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UFTA02	Podhu Tamil-II	6	3	25	75	100
II	23UFEN02	General English - II	6	3	25	75	100
III	23UBTCT03	Core III - Genetics	5	5	25	75	100
	23UBTCT04	Core IV - Human Physiology	2	2	25	75	100
	23UBTDE02	Elective Dicipline II - Fundamentals of Microbiology	3	3	25	75	100
	23UBTCP02	Core Practical II – Genetics and Microbiology	4	3	40	60	100
IV	23UBTSE01	Skill Enhancement - Vermicompost technology	2	2	25	75	100
	23UMBNE02	Non Major Elective Course - Nutrition and health hygiene	2	2	25	75	100
Total			30	23	215	585	800

*Non major elective: Choose any one from the other department

Second Year – Semester - III

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UFTA03	Podhu Tamil-III	6	3	25	75	100
II	23UFEN03	General English - III	6	3	25	75	100
III	23UBTCT05	Core V - Immune system and Immunotechnology	5	5	25	75	100
	23UBTCT06	Core VI - Clinical biotechnology	2	2	25	75	100
	23UBTDE03	Elective Dicipline III - Bioinformatics and Biostatistics	3	3	25	75	100
	23UBTCP03	Core Practical III – Immunotechnology, bioinformatics and biostatistics	4	3	40	60	100
IV	23UBTSE02	Skill Enhancement - Quality control in industries	1	1	25	75	100
	23UBTSE03	Skill Enhancement - Medicinal herbs	2	2	25	75	100
	23UES01	*Environmental Studies	1	-	-	-	-
Total			30	22	215	585	800

*Examination will be held in IV Semester

Second Year – Semester - IV

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UFTA04	Podhu Tamil - IV	6	3	25	75	100
II	23UFEN04	General English - IV	6	3	25	75	100
III	23UBTCT07	Core VII - Genetic Engineering	6	6	25	75	100
	23UBTDE04	Elective Dicipline IV - Bioinstrumentation	3	3	25	75	100
	23UBTCP04	Core Practical IV- Lab in Genetic Engineering and Bioinstrumentation	4	4	25	75	100
IV	23UBTSE04	Skill Enhancement - Fundamentals in Research Methodology	2	2	25	75	100
	23UBTSE05	Skill Enhancement - Cryogenics and cryobiology	2	2	25	75	100
		Environmental Studies	1	2	25	75	100
Total			30	25	215	585	800

Third Year – Semester – V

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
III	23UBTCT08	Core VIII - Plant Biotechnology	5	4	25	75	100
	23UBTCT09	Core IX - Animal Biotechnology	5	4	25	75	100
	23UBTDE05	Elective Dicipline V - Nano Biotechnology	4	3	25	75	100
	23UBTDE06	Elective Dicipline VI - Enzymology And Enzyme technology					
	23UBTDE07	Elective Dicipline VII - Pharmaceutical Biotechnology					
	23UBTDE08	Elective Dicipline VIII - Biofarming	4	3	25	75	100
	23UBTDE09	Elective Dicipline IX - Bioethics, Biosafety and IPR					
23UBTDE10	Elective Dicipline X - Dairy science and technology						
	23UBTCP05	Core Practical V – Plant Biotechnology	4	3	40	60	100
	23UBTCP06	Core Practical VI – Animal Biotechnology	4	3	40	60	100
	23UBTPR01	Project	2	2	25	75	100
IV	23UBTIO01	Internship	-	2	-	-	-
V		Value Education	2	2	25	75	100
Total			30	26	230	570	800

* **Choose any one Elective**

■ **Students undergo summer vacation after IV Semester for 2 weeks.**

Third Year – Semester - VI

Part	Course Code	Course Title	Ins. Hrs	Credit	CIA	ESE	Total
I	23UBTCT11	Core X – Entrepreneurship Development in Biotechnology	5	3	25	75	100
	23UBTCT12	Core XI - Environmental and Industrial Biotechnology	5	3	25	75	100
		Core XII - Stem cell technology and Tissue Engineering	4	3	-	-	-
	23UBTCP06	Core Practical XI – Environmental and Industrial Biotechnology	4	3	40	60	100
	23UBTDE11	ELECTIVE XI - Marine science and technology	5	3	25	75	100
	23UBTDE12	ELECTIVE XII - Food science and technology					
	23UBTDE13	ELECIVE XIII - Cancer Biology					
	23UBTDE14	ELECIVE XIV - Medical Biotechnology					
	23UBTDE15	ELECIVE XV - Forensic science and technology	5	3	25	75	100
	23UBTDE16	ELECIVE XVI - Good Laboratory Practices					
IV		Skill Based Paper For Competitive Examination	2	2	25	75	100
V	23UEX01	Extension Activities		1	25	75	100
Total			30	21	215	585	800

Remarks: English Soft Skill Two Hours will be handled by English Teachers (4+2 = 6 hours for English).

****Ins. Hrs** – Instructional Hours, **CIA-** Continuous Internal Assessment, **ESE-** End Semester Examination

Semester: I	Course Code: 23UBTCT01	Hours/Week: 4	Credit: 4
COURSE TITLE: CORE I - CELL AND DEVELOPMENTAL BIOLOGY			

Course Overview:

1. This subject focuses on gene structure, function and regulation which form the molecular basis of many important biological phenomena such as short-term organism and cellular responses to rapid changes in environmental conditions and long-term controls of development
2. The course introduces molecular mechanisms that underlie the organization, division, and growth of individual cells
3. To introduce some of the major ideas and current experimental approaches in cell and developmental biology

Learning Objectives:

1. Have an insight of the cell as the fundamental unit of life and to compare the structure of the Eukaryotic cell with the primitive prokaryotic cell
2. Analyze the structure and obtain a strong foundation about the functional aspects of cell organelles and cell membrane.
3. Study the structure and functions of Nucleic acid and discuss the molecular mechanism of Replication, Transcription and Translation and post translation all modifications of proteins.
4. Predict their response of cells to the intra and extracellular environment by studying about the intracellular signaling pathways.
5. Understand the principles and molecular mechanisms involved in cellular differentiation, morphogenesis, growth and Potency of the cell.

Unit - I	Discovery and diversity of cells	09 Hours
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Cell theory - Structure of prokaryotic (bacteria) and eukaryotic cells (plant and animal cells).

Unit - II	Structure and Functions of Cell Organelles	09 Hours
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Cell wall - Cell membrane - Cytoplasm - Nucleus - chromosomes - Endoplasmic reticulum - Ribosome's – Golgi bodies – Vacuoles – Lysosomes – Mitochondria – Micro bodies - Flagella - Cilia - Centrosome and Centrioles - Cytoskeleton.



Unit - III	Cell cycle	09 Hours
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Cell cycle checkpoints - Cell division - Mitosis and Meiosis - Cellular differentiation - Cell junctions - Cell Adhesion - Extracellular Matrix – Cell to cell communications-Signal transduction - G - Protein Coupled Receptors Signal transduction pathways.

Unit - IV	Specialized cells	09 Hours
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Motile cells(Amoeboid, Ciliary, Flagellar Movements, Nerve cells and Nerve impulse conduction, Muscle cells and Muscle contraction, Plant cells (Parenchyma cells, Xylem and Phloem Cells)

Unit - V	Gametogenesis	09 Hours
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Spermatogenesis and Oogenesis in mammals. Fertilization - Types of cleavage ,blastula formation, gastrulation and formation of germ layers in animals - Organogenesis

Text Book(s):

1. Gupta, Renu & Makhija, Seema & Toteja, Ravi. (2018). Cell Biology: Practical Manual.
2. Gilbert, S.F. 2016. Developmental Biology, 11th edition. Sinauer Associates Inc. Publishers, MA. USA.
3. Bruce Alberts, 6th Edition (2014). Molecular Biology of the cell, W. W. Norton & Company.
4. P.S. Verma & V.K. Agarwal., (2016 - Reprint)-Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand Publishing Company Pvt, Ltd, New Delhi.

Reference Books:

1. Karp's Cell and Molecular Biology: Concepts and Experiments. 8th Edition (2015). Wiley Publications.
2. Geoffrey M. Cooper, 7th Edition (2015). The Cell: A Molecular Approach, Sinauer Associates, Qxford University Press.
3. Lodish Harwey, 6th Edition (2016), Molecular Cell Biology, W. H. Freeman Publications
4. Wolpert L, Tickle C, 2015. Principles of Development, 5th edition, Oxford University Press.

Web Resources:

1. <http://www.cellbiol.com/education.php>
2. <https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/>

3. <https://www.cellsignal.com/contents/science/cst-pathways/science-pathways>
4. <https://nptel.ac.in/courses/102/106/102106025/11>.

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Understanding the prokaryotic and Eukaryotic cell.	K1
CO2	Overview of the central dogma of life and various molecular events Learning molecular events in the DNA replication and role of different enzymes- Molecular Events Translation leading to protein synthesis and Post translational modification.	K2
CO3	Compare and contrast the events of cell cycle and its regulation Gaining knowledge for cell to cell signaling.	K3
CO4	Understands the students about sequential changes from single cell organization to organ level in the development of multicellular organisms	K4
CO5	Discussing in detail the cell membrane and function.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	M	S	M	S	S	S	S
CO2	S	M	S	S	M	S	S	S	S
CO3	S	M	M	S	M	S	S	S	M
CO4	S	S	M	S	M	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23UBTCT02	Hours/Week: 3	Credit: 3
COURSE TITLE: CORE II - MOLECULAR BIOLOGY			

Course Overview:

1. To study the structure and function of biologically important molecules
2. To giving you a range of theoretical knowledge and practical lab skills
3. To covers DNA, RNA and proteins and the molecular events that govern cell function
4. To exploring the relevant aspects of biochemistry, genetics and cell biology

Learning Objectives:

1. Know about basics structure of DNA and RNA, and Organization of genes in prokaryotes & Eukaryotes. Gain knowledge about replication in Prokaryotes & Eukaryotes and role of enzymes in replication
2. Understand the gene expression by Translation and Transcription process and regulation of gene expression.
3. Know about the Mutation, their types and repair mechanism
4. Understand the Genetics exchanges in microbes
5. Understand the molecular biologist studies how molecules interact with one another in living organisms to perform the functions of life.

Unit - I	DNA and RNA	09 Hours
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DNA and RNA as genetic material, Characters of a genetic material, Chemistry & Molecular structure of DNA, Topology of DNA, Structure and types of RNA. Bacterial, Chromosome. Organization of genes in prokaryotes

Unit - II	Replication of DNA	09 Hours
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Replication in prokaryotes – Mechanism & enzymology of replication – Theta replication & Rolling circle replication. Replication in prokaryotes – Mechanism & enzymology

Unit - III	Transcription in prokaryotes	09 Hours
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Transcription in prokaryotes , Post transcriptional modifications – Genetic code – Translation of Proteins, Post translational modifications. Regulation of gene expression in prokaryotes – Operon & concept – lac trp Operon, Transcription in prokaryotes, Post transcriptional modifications. – Genetic code.

Unit - IV	Mutation	09 Hours
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Mutation - spontaneous and induced Mutagen & Mutagenesis – DNA repair mechanism

Unit - V	Genetic exchange	09 Hours
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Genetic exchange – Transduction (specialized & generalized), Transformation, Conjugation - Hfr mapping, genetic recombination.

Text Book(s):

1. Gardner, E. J, Simmons, M J&D P Snustard, 1991, Principles of Genetics, 8th edition. John Wiley & Sons. NY
2. David Freifelder.S, 1987 Microbial Genetics, Jones & Bartlett, Boston.
3. Robert H. Tamarin. Principles of Genetics, 5th edition, WmC Brown Publishers.

Reference Books:

1. Lewin. B, 1990. Genes, 6th edition, Oxford University Press.
2. Klug .W.S. & Cummings, MR, 1996, Essentials of Genetics, Mentics Hail. New Jersey.

Web Resources:

1. <https://www.youtube.com/watch?v=0lZRAShqft0>
2. https://www.youtube.com/watch?v=JQByjprj_mA
3. <https://www.youtube.com/watch?v=a48GfC0yggp>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Gain knowledge on the structure and characters of Genetic materials.	K1
CO2	Understand replication of DNA.	K2
CO3	Learn transcription and translation process in prokaryotes and Eukaryotes.	K3
CO4	Perceive Genetic alterations and their repair mechanisms.	K4
CO5	Understand the methods of genetic exchange.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	S	M
CO3	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	S

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23UBTDE01	Hours/Week: 4	Credit: 3
COURSE TITLE: ELECTIVE DISCIPLINE I - BIOLOGICAL CHEMISTRY			

Course Overview:

1. This course examines the chemical and physical properties of the cell and its building blocks
2. To special emphasis on the structures of proteins and principles of catalysis
3. The chemistry of organic / inorganic cofactors required for chemical transformations within the cell.
4. This course introduces the chemistry important to biological processes

Learning Objectives:

1. Comprehend the importance of Chemistry and Biochemistry through the concept of acids and bases, and chemical bonding.
2. Demonstrates the formation of different types of solutions, concentrations of solutions and preparation of buffer solutions
3. Recall the Structure, Classification, Chemistry and Properties of Carbohydrates and Explain Various Biochemical Cycles involved in Carbohydrate Metabolism.
4. Recall the Structure, Classification, Chemistry and Properties of Lipids, Nucleic acid and Explain Various Biochemical Cycles involved in Fatty acid and Nucleic acid Metabolism.
5. Understand the Structure, Classification, Chemistry and Properties of proteins amino acids and Identify and explain nutrients in foods and the specific functions in maintaining health.

Unit - I	Atoms & Molecules	09 Hours
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Atomic theory, formation of molecules, electronic configuration of atoms - s & p shapes of atomic Orbitals. Periodic table, periodic classification, valency. Types of chemical bonds. Classification of organic compounds - Hybridization in methane, ethane, acetylene, and benzene

Unit - II	Acids & Bases	09 Hours
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Acids & Bases properties and differences, Concepts of acids and bases - Arrhenius, Lowry - Bronsted and Lewis. Concentration of solution, ways of expressing concentrations of solutions – Percent by weight, normality, molarity, molality, molefraction. pH of solution, pH scale, Measurement of pH. Buffer solutions, properties of buffers, Henderson – Hassel belch equation, Mechanism of buffering action of acidic buffer and basic buffer.

Unit - III	Classification of carbohydrates	09 Hours
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Properties of carbohydrates. Metabolism of Carbohydrates – Glycogenesis, Glycogenolysis, Glycolysis, Gluconeogenesis TCA cycle, bioenergetics of carbohydrate metabolism

Unit - IV	Classification of Lipids.	09 Hours
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Characteristics, Properties and Biological importance of lipids. Metabolism of Fatty acids, Phospholipids, cholesterol. B-oxidation of fatty acids.

Unit - V	Classification and structure of amino acids	09 Hours
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Structural conformation of proteins. Classification of proteins. Properties and biological Importance of amino acids and proteins. Degradation of Amino acids and Urea Cycle. Vitamins (Biological functions, daily requirements, deficiency symptoms and diseases - Structure not Required) and Hormones.

Text Book(s):

1. P.L. Soni, A Text - book of Inorganic Chemistry, 11th Edition, S. Chand & Sons publications
2. Abhilasha Shourie, Shilpa S, Chapadgoankar & Anamika Singh (2020) Textbook of Biochemistry 1st Edition
3. J.L. Jain, 2016, Fundamentals of Biochemistry, S. Chand publication, 7th edition.
4. A.C. Deb, 2016, Fundamentals of Biochemistry, New central book agencies, 7th edition.
5. Satyanarayana. U, 2016, Biochemistry, MJ publishers 3rd edition (2006).

Reference Books:

1. Lehninger (2013) Principles of Biochemistry 4th edition WH Freeman and Company NY
2. Murray et al., (2003) Harper's biochemistry 26th edition Appleton and Lange Publishers Florida USA
3. Geoffrey L. Zubay, William W. Parson, Dennis E. Vance, 1995, Principles of Biochemistry, W.C. Brown Publishers, 1995, 3rd edition.
4. Lubert Stryer (2007) Biochemistry – Stanford University 5th Edition - WH Freeman and company San Francisco
5. Bahl Arun, Bahl B.S. (2016), A Textbook of Organic Chemistry, 22nd Edition, S. Chand & Sons publications

Web Resources:

1. <http://dwb4.unl.edu/chem869p/chem869plinks/s>
2. www.longwood.edu/staff/buckalewdw/C3%20Biomolecules.pp
3. <https://www.britannica.com/science/biochemistry>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	To make students have a strong foundation in chemical biology.	K1
CO2	To introduce them to metabolic pathways of them bimolecular and relevance to clinical conditions	K2
CO3	To correlate Biochemical process with biotechnology applications	K3
CO4	To discuss the significance of various metabolic processes s occurring in biological system	K4
CO5	To evaluate of both Hormones and Enzymologist and also its medical importance in the human life.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	M
CO2	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S
CO4	S	S	M	S	M	S	M	S	S
CO5	S	M	S	M	S	S	S	M	S

S - Strong, M – Medium, L – Low



Semester: I	Course Code: 23UBTCP01	Hours/Week: 4	Credit: 3
COURSE TITLE: CORE PRACTICAL - I CELL AND DEVELOPMENTAL BIOLOGY AND BIOLOGICAL CHEMISTRY			

Course Overview:

1. This is a relatively new discipline that has emerged from studies in physiology and biochemistry
2. Some cell and developmental biologists concentrate on the role that one particular molecule plays within cells.
3. Others study the way in which molecules assemble into structures such as chromosomes or nuclei.
4. Modern cell biology is a dynamic discipline that combines the interests and techniques of many scientific fields.

Learning Objectives:

1. Demonstrate the operation of Light Microscope Identify blood cells and its components
2. Isolate and identify plant, and animal cells. Summarizes the concept of gametes
3. Perform and estimate the amount of chemical substance present in a solution qualitatively. To analyze and detect the nature of various organic class of compounds qualitatively
4. Qualitatively analyze the carbohydrates and amino acids and report the type of carbohydrate based on specific tests. Differentiate the carbohydrates based on microscopic examination of the crystal.
5. Understand the methods of acidimetric, alkalimetric and permanganometry.
Quantify Ascorbic acid in lemon by Dichlorophenol indo phenol dye method,
Glycine by sorensons formal titration method.
Estimate Glucose, Cholesterol and Proteins.

Unit - I	Cell and Molecular Biology	09 Hours
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Blood smear preparation and Identification of Blood cells

Components of a Compound / Light Microscope.

Buccal smear preparation and Identification of squamous epithelial cells

Unit - II	Developmental Biology	09 Hours
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Isolation and Identification of plant cells and animal cells

Observation of sperm & Egg

Mounting of chick Embryo - 24 hrs, 48 hrs, 72 hrs, 96 hrs.

Cell fractionation and Identification of cell organelles (Demo)

Unit - III	Biological chemistry - Systematic analysis of Organic compounds	09 Hours
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Functional group tests (Carboxylic acid, Benzoic acid, phthalic acid), Phenol, Urea, Benzaldehyde, Aniline (Aniline not to be given for exam) Detection of elements (N, Halogens)

Unit - IV	Biological Chemistry - Qualitative Analysis	09 Hours
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Qualitative analysis of carbohydrates - Glucose, Fructose, Lactose, maltose, sucrose, starch.

Qualitative analysis of amino acids - Tyrosine, Tryptophan, Arginine, Proline and Cysteine, Histidine.

Unit - V	Colorimetric Analysis	09 Hours
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Estimation of glucose - Ortho toluidine method

Estimation of Cholesterol- Zak's method

Estimation of proteins–Lowry's method

Text Book(s):

1. K.V. Chaitanya, (2013), Cell and molecular biology: Lab manual, PHI publishers, ISBN 978-81-203-800-4
2. J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.
3. S. K. Sawhney Randhir, Singh, Introductory Practical Biochemistry, Alpha Science International Ltd, 2nd edition, 2005.
4. Irwin H. Segel, Biochemical calculations, Liss, Newyork, 1991.

Reference Books:

1. Dr. O.P. Panday, D.N, Bajpai, Dr. S Giri, PRACTICAL CHEMISTRY, S. Chand, Revised edition 2016.
2. Hands Thacher Clarke, A handbook of Organic: Qualitative and quantitative Analysis, 2007.
3. N.S. Gnanapragasam and G. Ramamurthy, Organic chemistry Labmanual, S. Viswanathan Co. Pvt. Ltd., 1998.

Web Resources:

1. <https://global.oup.com/uk/orc/biosciences/cellbiology/wang/student/weblinks/ch16/>
2. https://www.youtube.com/watch?v=JQByjprj_mA
3. <https://www.britannica.com ›science ›biochemistry>
4. <https://www.sciencedirect.com ›topics ›agricultural-and-biological-sciences>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	To make students have a strong foundation in chemical biology.	K1
CO2	To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions	K2
CO3	To correlate Biochemical process with biotechnology applications	K3
CO4	To discuss the significance of various metabolic processes occurring in biological system	K4
CO5	To evaluate of both Hormones and Enzymology and also its medical importance in the human life.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	M	S
CO2	M	S	M	S	M	S	M	S	S
CO3	S	M	S	M	S	S	S	M	S
CO4	S	S	S	S	S	M	S	S	M
CO5	S	M	S	M	S	S	S	M	M

S - Strong, M – Medium, L – Low

Semester: I	Course Code: 23UBTFC01	Hours/Week: 2	Credit: 2
COURSE TITLE: SKILL ENHANCEMENT (FOUNDATION COURSE) MUSHROOM CULTIVATION TECHNOLOGY			

Course Overview:

1. To make the learners self-reliant to identify several kind of mushrooms
2. To provide detailed hands on training on mushroom cultivation, packaging and marketing.
3. To develop a business plan on mushroom cultivation.
4. To help the learners to practice a means of self - employment and income generation.

Learning Objectives:

1. Students can start small scale industry of Mushroom cultivation- Students study the morphology and type's of Mushrooms. They are aware of the identification of edible and poisonous Mushrooms
2. Learned the prospects and scope of mushroom cultivation in small scale industry.
3. Learned the lifecycle of the Agaricusspecies
4. Students will be able produces pawn on their own.
5. Studied the technique of Mushroom cultivation. Understood the Diseases. Post harvesting techniques of Mushrooms.

Unit - I	Introduction	09 Hours
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Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive Values, life cycle of mushrooms.

Unit - II	Spawn production	09 Hours
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Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.

Unit - III	Mushroom cultivation	09 Hours
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Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry

Unit - IV	Life cycle	09 Hours
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Life cycle of Pleurotus spp and Agarics spp.

Unit - V	Diseases	09 Hours
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Diseases and post - harvest technology, Insect pests, nematodes, mites, viruses, fungal, competitors and other important diseases.

Text Book(s):

1. Handbook of Mushroom Cultivation. 1999. TNAU publication.
2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. (1991).Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3. Swaminathan, M.1990.Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
5. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijay primplani for oxford & IBH publishingco., Pvt.,Ltd., NewDelhi.5.Dr.C.Sebastian Rajesekaran Readerin Botany Bishop Heber College, Trichy– 17.
6. Bahl,N.(1984-1988). Handbook of Mushrooms, II Edition, Vol. I & Vol .II.

Reference Books:

1. Suman.2005. Mushroom Cultivation Processing and Uses, M/s.IBD Publishers and Distributors, New Delhi.
2. Sing.2005.Modern Mushroom Cultivation, International Book Distributors, Dehradun.
3. Handbook of Edible Mushroom Today and Tomorrows printers and publishers.
4. SharmaV.P.2006.Diseases and Pests of Mushrooms, M/s. IBD Publishers and Distributors, New Delhi.
5. Tewari, Pand Kapoor, S.C. 1988.Mushroom cultivation, Mittal Publications NewDelhi.

Web Resources:

1. <https://www.britannica.com ›science>
2. <https://www.sciencedirect.com ›topics ›agricultural-and-biological-sciences>

<p>Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning</p>

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	To know the nutrient value of mushroom-To studies the morphology and types of Mushrooms. To aware the identification of edible and poisonous Mushrooms	K1
CO2	To learn the prospects and scope of mushroom cultivation in small scale industry.	K2
CO3	To learn the lifecycle of Agaricusspecies	K3
CO4	To know the spawn production technique.	K4
CO5	To understand the Diseases. Post harvesting techniques of Mushrooms.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	M	S
CO2	M	S	M	S	M	S	M	S	S
CO3	M	S	S	S	M	S	M	M	S
CO4	S	S	M	S	S	M	S	S	S
CO5	S	S	S	M	S	S	S	M	M

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UBTCT03	Hours/Week: 5	Credit: 5
COURSE TITLE: CORE III - GENETICS			

Course Overview:

1. It is a branch in the biological sciences that helps to study any species at the gene level.
2. To understand the basic principles of human genetics at the micro and macro levels
3. To provide the broad view of gene action from the molecular to the population levels.
4. To function and expression of genes and an understanding of the current state of genetic research, methodology, ethics and technology.

Learning Objectives:

1. Learn about the classical genetics and transmission of characters from one generation to the next.
2. Obtain a strong foundation for the advanced genetics.
3. Explain the properties of genetic materials and storage and processing of genetic information.
4. Acquire knowledge about the Mutagens, Mutations, DNA Repairs and Genetic disorders in human.
5. Categories Eugenics, Euthenics and Euthenics and in depth Knowledge on population Genetics.

Unit - I	Mendel's experiments	09 Hours
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Mendel's experiments, Monohybridcross, Dihybridcross, Backcrossor Testcross, Mendel's Laws. Dominance (complete and incomplete). Interaction of Genes - Epistasis and lethal genes. Multiple alleles in Drosophila and Blood group inheritance in man

Unit - II	Linkage	09 Hours
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Linkage - linkage in Drosophila - Morgan's experiments, factors affecting linkage. Crossing over - Types, mechanism, significance of crossing over. Mapping of Chromosomes, interference and Coincidence. Cytoplasm inheritance – Linked Inheritance and Sex-Determination in Man.

Unit - III	Gene	09 Hours
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Fine structure of the gene and gene concept, Operon Concept. Identification of the DNA as the Genetic material- Griffith experiments, Avery, McLeod, McCarty and Hershey Chase experiment.

Unit - IV	Mutation	09 Hours
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Mutation – types of mutation, mutagens, DNA damage and Repair Mechanism. Chromosomal



Aberrations - Numerical and Structural, Pedigree Analysis-Mendel an inheritance in human.
(Cystic Fibrosis, Muscular Dystrophy).

Unit - V	Population Genetics	09 Hours
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Population Genetics – Hardy Weinberg principle, gene frequency, genotype frequency and factors Affecting gene frequency. Eugenics and Euthenics.

Text Book(s):

1. Dr. Veer Bala Rastogi, 2020, Elements of Genetics, 11 th Revised & Enlarged Edition, Kedar Nath Ram
2. Nath Publications, Meerut, 250001. www.knrnpublishations.com, ISBN-978-81-907011-2-9
3. Verma, P.S. and Agarwal, V.K., 1995. Genetics, 8th edition, S. Chand & Co., New Delhi – 10055.
4. Verma, P.S., and Agarwal, V.K., 1995. Cell and Molecular Biology, 8th edition, S. Chandand Co., New Delhi, 110055.

Reference Books:

1. Gardener E. J. Simmons M. J. Slustad D.P.2006. Principles of Genetics
2. Lewis, R.2001. Human Genetics- Concepts and application. 4th edition. Mc Graw Hill.
3. Griffiths, Miller, J. H., An Introduction to Genetic Analysis W.H. Freeman. New York.
4. Winter, P.C., Hickey, G.J. and Fletcher, H.L.2000.Instantnotes in Genetics. Viva books, Ltd
5. Good enough U.1985.Genetics.Hold Saunders international.

Web Resources:

1. <https://nptel.ac.in/courses/102/106/102106025/>
2. <http://www.ocw.mit.edu>
3. <http://enjoy.m.wikipedia.org>
4. <https://www.acpsd.net>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Obtain acquaintance on historical overview of microbial genetics and genetic Materials	K1
CO2	Comprehend the concept of replication of genetic materials	K2
CO3	Understand about regulation of gene expression and mutation	K3
CO4	Grasp the Basic of genetics and their role	K4
CO5	Gain knowledge on mutation	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	S	M	S	S	S
CO3	S	M	S	S	S	S	S	S	M
CO4	S	S	S	S	S	S	S	M	S
CO5	S	S	S	S	M	S	S	S	S

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UBTCT04	Hours/Week: 5	Credit: 2
COURSE TITLE: CORE IV- HUMAN PHYSIOLOGY			

Course Overview:

1. To provide students with an understanding of the function, regulation and integration of human body organ systems.
2. To emphasis is placed on homeostatic maintenance in health as well as in some disease processes.
3. To provides knowledge about both animal and plant physiology.
4. To understanding how each one works when healthy and when sick, scientists can understand how to treat illness

Learning Objectives:

1. Illustrate about digestive secretions and absorptive mechanisms
2. Comprehend the process of gaseous exchange in tissues and lungs
3. Obtain an insight about muscle physiology and cardio vascular system
4. Understand urine formation and physiology of reproductive system
5. Get an idea about neuron structure and sensory physiology

Unit - I	Digestive System	09 Hours
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Overview of the digestive system, secretions of digestive tract, digestive hormones, process of Digestion, absorption, assimilation of carbohydrates, proteins, fats, nucleic acids. Absorption of vitamins, minerals and water

Unit - II	Respiratory System	09 Hours
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Overview of the respiratory system, pulmonary ventilation, alveolar ventilation, composition and partial pressure of inspired air, alveolar air and expired air, exchange and transport of Respiratory gases

Unit - III	Muscle physiology and Cardiovascular System	09 Hours
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Overview of muscle tissue, contraction and relaxation of skeletal muscle, cardiac muscle tissue and Cardiac conduction system, cardiac cycle, cardiac output, blood pressure and human Skeletal system, skeletal divisions and functions of skeleton

Unit - IV	Excretory System & Reproductive System	09 Hours
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Overview of renal system, Renal physiology:- glomerular filtration, tubular reabsorption and Secretion, production of dilute and concentrated urine. Overview of male and female reproductive system, menstrual cycle, physiology of pregnancy fetal development), fertilization process, parturition and lactation

Unit - V	Nervous System	09 Hours
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Overview of nervous system, classification of nervous system, signal transmission at synapse, neuro transmitters. Special Senses: Physiology of Olfaction, Gustation, Vision, Hearing and equilibrium

Text Book(s):

1. Essentials of Medical Physiology, K. Sembulingam and PremaSembulingam,6th Edition, 2012
2. Principles of Anatomy and Physiology, Tortora and Grabowski, 2003, John Wiley & Sons, nc.
3. Human Physiology, Chatterjee.C.11th edition Medical agency allied, Calcutta.

Reference Books:

1. Textbook of medical physiology, A.C.Guyton10th edition.
2. Human body, Atlas, Publication Gardencheers.
3. A Text Book of Human physiology, Sarada Subrahmanya metal., 2010,SC hand &Company

Web Resources:

1. <https://mymedicallibrary.files.wordpress.com/2016/08/jaypee-essentials-of-medical-physiology-6thedition.pdf>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	To build an in depth knowledge about basic physiological principles of various organs in the human body.	K1
CO2	To understand physiology of various systems and its functions.	K2
CO3	To get adequate knowledge on cardiovascular system and skeletal system	K3
CO4	To understand physiology of excretory system	K4
CO5	To get adequate knowledge on sensory organs.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	M	S	M	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	S	M	S	S	S	S	S
CO5	M	S	S	S	S	M	S	S	S

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UBTDE02	Hours/Week: 3	Credit: 3
COURSE TITLE: ELECTIVE DICIPLINE II - FUNDAMENTALS OF MICROBIOLOGY			

Course Overview:

1. To undergraduate academic degree program that focuses on the study of microorganisms, including bacteria, viruses, fungi, protozoa, and other microscopic life forms.
2. To covers principles of microbiology and the impact these organisms have on man and the environment
3. To impart knowledge on basic activities, living and effects of microorganisms.
4. To inform students on why and how the micro biome is a new field of study

Learning Objectives:

1. Understand the classification of Microorganisms and structure of bacteria
2. Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms.
3. Categorize the methods of sterilization and identify the significance of culture mediain the growth of different microbes.
4. Exhibit knowledge in analyzing the importance of Bioinsecticides, Biofertilizers prebiotics and probiotics.
5. Distinguish between normal flora and pathogens and describe the role of microbesin food in toxications.

Unit - I	History of Microbiology	09 Hours
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(Biogenesis and a biogenesis, spontaneous generation), Classification of bacteria, fungi, virus, Protozoa and algae – classical and molecular approaches. Scope and applications of microbiology
- Contributions microbiology.

Unit - II	Structure of bacteria	09 Hours
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Structure of bacteria (Gram positive and Gram negative) - Bacterial growth and measurement of Growth, Media and its types staining methods (Gram's, capsule, spore, LCB mount). Methods of Preservation of microorganisms. In vitro cultivation of virus and algae.

Unit - III	Sterilization methods	09 Hours
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Sterilization methods - physical and chemical methods. Definition and classification of antibiotics. Mode of action of different groups of antibiotics – Antimicrobial resistance and its mechanism. MRSA, ESBL

Unit - IV	Bio insecticides	09 Hours
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Bioinsecticides - Bacillus thuringiensis, Baculoviruses - Biofertilizers - Azospirillum and blue green algae - single cell protein – prebiotics and probiotics - Dairy products (Cheese and Yoghurt). Types of microscopy – Definitions, light, dark field, phase contrast, fluorescence, and electron microscopes

Unit - V	Microbial Disease	09 Hours
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Microbial Disease- host - pathogen interaction, clinical features, lab diagnosis and treatment of Airborne disease (Pneumonia), food borne disease (Typhoid), Water borne disease (Cholera), Sexually transmitted disease (AIDS), Vector borne disease (Dengue).

Text Book(s):

1. Pelczar. M. J., Chan E. C. S. and Edition., Mc Graw – Hill, New York.
2. Dubey R. C. and Maheswari, S. (2003). A textbook of Microbiology, New Delhi: S. Chand & Co.
3. Ananthanarayanan, Paniker, Kapil, Text book of Microbiology, 9th edition, Orient Black Swan, 2013.
4. Prescott, Harley, Klein, Microbiology, 10th Edition, McGraw– Hill, 2016.
5. Gerhardt, P., Murray, R.G., Wood, W.A. and Krieg, N.R. (Editions) (1994) Methods for General and Molecular Bacteriology. ASM Press, Washington, DC

Reference Books:

1. Madigan, Martinko, Bender, Buckley, Stahl, Brock Biology of Microorganisms, 14th edition, 2017.
2. Gillespie, Bamford, Medical Microbiology and Infection at a Glance, 4th edition, 2012.
3. Boyd, R.F (1998). General Microbiology, 2nd Edition. Times Mirror, Mosby College Publishing, St Louis.
4. Tortora, G.J., Funke, B.R., Case, C.L.(2013). Microbiology. An Introduction 11th Edition., Ala Carte Pearson.
5. Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition. Mc Graw Hill Inc. New York.

Web Resources:

1. Horst W. Doelle (2004). Microbial Metabolism and Biotechnology. Proceedings of an E-seminar organized by the International organization for Biotechnology and Bioengineering (IOBB)
2. <http://www.ijb.org/content>.
3. www.Biotech.kth.se Electronic Journal of biotechnology
4. https://www.cliffsnotes.com/study_guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology
5. <https://bio.libretexts.org/@go/page/9188>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Remember and recall the historical events which paved the development of different types of microscopes.	K1
CO2	Understand and differentiate the different types of microbes	K2
CO3	Analyze the media composition and growth desired microbe	K3
CO4	Apply the knowledge to enumerate the microorganisms from natural environment.	K4
CO5	Evaluate the success of understanding the microbial diseases	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	S	S	S	M	S
CO3	M	M	S	S	S	M	S	S	M
CO4	S	S	M	S	S	S	S	S	S
CO5	M	S	S	S	S	S	M	S	S

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UBTCP02	Hours/Week: 4	Credit: 3
COURSE TITLE: CORE PRACTICAL II – GENETICS AND MICROBIOLOGY			

Course Overview:

1. To focus on the application of Biotechnology and Microbiology in the functioning of genes, expression of genes, genetic variation, gene pool, structure and function of genes, and heredity of animals, plants, and human beings
2. To field of basic science research as microorganisms offer several features that facilitate the study of evolutionary processes
3. To examines the design and interpretation of experiments that have led to our current understanding of the biological roles of DNA, RNA and proteins
4. To covers principles of microbiology and the impact these organisms have on man and the environment

Learning Objectives:

1. Demonstrate the basic principles of important techniques in Molecular biology and Genetics. Analyze the Polytene chromosome of the organisms. Identify Barr bodies from Buccal smear
2. Demonstrate the Preparations and maintenance of culture medium Demonstrate Human karyo typing
3. Describe the general Laboratory safety & Sterilization Techniques
Develop Skills in Media Preparation, Isolation & Serial Dilution Techniques and Pure Culture Techniques
4. Microscopically analyze the morphological features of Bacteria and fungi and define various Staining Techniques. Perform the Motility of organisms
5. Able to characterize and identify bacteria using Biochemical tests.

Unit - I	Genetics	09 Hours
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Mitotic stages of onion (*Allium cepa*) root tip

Meiotic stages of cockroach testes/ Flower bud

Giant chromosomes from *Chironomus* larvae/ *Drosophila* salivary glands

Identification of Barr bodies from Buccal smear

Unit - II	Preparation	09 Hours
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Genetic Model Organisms (i) Arabidopsis Thaliana (ii) Caenorhabditis elegans (DEMO).

Identifications of mutants of Drosophila Human karyo typing (Demo)

Unit - III	Microbiology	09 Hours
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Sterilization techniques – Preparation of Media

Inoculation techniques- Pour plate, spread plate and streak plate (simple, continuous, „T“ streak and quadrant streak methods)

Isolation of bacteria from air, soil and water. Serial dilution method

Unit - IV	Techniques	09 Hours
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Staining techniques: Simple, Gram's, Capsule Spores,

Preparation of temporary mounts- Lacto phenol cotton blue staining

Motility test: Hanging drop technique.

Unit - V	Biochemical characterization	09 Hours
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Biochemical characterization - catalase, oxidase, IMVIC test and TSI.

Antibiotic sensitivity test by Kirby -Bauer method (demonstration).

Text Book(s):

1. Practical Manual on "Fundamentals of Genetics" (PBG-121). 2019, Edition: First
Publisher: Odisha University of Agriculture & Technology. Editor: Kaushik Kumar Panigrahi
2. Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications.
3. James G Cappucino and N. Sherman MB (1996). Alabmanual Benjamin Cummins, New York 1996.
4. Sundararaj T (2005). Microbiology Lab Manual (1st edition) publications.
5. Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi.
6. RC Dubey and DK Maheswari (2002). Practical Microbiology. S. Chand Publishing.

Reference Books:

1. Atlas. R (1997). Principles of Microbiology, 2nd Edition, Wm.C. Brown publishers.
2. Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. (1st Edition). Elsevier India.
3. Talib VH (2019). Hand book Medical Laboratory Technology. (2nd Edition). CBS.

4. Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication.
5. Lim D. (1998). Microbiology, 2nd Edition, WCB Mc Graw Hill Publications.

Web Resources:

1. <http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403>.
2. <https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635>
3. https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf
4. <https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Examine and evaluate the stages of Mitosis	K1
CO2	Analyze the sex chromatin present in different cells	K2
CO3	Be aware of the laboratory rules and regulations	K3
CO4	Learns to visualize the cells by employing different types of microscopes	K4
CO5	Bring in the concepts of microbial culturing techniques	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	M	S	S

S - Strong, M – Medium, L – Low

Semester: II	Course Code: 23UBTSE01	Hours/Week: 4	Credit: 2
COURSE TITLE: SKILL ENHANCEMENT - VERMICOMPOST TECHNOLOGY			

Course Overview:

1. To sustainable process harnessing earthworms and microorganisms for aerobic decomposition
2. To nutrient-rich organic soil amendment, brimming with plant nutrients and beneficial microorganisms
3. To Understand the importance of vermicompost application to the soil
4. To provides vermicompost which is organic fertilizer and as natural manure for crops and gardens.

Learning Objectives:

1. Vermicomposting technology broadly followed at the global level and some Indigenous methods, role of microbes in increasing the soil fertility by the action of earthworms, their advantages and limitations death
2. Understand the environmental conservation process and its importance, pollution control, biodiversity and protection of earthworms through vermiculture
3. To learn vermicomposting techniques
4. Contribute their knowledge to develop organic fertilizer with rural and urban biodegradable wastes using the Earthworms.
5. To understand various applications of earthworms inorganic solid waste management, soil fertility, and bioremediation.

Unit - I	Types, Collection and Preservation of earthworms	09 Hours
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Types, Collection and Preservation of earthworms - Types and basic suitable characteristics of species for vermicomposting; Role of earth worms in soil fertility, Biology of Lampito maruitti; Collection and Preservation of Earthworms; Flow sheet for vermi technology Giant chromosomes from Chironomus larvae/ Drosophila salivary glands

Unit - II	Culturing techniques of earthworms	09 Hours
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Culturing techniques of earthworms and composting materials General method; Pot method; Wooden box method; Propagation; Factor affecting culturing of earthworm; Vermicomposting materials; Preliminary treatment of composting materials.

Unit - III	Small scale techniques of Vermicomposting	09 Hours
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Small scale techniques of Vermicomposting - Indoor dual bin method; Bed method; Pit method; Heap method; Expandable worm tower assembly method; Hanging basket method; Physical, chemical and biological properties of vermicompost.

Unit - IV	Large scale techniques	09 Hours
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Large scale techniques of Vermicomposting Outdoor dual bin; Raised cage; Dual pit; Commercial Model; Trickling filter vermicomposting; Keep it simple and save plan.

Unit - V	Vermiwash and Economics	09 Hours
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Vermiwash and Economics - Chemical composition of vermiwash; Techniques of vermiwash production: Advantages of Vermicomposting; Prospects of vermi-culture as self employment venture.

Text Book(s):

1. The Earthworm book, Ismail, S.A., other India Press, Goa
2. Somani, L.L. 2008. Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaipur.
3. Talashilkar and Dosani, 2005. Earthworm in Agriculture. Agrobios (India), Jodhpur.
4. Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India.

Reference Books:

1. Ranganathan, L.S. 2006. Vermibiotechnology from soil health to human health – Agrobios, India.
2. Somani, L. L. 2008. Vermicomposting and vermiwash. Agrotech Publishing Academy, Udaiur.

Web Resources:

1. <https://www.ebooks.cambridge.org/ebook.jsf?bid>

<p>Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning</p>

Learning Outcomes:		
Upon successful completion of this course, the student will be able to		
COs	Statements	Bloom's Level
CO1	Find out Vermicomposting is an eco-friendly, economically and socially acceptable technology	K1
CO2	Illustrate that Vermitechnology is useful for stabilization and recycling of both industrial and domestic organic waste.	K2
CO3	Utilize Vermitechnology to improve the soil texture, soil aeration, improve the water retention capacity in the soil	K3
CO4	Improve Vermitechnology to manufacture the vermicompost in small scale industry by which the economy of the farmer is improved. It provides the employment opportunity in rural and urban areas.	K4
CO5	Justify and prove that the Earthworms are having the capacity to absorb heavy metals into their body tissues and converting the soil without heavy metals.	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	M	S	S

S - Strong, M – Medium, L – Low



Semester: II	Course Code: 23UMBNE02	Hours/Week: 2	Credit: 2
COURSE TITLE: NON MAJOR ELECTIVE COURSE - NUTRITION AND HEALTH HYGIENE			

Course Overview:

1. Students learn about the importance of nutrition for a healthy life and health hygiene
2. Student know about the process of nutrition for life cycle
3. Understand the Improper diets and its disadvantages.

Learning Objectives:

1. Understand the importance of nutrition for a healthy life
2. Study the nutrition for life cycle
3. Know the health care programmes of India
4. Learn the importance of community and personal health & hygiene Measures

Unit - I	Nutrition	09 Hours
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Definition, importance, Good nutrition, and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates, Lipids, Proteins and Vitamins – functions, dietary sources, effects of deficiency. Macro and micro minerals – functions, effects of deficiency; food sources of Calcium, Potassium, and Sodium; food sources of Iron, Iodine, and Zinc. Importance of water – functions, sources, requirements and effects of deficiency

Unit - II	Nutrition for Life Cycle	09 Hours
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Balanced diet - Normal, Pregnant, lactating women, Infancy, young children Adolescents, Adults, and the Elderly; Diet Chart; Nutritive value of Indian foods.

Unit - III	Improper diets	09 Hours
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Definition, Identification, Signs and Symptoms - malnutrition, under - nutrition, over-nutrition, Protein Energy Malnutrition, obesity; Nutritional Disease and Disorder - hypertension, diabetes, anemia, osteomalacia, cardiovascular disease

Unit - IV	Health	09 Hours
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Determinants of health, Key Health Indicators, Environment health & Public health; Health - Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health



organizations in India

Unit - V	Hygiene	09 Hours
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Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places

Text Book(s):

1. Bamji, M.S., K. Krishnaswamy & G.N.V. Brahmam (2009) Textbook of Human Nutrition(3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2. Swaminathan (1995) Food & Nutrition(Vol I, Second Edition) The Bangalore Printing & Publishing Co Ltd., , Bangalore
3. SK. Haldar (2022). Occupational Health and Hygiene in Industry. CBS Publishers.
4. Acharya, Sankar Kr, Rama Das, Minati Sen (2021). Health Hygiene and Nutrition Perception
5. and Practices. Satish Serial Publishing House

Reference Books:

1. Vijaya Khader (2000) Food, nutrition & health, Kalyan Publishers, New Delhi
2. Arvind Kumar Goel (2005). A College Textbook of Health & Hygiene, ABD Publishers

Web Resources:

1. National Rural Health Scheme :[https://nhm.gov.in/Index1.php?lang=1&level=1 &sublinkid=969 &lid=49](https://nhm.gov.in/Index1.php?lang=1&level=1&sublinkid=969&lid=49)
2. Health Impact Assessment - <https://www.who.int/hia/about/faq/en/>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

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

COs	Statements	Bloom's Level
CO1	Learn about nutrition and their importance	K1
CO2	Make student understand the nutritional facts for a better life.	K2
CO3	Learn information to optimize our diet	K3
CO4	Impart knowledge on different health care programs taken up by India	K4
CO5	Learn knowledge on different health indicators and types of hygiene methods	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	M	M	S	S
CO2	S	S	S	M	S	M	M	S	S
CO3	M	S	S	S	S	M	M	S	M
CO4	S	S	M	M	S	S	S	S	S
CO5	S	S	S	S	S	S	M	S	S

S - Strong, M – Medium



Semester: III	Course Code:23UBTCT05	Hours/Week: 5	Credit: 5
COURSE TITLE: CORE V- IMMUNE SYSTEM AND IMMUNOTECHNOLOGY			

Course Overview:

1. To studies you will establish how the immune system can distinguish between healthy and damaged self and identify dangerous non-self
2. To protect against different types of infectious agents and how responses vary when these agents are encountered in different anatomical sites
3. To keeps a record of every germ (microbe) it has ever defeated so it can recognize and destroy the microbe quickly if it enters the body again
4. To discusses basic immunology including cellular and molecular processes that represents the human immune system

Learning Objectives:

1. Explain the role of immune cells and their mechanism in body defense mechanism.
2. Demonstrate the antigen–antibody reactions in various immune techniques.
3. Gain new insights into Antigen –Antibody interactions and to demonstrate immunological techniques.
4. Gain knowledge of production of vaccines.
5. Apply the knowledge of immune associated disease, hypersensitivity reactions.

Unit - I	Introduction to Immunology	09 Hours
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Introduction to Immunology - Cells involved in immune response. Primary and Secondary Lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – Development of B and T lymphocytes. Types of immunity – Innate and acquired

Unit - II	Antigen	09 Hours
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Antigen: Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Production of antibodies- Hybridoma technology: Applications of Monoclonal antibodies in biomedical research. Antigen processing and presentation (MHC molecules – structure, types and functions).

Unit - III	Antigen – Antibody interactions	09 Hours
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Antigen – Antibody interactions- Agglutination and precipitation reactions, Immuno diffusion and Immuno electrophoresis. Principle and application of ELISA and RIA and Western and

southern blotting.

Unit - IV	The complement system and activation and regulation	09 Hours
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The complement system and activation and regulation. Types – Classical, alternative and Lectin pathway. Biological function of complement proteins. Cytokines - Structure, types and biological functions. Vaccines – Types, Production and application.

Unit - V	Hypersensitivity Reactions and Types	09 Hours
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Major Histocompatibility Complex – MHC genes, MHC in immune responsiveness, Structure and function of Class I and Class II MHC molecules. HLA tissue typing. Auto immunity and Autoimmune disorders. Transplantation immunology.

Text Book(s):

1. Thomas J. Kindt, Barbara A. Osborne and Richard A Golds by, 2006. Kuby Immunology. 6th edition, W. H. Freeman and Company.
2. Kannan, I., 2010. Immunology. MJ P Publishers, Chennai
3. Abbas, A.K., A. H. L., Lichtman and S. Pillai, 2010. Cellular and Molecular Immunology, 6th Edition. Saunders Elsevier Publications, Philadelphia
4. Nandini Shetty, 1996, Immunology: introductory textbook – I. New Age International, New

Reference Books:

1. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt.S Essential Immunology, 12th edition, Wiley-Blackwell. USA.
2. Janeway Travers. (1997). Immunobiology - the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
3. William R Clark. (1991). The Experimental Foundations of Modern Immunology. 3rd Edition. John Wiley and Sons Inc. New York.
4. Frank C. Hay, Olwyn M. R. Westwood. (2002). Practical Immunology, 4th Edition. Wiley-Blackwell.
5. Noel R. Rose, Herman Friedman, John L. Fahey. (1986). Manual of Clinical Laboratory Immunology. ASM. 3rd Edition

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/books/NBK279395/>
2. <https://med.stanford.edu/immunol/phd-program/ebook.html>



3. <https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/>
4. Immunology Overview –Medical Microbiology- NCBI Book shelf (nih.gov)

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Design a model of Immunoglobulin/Antibodies	K1
CO2	Describe which cell types and organs present in the immune response	K2
CO3	Illustrate various mechanisms that regulate immune responses and maintain Tolerance	K3
CO4	Exemplify the adverse effect of immune system including Allergy,	K4
CO5	Gain knowledge on hypersensitivity and autoimmunity	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	S	M	S	S	M
CO3	S	M	S	S	M	S	S	S	S
CO4	S	S	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	M	S	M

S - Strong, M – Medium, L – Low

Semester: III	Course Code:23UBTCT06	Hours/Week: 2	Credit: 2
COURSE TITLE: CORE VI - CLINICAL BIOTECHNOLOGY			

Course Overview:

1. To study the fusion of genetics, cell biology and many other sciences in order to further advance in medicine
2. To course in the medical stream for the students interested in studying living cells and organisms
3. To study covers almost all branches of life sciences related to body chemistry, microbiology, molecular study of living things, crop and plant improvement
4. To gain practical knowledge and technological expertise in cell and molecular biology

Learning Objectives:

1. The major objective of the paper is to envisage thorough knowledge in genetic diseases
2. Offers knowledge regarding Chromosomal aberrations
3. Provides knowledge on genetic diseases
4. Provides knowledge regarding various aspects of Humangenetics
5. Provide knowledge regarding clinical management and clinical enzymes

Unit - I	Classification of genetic diseases	09 Hours
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Classification of genetic diseases - Chromosomal disorders - numerical disorders e.g. trisomers and monosomes, structural disorders e.g. deletions, duplications, translocations and inversions, Chromosomal instability syndromes.

Unit - II	Gene controlled diseases	09 Hours
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Gene controlled diseases - autosomal and X- linked disorder, mitochondrial disorders, Fragile X Syndrome, myotonic dystrophy. Mitochondrial diseases. Microarray technology application in diseases.

Unit - III	Huntington's disease	09 Hours
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Huntington's disease - sickle cell diseases, AAT (alpha-1 antitrypsin deficiency), Alzhemiers Disease, cystic fibrosis, infection of nervous system

Unit - IV	Clinical management	09 Hours
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Clinical management & metabolic manipulation – PKU, Familial hyper cholesterolemia, Rickets, ADA, Congenital hypothyroidism

Unit - V	Clinical Enzymes	09 Hours
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Enzymes as thrombolytic agents, anti inflammatory agents, Streptokinase & Asparaginase. Catalytic antibodies

Text Book(s):

1. Betty Forbes, Danial SAHM Alics Weinfield, Bailey 2007. Scott's diagnostic microbiology, 12th edition Mosby.
2. Gerald collee, J, Andrew G. Fraser, Barri P Marmion, Mackie and Mc Cartney's Pratical medical microbiology, elesiver 2006.
3. Elmer W Koneman et al., Koneman's 2005. Color Atlas and Textbook of diagnostic microbiology, 6th edition. Lippincott Williams and Wilkins 35

Reference Books:

1. Gerald collee, J, Andrew G. Fraser, Barri P Marmion, Mackie and McCartney's Practical medical microbiology, elesiver 2006.

Web Resources:

1. <https://careers.iconplc.com>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	The students will gain knowledge about the inheritance pattern of the genes and genetic diseases	K1
CO2	Gain knowledge on numerical and structural changes of chromosomal	K2
CO3	The students will learn the modern molecular techniques for genetic disease diagnosis	K3
CO4	The students learn about the inheritance pattern of genes which cause genetic diseases in humans	K4
CO5	Gain knowledge on clinical management and clinical enzymes	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	S	M	S	S	M
CO3	S	M	M	S	M	S	M	S	M
CO4	S	S	M	S	M	S	S	S	S
CO5	M	S	S	S	S	S	M	S	M

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23UBTDE03	Hours/Week: 3	Credit: 3
COURSE TITLE: Elective Discipline III - BIOINFORMATICS AND BIostatITICS			

Course Overview:

1. To collaborate with researchers in the basic, medical and clinical sciences
2. To conduct methodological research
3. To collaborate with local, state or national health institutions; and to serve our institute
4. To provide a comprehensive approach to developing modern medicines and new agricultural products

Learning Objectives:

1. Acquire knowledge about the Developments and Applications of Bioinformatics.
2. Gain knowledge about the importance of the bioinformatics, databases, tools and software of bioinformatics and explain different types of Biological Databases.
3. Understand the basics of sequence alignment, sequence analysis and Protein structure prediction method.
4. Demonstrate the basic methods of data collection, graph construction and sampling techniques and Calculate measures of central tendency
5. Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods.



Unit - I	Introduction to Bioinformatics	09 Hours
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Genome, Transcriptome and Proteome, Gene prediction rules and software. Nucleic acid Databases – Primary and Secondary Databases – Structure Database – CATH, SCOP – Data base Searching – BLAST and FASTA, BLOSSUM.

Unit - II	Sequence analysis	09 Hours
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Sequence analysis (Proteins and Nucleic acids), Protein Database: Comparison of Protein Sequences and Database searching – methods for protein structure prediction - Homology Modeling of proteins, visualization tools (RASMOL).

Unit - III	Multiple Sequences alignment	09 Hours
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Method of multiple sequences alignment - Evolutionary analysis, clustering methods Phylogenetic Trees - Methods to generate phylogenetic tree- Tools for multiple sequences alignment and phylogenetic analysis - History of Drug Discovery, Steps in Drug design - Chemical libraries – Role of molecular docking in drug design

Unit - IV	Statistics	09 Hours
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Statistics – collection, classification, tabulations of Statistical Data – Diagrammatic representation – Graphs – Sampling method and standard error. Measures of central tendency – measures of dispersion

Unit - V	Correlations and regression.	09 Hours
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Probability distribution - Binomial, Negative binomial, multinomial distribution, Poisson Distribution. Tests of significance – t tests – F tests – Chi square test. Analysis of variance – Statistical Soft wares.

Text Book(s):

1. Pennington, S.R. and Punn, M. J. 2002. Proteomics: from protein sequence to function. Vivabooks Pvt. Ltd.
2. Shuba G., 2010. Bioinformatics., Tata Mc Graw Hill publishing. India.
3. Rastogi, S. C, Mendiratta, N, Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.
4. N. Gurumani (2011)"An Introduction to Biostatistics "M J P Publishers
5. Verbala Rastogi. (2011)."Fundamentals of Biostatistics", Ane books Pvt Ltd Publishers, Chennai.

Reference Books:

1. Attwood, T.K. and Parry-Smith, D. J.2008. Introduction to Bioinformatics. Pearson Education.
2. David Mount., Bioinformatics: sequence and genome analysis, second edition., Taylor & Francis, UK; 2009.
3. D.R. Westhead. Instant Notes in Bioinformatics, second edition., Taylor & Francis, UK; 2009.
4. Zar, (J.H.2010). Biostatistical Analysis Fifth Edition, Pearson Education Pvt Ltd, Indian Branch, New Delhi.
5. P.N. Arora and P. K. Malhan. (2013) " Biostatistics" Himalaya publishing House.

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	A student will develop a fundamental knowledge of DNA databank, protein databank and sequence alignment tool	K1
CO2	Acquire knowledge on handling biological databases	K2
CO3	Understand the practical skills in Statistics	K3
CO4	Understand test of significance	K4
CO5	Understand measures of central tendency like mean median-mode	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	M	M	S	S	S	M	S	M	M
CO3	S	M	M	M	M	S	M	S	M
CO4	S	S	M	S	M	S	S	M	S
CO5	M	S	S	S	S	S	M	S	M

S - Strong, M – Medium, L – Low

Semester: III	Course Code: 23UBTCP03	Hours/Week: 4	Credit: 3
COURSE TITLE: CORE PRACTICAL III – IMMUNOTECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS			

Course Overview:

1. The program aims to utilize and understand biological databases to gather, store, retrieve, manage, analyze and integrate biological data
2. To prepares you to apply and develop new computational techniques in biomedical research
3. To the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex
4. To course is aimed at individuals working in immunology research who have minimal experience in bioinformatics

Learning Objectives:

1. Perform blood grouping and determine blood type.
2. Able to count WBC and RBC.
3. Conduct serological diagnostic tests such as ASO, CRP, RA and Widal test.
4. Analyze the Biological databases, Able to perform BLAST and FASTA
5. Represent data into graphical form, Test the level of significance of biological data and interpret the results. Determine averages of the biological data

Unit - I	Immunotechnology	09 Hours
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Separation of Serum and Plasma.

Blood grouping and Rh typing.

WBC counting

RBC counting

Differential blood count

Unit - II	Analysis	09 Hours
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WIDAL Slide test

ASO test

Immuno electrophoresis

Double Immuno diffusion

Single Radial Immunodifusion

Unit - III	Immunology	09 Hours
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ELISA – Demonstration
Western blotting (demo)

Handling of Laboratory animals - Demonstration

Skin test – Demonstration

Unit - IV	Bioinformatics	09 Hours
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Biological databases (NCBI, SWISSPROT and PDB)

Sequence retrieval and alignment

BLAST FASTA

Protein visualization tools (Rasmol)

Identification of functional domain sinnucleotide binding proteins using a domain analysis server like SMART

Unit - V	Correlations and regression.	09 Hours
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Preparation of bar diagram, line diagram and pie diagram using MS EXCEL.

Measurement of Central tendency- mean, geometric mean, median using MS EXCEL

Calculation of dispersion – Mean deviation, quartile deviation and standard deviation

using MS EXCEL - Calculation of student's t test using MS EXCEL, Analysis of variance (ANOVA)

Text Book(s):

1. Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.
2. Asim Kumar Roy. (2019) Immunology Theory and Practical, Kalyani Publications.

Reference Books:

1. Frank C. Hay, Olwyn M. R. Westwood (2008). Practical Immunology, 4th Edition, Wiley-Black well.
2. Rose.(1992). Manual of Clinical Lab Immunology, ASM.
3. Wilmore Webley. (2016). Immunology LabManual, LAD Custom Publishing.
4. Janeway Travers (1997). Immunobiology - the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.
5. Peter J. Delves, Seamus Martin, Dennis R. Burton, Ivan M. Roitt. (2006). Roitt's Essential Immunology, 11th Edition., Wiley-Blackwell.

**Web Resources:**

- https://www.researchgate.net/publication/275045725_Practical_Immunology-_A_Laboratory_Manual
- <https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelingerlab/documents/Immunology-Lab-Manual.pdf>
- https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC106J-lab-manual.pdf 4
Immunology Overview - Medical Microbiology - NCBI Bookshelf (nih.gov) 5 Immunology - an
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Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Understand the practical skills in Immunology	K1
CO2	Examining and analyzing the results involved in immune techniques	K2
CO3	Acquire skills in instrument handling	K3
CO4	To know about the biological databases	K4
CO5	Learn about MS Excel, Data Analysis and Interpretation	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	M	M	S	S	S	M	S	M	M
CO3	S	M	M	M	M	S	M	S	M
CO4	S	S	M	S	M	S	S	M	S
CO5	M	S	S	S	S	S	M	S	M

S - Strong, M – Medium, L – Low

Semester: III	Course Code:23UBTSE02	Hours/Week: 1	Credit: 1
COURSE TITLE: SKILL ENHANCEMENT COURSE (SEC-4) QUALITY CONTROL IN INDUSTRIES			

Course Overview:

1. To involves testing units and determining if they are within the specifications for the final product
2. To purpose of the testing is to determine any need for corrective actions in the manufacturing process
3. To control helps companies meet consumer demands for better products
4. To focuses on two important management methodologies — Lean practices and Six Sigma

Learning Objectives:

1. To impart basic knowledge about quality control in pharmaceutical industry, quality control audits in industries.
2. Train the students on the basics of food safety and food quality.
3. To teach the microbial quality control in hospitals aim to impart knowledge on manufacturing operation in industries
4. Acquire skills to Manufacturing operations and controls
5. Demonstrate handling of waste and scrap disposal.

Unit - I	Industrial quality control	09 Hours
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Process of quality control - sterile and non - sterile preparations – raw materials, purity check, Quality check of finished products - Pharmaceutical products and their quality control - drugs and Vaccines. Environmental Monitoring – Pharmaceutical industry

Unit - II	Food safety and Food Quality	09 Hours
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Microbiological criteria of food, food products, Monitoring of factory hygiene and sanitation, Food Safety and Standards. Food contaminants and diseases

Unit - III	Microbial quality control in Hospitals	09 Hours
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Sanitation of manufacturing premises, cross contamination, processing of bulk products, Packaging operations, release of finished product.

Unit - IV	Manufacturing operations and controls	09 Hours
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Packaging operations, release of finished product.

Unit - V	Manufacturing operations and controls	09 Hours
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Expiry date calculation, calculation of yields, production record review, and handling of waste and Scrap disposal.

Text Book(s) :

1. Nally, J. D. (Ed.) (2007). Good Manufacturing Practices for Pharmaceuticals, Sixth Edition, Informa Healthcare USA, Inc., ISBN 10: 0-8593-3972-3 & ISBN 13: 978-0- 8493-3972-1, New York.
2. The training manual for Food Safety Regulators (2011) Food Safety regulations and food safety management. Food Safety and Standards Authority of India, New Delhi (<http://www.fssai.gov.in/trainingmanual.aspx>)

Reference Books:

1. U.S. Environmental Protection Agency (EPA). Washington, DC (2014). 21-Food and drugs, chapter I--Food and Drug Administration.
2. WHOTRS823 (1992).WHO expert committee on specifications for pharmaceutical preparations: thirty-second report. WHO Technical Report Series: 823, ISBN 9241408236, ISSN 0512-3054, Geneva

Web Resources:

1. <https://foodlicensing.fssai.gov.in/index.aspx>
2. <https://www.fda.gov/drugs/pharmaceutical-quality-resources/guidances-and-manuals-pharmaceutical-quality>

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	To acquire the knowledge quality control in pharmaceutical industry	K1
CO2	To learn the quality control audits in industries.	K2
CO3	To understand the basics of food safety and food quality.	K3
CO4	Skilled on manufacturing operation in industries	K4
CO5	To understand the manufacturing skills and controls	K5
K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create		

Mapping (COs vs POs)									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	M	M	S	S	S	M	S	M	S
CO3	S	M	S	M	S	S	M	S	M
CO4	S	S	M	S	M	S	S	S	S
CO5	S	S	S	S	S	S	M	S	S

S - Strong, M – Medium, L – Low

Semester: III	Course Code:23UBTSE03	Hours/Week: 2	Credit: 2
COURSE TITLE: SKILL ENHANCEMENT COURSE (SEC-5) MEDICINAL HERBS			

Course Overview:

1. To learn as to what constitutes a medicinal herb, how to identify one, and how different plants and plant parts are used as medicines
2. To learn about the type of soil that is suitable for growing herbs, the quantity and quality of water needed and other useful information
3. To provides the necessary background for providers to begin to incorporate herbal medicines into their practice, particularly in regards
4. To identify herbs accurately, how to grow them, harvest herbs, types of herbal medicines, chemical components

Learning Objectives:

1. The student can analyses the importance of herbal medicine
2. Can learn the role of herbal medicines for health
3. Can explain about Tribal medicine
4. Can analyses the role of traditional medicine for today sheath
5. Can demonstrate the use of medicinal herbs to health

Unit - I	Ethno medicine	09 Hours
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Definition, history and its scope – Inter disciplinary approaches in ethno botany – Collection of Ethnic information

Unit - II	Importance of medicinal plants	09 Hours
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Role in human health care – health and balanced diet (Role of proteins, carbohydrates, lipids and vitamins).

Unit - III	Tribal medicine	09 Hours
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Methods of disease diagnosis and treatment – Plants in folk religion – Aeglemarmelos, Ficus benghalensis, Curcuma domestica, Cynodondactylon and Sesamumindicum

Unit - IV	Traditional knowledge	09 Hours
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Traditional knowledge and utility of some medicinal plants in Tamil Nadu Solanumtrilobatum, Cardiospermumhalicacabum, Vitexnegundo, Adathodavasica, Azadirachtaindica, Gloriosa superba, Ecliptaalba, Aristolochiaindica and Phyllanthus fraternus

Unit - V	Plants in day today life	09 Hours
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Ocimum sanctum, Centellaasiatica, Cassia auriculata, Alovera. Nutritive and medicinal value of Some fruits (Guava, Sapota, Orange, Mango, Banana, Lemon, Pomegranate) and Vegetables - Greens (Moringa, Solanumnigrum Cabbage).

Text Book(s):

1. R.K. Sinha & Shweta Sinha (2001), Ethnobiology. Surabhe Publications–Jaipur.
2. D.C. Pal & S.K. Jain Naya Prakash, (1998), Tribal medicine, Bidhan Sarani, Calcutta,
3. S.K. Jain (2001) Contribution to Indian Ethnobotany – S.K. Jain, 3rd edition, scientific publishers, B.No.91, Jodhpur, India.
4. Andrew Chevallie, (2000) Encyclopedia of Herbal Medicine
5. James Green (2000). The Herbal Medicine-Maker's Handbook: A Home Manual

Reference Books:

1. Steven Horne and Thomas Easley (2016), Modern Herbal Dispensatory: A Medicine Muide
2. M.C. Joshi (2007) Handbook of Indian Medicinal Plants Hard covers.

3. Neelesh Malviya and Sapna Malviya (2019). *Herbal Drug Technology*, (1st Edition), CBS Publishers and Distributors, ISBN:9789387964334.
4. Rageeb Md. Usman, Vaibhav M. Darvhekar, Vijay Kumar D, and Akhila S.A, (2019). *Practical Book of Herbal Drug Technology*, (1st Edition), Nirali Prakashan Publishers, ISBN:9789388108002.
5. Pragi and Varun Arora (2019). *Herbal Drug Technology*, (1st Edition), S.Vikas and Company Publisher, ISBN:9781543343687

Teaching Methodology: Videos, Audios, PPT, Role Play, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

Learning Outcomes:

Upon successful completion of this course, the student will be able to

COs	Statements	Bloom's Level
CO1	Demonstrate the ability to acquire basic knowledge on ethanobotany	K1
CO2	To understand the role of herbal medicine	K2
CO3	To know the diagnosis and treatment of diseases by tribal medicine	K3
CO4	To understand the knowledge and utility of some medicinal plants	K4
CO5	To understand the role of traditional medicine	K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping (COs vs POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	S	S	S	S	S	S	S	S	S
CO2	M	S	S	S	S	M	S	M	M
CO3	S	S	S	M	M	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S
CO5	M	S	S	S	S	S	M	S	M

S - Strong, M – Medium, L – Low