



**SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE**

(An Autonomous Institution)

(Approved by AICTE, New Delhi & Affiliated to Pondicherry University)  
(Accredited by NBA-AICTE, New Delhi & Accredited by NAAC with "A" Grade)  
Madagadipet, Puducherry - 605 107



---

## **SCHOOL OF ARTS AND SCIENCE**

### **BACHELOR OF SCIENCE IN BIOTECHNOLOGY**

**ACADEMIC REGULATIONS  
2020(R-2020)  
CURRICULUM AND SYLLABI**

## COLLEGE VISION AND MISSION

### Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

### Mission

#### M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting-edge technologies with best practices.

#### M2: Research and Innovation:

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

#### M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill-based training.

#### M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

## DEPARTMENT OF BIOSCIENCE

### BIOTECHNOLOGY - VISION AND MISSION

#### Vision

- To give Knowledge of both fundamental and applied aspects of Biotechnology
- To develop hardcore specialization in various diversified areas of biotechnology and its application to Medicine, Agriculture, Environment, Nutraceuticals and functional food etc.
- To encourage students to follow emerging scientific interests and talents.
- To provide students with transferable skills and critical thinking and analytical methods, laboratory techniques, team work and scientific communication, information technology and bioinformatics.
- To provide students with high quality research experience

#### Mission

##### M1: Quality Education:

- Updating the course curriculum to cater the needs of Academia and Industry
- To impart quality education for life- long professional growth and opportunity in a wide range of Careers.

##### M2: Research and Innovation:

- To create awareness towards socio-ethical implications of potentials of Biotechnology
- Emphasis on recent trends in Biotechnology through organization of conferences, symposia, workshops.

##### M3: Employability and Entrepreneurship:

- To inculcate the employability and entrepreneurial skills through value and skill based training.
- To foster value based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

**STRUCTURE FOR UNDERGRADUATE PROGRAMME**

S. No	Course Category	Break down of Credits
1	Language Modern Indian Language (MIL)	6
2	English (ENG)	6
3	Discipline Specific Core Courses(DSC)	74
4	Discipline Specific Elective Courses (DSE)	12
5	Inter-Disciplinary Courses(IDC)	24
6	Skill Enhancement Courses(SEC)	14
7	Employability Enhancement Courses(EEC*)	-
8	Ability Enhancement Compulsory Courses(AECC)	4
9	Open Elective(OE)	4
10	Extension Activity(EA)	1
<b>Total</b>		<b>145</b>

**SCHEME OF CREDIT DISTRIBUTION –SUMMARY**

S. No	Course Category	Credits per Semester						Total Credits
		I	II	III	IV	V	VI	
1	Language Modern Indian Language (MIL)	3	3	-	-	-	-	6
2	English (ENG)	3	3	-	-	-	-	6
3	Discipline Specific Core Courses(DSC)	10	10	10	10	16	18	74
4	Discipline Specific Elective Courses (DSE)	-	-	3	3	3	3	12
5	Inter-Disciplinary Courses(IDC)	6	6	6	6	-	-	24
6	Skill Enhancement Courses(SEC)	2	2	2	2	2	4	14
7	Employability Enhancement Courses(EEC*)	-	-	-	-	-	-	-
8	Ability Enhancement Compulsory Courses(AECC)	2	2	-	-	-	-	4
9	Open Elective(OE)	-	-	2	2	-	-	4
10	Extension Activity(EA)	-	1	-	-	-	-	1
<b>Total</b>		<b>26</b>	<b>27</b>	<b>23</b>	<b>23</b>	<b>21</b>	<b>25</b>	<b>145</b>

\* EEC will not be included for the computation of "Total of Credits " as well as "CGPA"

3

Bachelor of Science in Biotechnology

SEMESTER-I										
S.No	Course Code	Course Title	Category	Periods			Credits	Max.Marks		
				L	T	P		CAM	ESM	Total
<b>Theory</b>										
1	A20TAT101 A20FRT101	Tamil-I/French-I	MIL	3	0	0	3	25	75	100
2	A20GET101	General English -I	ENG	3	0	0	3	25	75	100
3	A20BTT101	Cell biology	DSC	4	0	0	4	25	75	100
4	A20BTT102	Biochemistry - I - Biomolecules	DSC	4	0	0	4	25	75	100
5	A20BTD101	Chemistry - I	IDC	3	1	0	4	25	75	100
<b>Ability Enhancement Compulsory Course</b>										
6	A20AET101	Environmental Studies	AECC	2	0	0	2	100	0	100
<b>Practical</b>										
7	A20BTL103	Cell biology and Biomolecules Practical	DSC	0	0	4	2	50	50	100
8	A20BTD102	Chemistry - I Practical	IDC	0	0	4	2	50	50	100
<b>Skill Enhancement Course</b>										
9	A20BTS101	Communication Skills Lab	SEC	0	0	4	2	100	0	100
<b>Employment Enhancement Course</b>										
10	A20BTC101	Certification course -I	EEC	2	0	2	0	100	0	100
							<b>26</b>	<b>525</b>	<b>475</b>	<b>1000</b>
SEMESTER- II										
S. No.	Course Code	Course Title	Category	Periods			Credits	Max.Marks		
				L	T	P		CAM	ESM	Total
<b>Theory</b>										
1	A20TAT202 A20FRT202	Tamil-II/French-II	MIL	3	0	0	3	25	75	100
2	A20GET202	General English-II	ENG	3	0	0	3	25	75	100
3	A20BTT204	Fundamentals of Microbiology	DSC	4	0	0	4	25	75	100
4	A20BTT205	Biochemistry-II- Intermediary Metabolism	DSC	4	0	0	4	25	75	100
5	A20CHD203	Chemistry -II	IDC	3	1	0	4	25	75	100
<b>Ability Enhancement Compulsory Course</b>										
6	A20AET202	Public Administration	AECC	2	0	0	2	100	0	100
<b>Practical</b>										
7	A20BTL206	Fundamentals of Microbiology and Intermediary Metabolism Practical	DSC	0	0	4	2	50	50	100
8	A20CHL224	Chemistry-II Practical	IDC	0	0	4	2	50	50	100
<b>Skill Enhancement Course</b>										
9	A20BTS202	Medical Laboratory Technology	SEC	0	0	4	2	100	0	100
<b>Extension Activities</b>										
10	A20EAL201	National Service Scheme	EA	0	0	2	1	100	0	100
<b>Employment Enhancement Course</b>										
11	A20BTC202	Certification course- II	EEC	2	0	2	0	100	0	100
							<b>27</b>	<b>625</b>	<b>475</b>	<b>1100</b>

SEMESTER - III										
S. No	Course Code	Course Title	category	Periods			Credits	Max.Marks		
				L	T	P		CAM	ESM	Total
<b>Theory</b>										
1	A20BTT307	Molecular Biology	DSC	4	0	0	4	25	75	100
2	A20BTT308	Analytical Techniques in Biotechnology	DSC	4	0	0	4	25	75	100
3	A20BTD304	Applied Microbiology	IDC	4	0	0	4	25	75	100
4	A20BTE3XX	DSE-I	DSE	3	0	0	3	25	75	100
5	A20XXO3XX	Open Elective-I	OE	2	0	0	2	25	75	100
<b>Practical</b>										
6	A20BTL309	Molecular Biology and Analytical Techniques in Biotechnology Practical	DSC	0	0	4	2	50	50	100
7	A20BTL323	Applied Microbiology Practical	IDC	0	0	4	2	50	50	100
<b>Skill Enhancement Course</b>										
8	A20BTS303	Soft Skills Lab	SEC	0	0	2	2	100	0	100
<b>Employment Enhancement Course</b>										
9	A20BTC303	Certification course- III	EEC	2	0	2	0	100	0	100
							<b>23</b>	<b>425</b>	<b>475</b>	<b>900</b>

SEMESTER- IV										
S. No	Course Code	Course Title	Category	Periods			Credits	Max.Marks		
				L	T	P		CAM	ESM	Total
<b>Theory</b>										
1	A20BTT410	Genetic Engineering	DSC	4	0	0	4	25	75	100
2	A20BTT411	Immunology	DSC	4	0	0	4	25	75	100
3	A20MAD409	Biostatistics	IDC	3	1	0	4	25	75	100
4	A20BTE4XX	DSE-II	DSE	3	0	0	3	25	75	100
5	A20XXO4XX	Open Elective- II	OE	2	0	0	2	25	75	100
<b>Practical</b>										
6	A20BTL412	Genetic Engineering and Immunology Practical	DSC	0	0	4	2	50	50	100
7	A20MAL404	Biostatistics Practical	IDC	0	0	4	2	50	50	100
<b>Skill Enhancement Course</b>										
8	A20BTS404	Research Methodology	SEC	0	0	4	2	100	0	100
<b>Employment Enhancement Course</b>										
9	A20BTC404	Certification course- IV	EEC	2	0	2	0	100	0	100
							<b>23</b>	<b>425</b>	<b>475</b>	<b>900</b>

SEMESTER-V										
S. No	Course Code	Course Title	Category	Periods			Credits	Max.Marks		
				L	T	P		CAM	ESM	Total
<b>Theory</b>										
1	A20BTT513	Bioprocess Technology	DSC	4	0	0	4	25	75	100
2	A20BTT514	Bioinformatics	DSC	4	0	0	4	25	75	100
3	A20BTT515	Plant Biotechnology	DSC	4	0	0	4	25	75	100
4	A20BTE5XX	DSE-III	DSE	3	0	0	3	25	75	100
<b>Practical</b>										
5	A20BTL516	Bioprocess Technology and Bioinformatics Practical	DSC	0	0	4	2	50	50	100
6	A20BTL517	Plant Biotechnology Practical	DSC	0	0	2	2	50	50	100
<b>Skill Enhancement Course</b>										
7	A20BTS505	In-Plant training / Internship	SEC	0	0	2	2	100	0	100
							<b>21</b>	<b>300</b>	<b>400</b>	<b>700</b>

SEMESTER-VI										
S. No	Course Code	Course Title	Category	Periods			Credits	Max.Marks		
				L	T	P		CAM	ESM	Total
<b>Theory</b>										
1	A20BTT618	Marine Biotechnology	DSC	4	0	0	4	25	75	100
2	A20BTT619	Pharmaceutical Biotechnology	DSC	4	0	0	4	25	75	100
3	A20BTT620	Biosafety, Bio-ethics and IPRs	DSC	4	0	0	4	25	75	100
4	A20BTT621	Medical Biotechnology	DSC	4	0	0	4	25	75	100
5	A20BTE6XX	DSE- IV	DSE	3	0	0	3	25	75	100
<b>Practical</b>										
6	A20BTL622	Marine Biotechnology and Pharmaceutical Biotechnology Practical	DSC	0	0	4	2	50	50	100
<b>Skill Enhancement Course</b>										
7	A20BTS606	R & D and Bio entrepreneurship	SEC	0	0	2	2	100	0	100
8	A20BTS607	Seminar presentation	SEC	0	0	2	2	100	0	100
							<b>25</b>	<b>375</b>	<b>425</b>	<b>800</b>

*\*Discipline Specific Electives are to be selected from the list given in Annexure I*

*\*\*Open electives are to be selected from the list given in Annexure II*

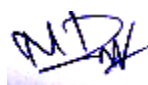
## ANNEXURE I

## DISCIPLINE SPECIFIC ELECTIVE COURSES

DISCIPLINE SPECIFIC ELECTIVES										
S. No.	Course Code	Course Title	Category	Periods			Credits	Max.Marks		
				L	T	P		CAM	ESM	Total
<b>Discipline Specific Electives (DSE - I) - offered in Third Semester</b>										
1	A20BTE301	Genetics	DSE	3	0	0	3	25	75	100
2	A20BTE302	General Biology	DSE	3	0	0	3	25	75	100
3	A20BTE303	Parasitology and Entomology	DSE	3	0	0	3	25	75	100
<b>Discipline Specific Electives (DSE - II) - offered in Fourth Semester</b>										
1	A20BTE404	Developmental Biology	DSE	3	0	0	3	25	75	100
2	A20BTE405	Biology of Cloning Vectors	DSE	3	0	0	3	25	75	100
3	A20BTE406	Molecular Diagnosis	DSE	3	0	0	3	25	75	100
<b>Discipline Specific Electives (DSE - III) - offered in Fifth Semester</b>										
1	A20BTE507	Animal Biotechnology	DSE	3	0	0	3	25	75	100
2	A20BTE508	Nanobiotechnology	DSE	3	0	0	3	25	75	100
3	A20BTE509	Microbial Biotechnology	DSE	3	0	0	3	25	75	100
<b>Discipline Specific Electives (DSE - IV) - offered in Sixth Semester</b>										
1	A20BTE610	Environmental Biotechnology	DSE	3	0	0	3	25	75	100
2	A20BTE611	Genomics and Proteomics	DSE	3	0	0	3	25	75	100
3	A20BTE612	Enzyme Technology	DSE	3	0	0	3	25	75	100

**Annexure -II**  
**OPEN ELECTIVE COURSES**

<b>Open Elective - I (Offered in Semester III)</b>				
<b>Sl. No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Offering Department</b>	<b>Permitted Departments</b>
1	A20BTO301	Biotechnology for human welfare	Bioscience	Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
2	A20BTO302	Food Processing	Bioscience	Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
3	A20BTO303	Food Technology	Bioscience	Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
4	A20CHO304	Food Analysis (Practical)	Chemistry	Bioscience, Computational Studies, Food Science, Mathematics, Physics
5	A20CHO305	Molecules of Life (Practical)	Chemistry	Bioscience, Computational Studies, Food Science, Mathematics, Physics
6	A20CHO306	Water Analysis (Practical)	Chemistry	Bioscience, Computational Studies, Food Science, Mathematics, Physics
7	A20CMO307	Fundamentals of Accounting and Finance	Commerce and Management	Bioscience, Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
8	A20CMO308	Fundamentals of Management	Commerce and Management	Bioscience, Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
9	A20CMO309	Fundamentals of Marketing	Commerce and Management	Bioscience, Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
10	A20CPO310	Data Structures	Computational Studies	Mathematics
11	A20CPO311	Programming in C	Computational Studies	Commerce and Management, Mathematics, Media Studies
12	A20CPO312	Programming in Python	Computational Studies	Commerce and Management, Mathematics, Media Studies
13	A20ENO313	Conversational Skills	English	Chemistry, Commerce and Management, Computational Studies, Media Studies, Mathematics, Physics



Academic Curriculum and Syllabi R-2020

14	<b>A20ENO314</b>	Fine-tune your English	English	Chemistry, Commerce and Management, Computational Studies, Media Studies, Mathematics, Physics
15	<b>A20ENO315</b>	Interpersonal Skills	English	Chemistry, Commerce and Management, Computational Studies, Media Studies, Mathematics, Physics
16	<b>A20MAO316</b>	Mathematical Modelling	Mathematics	Chemistry, Commerce and Management, Computational Studies, Physics, Biotechnology, Nutrition and Dietetics
17	<b>A20MAO317</b>	Quantitative Aptitude - I	Mathematics	Chemistry, Commerce and Management, Computational Studies, Physics, Biotechnology, Nutrition and Dietetics
18	<b>A20MAO318</b>	Statistical Methods	Mathematics	Chemistry, Commerce and Management, Computational Studies, Physics, Biotechnology, Nutrition and Dietetics
19	<b>A20VCO319</b>	Event Management	Media Studies	Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Physics
20	<b>A20VCO320</b>	Graphic Design	Media Studies	Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Physics
21	<b>A20VCO321</b>	Role of social media	Media Studies	Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Physics
22	<b>A20NDO322</b>	Basic Food Groups	Food Science	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Media Studies, Physics, Tamil
23	<b>A20NDO323</b>	Life Style Management	Food Science	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Media Studies, Physics, Tamil
24	<b>A20NDO324</b>	Nutritive Value of Foods	Food Science	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Media Studies, Physics, Tamil
25	<b>A20PHO325</b>	Astrophysics	Physics	Bioscience, Chemistry, Computational Studies, Mathematics, Media Studies

Academic Curriculum and Syllabi R-2020

26	A20PHO326	Basic of Modern Communication System	Physics	Bioscience, Chemistry, Computational Studies, Mathematics, Media Studies
27	A20PHO327	Bio-Physics	Physics	Bioscience, Chemistry, Computational Studies, Mathematics, Media Studies
28	A20TMO328	அடிப்படைத்தமிழ்	Tamil	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
29	A20TMO329	வாழ்வியல் இலக்கணம்	Tamil	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
30	A20TMO330	புதுக்கவிதைப் பட்டறை	Tamil	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics

Open Elective - II (Offered in Semester IV)

Sl. No.	Course Code	Course Title	Offering Department	Permitted Departments
1	A20BTO401	Herbal Technology	Bioscience	Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
2	A20BTO402	Vermiculture	Bioscience	Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
3	A20BTO403	Biotechnology for Society	Bioscience	Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
4	A20CHO404	C++ Programming and its Application to Chemistry	Chemistry	Computational Studies, Mathematics, Physics
5	A20CHO405	Computational Chemistry Practical	Chemistry	Computational Studies, Mathematics, Physics
6	A20CHO406	Instrumental Methods of Analysis	Chemistry	Computational Studies, Mathematics, Physics
7	A20CMO407	Essential Legal Awareness	Commerce and Management	Bioscience, Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics

Academic Curriculum and Syllabi R-2020

8	<b>A20CMO408</b>	Essentials of Insurance	Commerce and Management	Bioscience, Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
9	<b>A20CMO409</b>	Practical Banking	Commerce and Management	Bioscience, Chemistry, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
10	<b>A20CPO410</b>	Database Management Systems	Computational Studies	Commerce and Management, Media Studies, Mathematics
11	<b>A20CPO411</b>	Introduction to Data Science using Python	Computational Studies	Chemistry, Commerce and Management, English, Media Studies, Mathematics, Physics
12	<b>A20CPO412</b>	Web Development	Computational Studies	Commerce and Management, Media Studies, Mathematics
13	<b>A20ENO413</b>	Functional English	English	Chemistry, Commerce and Management, Computational Studies, Media Studies, Mathematics, Physics
14	<b>A20ENO414</b>	English Next-India	English	Chemistry, Commerce and Management, Computational Studies, Media Studies, Mathematics, Physics
15	<b>A20ENO415</b>	English for Competitive Exam	English	Chemistry, Commerce and Management, Computational Studies, Media Studies, Mathematics, Physics
16	<b>A20MAO416</b>	Discrete mathematics	Mathematics	Chemistry, Computational Studies, Physics
17	<b>A20MAO417</b>	Operations Research	Mathematics	Chemistry, Commerce and Management, Computational Studies, Physics, Biotechnology, Nutrition and Dietetics
18	<b>A20MAO418</b>	Quantitative Aptitude - II	Mathematics	Chemistry, Commerce and Management, Computational Studies, Physics, Biotechnology, Nutrition and Dietetics
19	<b>A20VCO419</b>	Basics of News Reporting	Media Studies	Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Physics
20	<b>A20VCO420</b>	Scripting for media	Media Studies	Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Physics
21	<b>A20VCO421</b>	Video Editing	Media Studies	Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Physics

Academic Curriculum and Syllabi R-2020

22	A20NDO422	Food Labelling	Food Science	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Media Studies, Physics, Tamil
23	A20NDO423	Hygiene and Sanitation	Food Science	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Media Studies, Physics, Tamil
24	A20NDO424	Nutrition for Adolescent	Food Science	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Mathematics, Media Studies, Physics, Tamil
25	A20PHO425	Digital Electronics	Physics	Bioscience, Chemistry, Computational Studies, Mathematics, Media Studies
26	A20PHO426	Geo-Physics	Physics	Bioscience, Chemistry, Computational Studies, Mathematics, Media Studies
27	A20PHO427	Space Science	Physics	Bioscience, Chemistry, Computational Studies, Mathematics, Media Studies
28	A20TMO428	சிறுகதைப் பயிற்சி	Tamil	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
29	A20TMO429	செய்தி வாசிப்பு பயிற்சி	Tamil	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics
30	A20TMO430	நிகழ்த்துக்கலை	Tamil	Bioscience, Chemistry, Commerce and Management, Computational Studies, English, Food Science, Mathematics, Media Studies, Physics

**மொழித்தாள்**

**தமிழ்-I**

(B.A., B.Sc., B.Com., B.B.A., & B.C.A., பாடப்பிரிவுகளுக்கும்மான வொதுத்தாள்)

**L T P C Hrs**  
**3 0 0 3 45**

**A20TAT101**

**பாத்திரத்தின் நோக்கம்**

இரண்டாறாம் ஆண்டுகால தமிழின் தொன்மையையும் வரலாற்றையும் அதன் விழுமியங்களையும் பண்பாட்டையும் எடுத்துரைப்பதாக இப்பாத்திரம் அமைக்கப்பட்டுள்ளது. தமிழ் இலக்கியம் உள்ளடக்கத்திலும், வடிவத்திலும் பெற்ற மாற்றங்கள், அதன் சிந்தனைகள், அடையாளங்கள் ஆகியவற்றைக் காண்பதோடும் எழுதப்பட்ட இலக்கியங்களின் வழியாகக் கூறுவதற்கு இப்பாத்திரம் அமைக்கப்பட்டுள்ளது. மொழியின் கட்டமைப்பைப் பற்றி உள்ளடக்க இப்பாத்திரம் வடிவமைக்கப்பட்டுள்ளது. வாழ்வியல் சிந்தனைகள், ஒழுக்கவியல் கோட்பாடுகள், சமத்துவம், சூழ்வியல் எனப் பல கூறுகளை மாணவர்களுக்கு எடுத்துரைக்கும் விதத்தில் இப்பாத்திரம் உருவாக்கப்பட்டுள்ளது. சிந்தனை ஆற்றலை வகுக்குவதற்குத் தாய்மொழியின் பங்களிப்பினை உணர்த்த இப்பாத்திரம் அமைக்கப்பட்டுள்ளது.

**பாத்திரத்தின் வெளியடிகள்**

- CO1** - இலக்கியங்கள் காட்டும் வாழ்வியல் நெறிமுறைகளைப் பேணிநடத்தல்.  
**CO2** - நமது எண்ணத்தை வெளியடுத்தும் கருவியாகத் தாய்மொழியைப் பயன்படுத்துதல்.  
**CO3** - தகவல் தொடர்புக்குத் தாய்மொழியின் முக்கியத்துவத்தை உணர்த்தல்.  
**CO4** - தாய்மொழியின் சிறப்பை அறிதல்.  
**CO5** - இலக்கிய இனங்களை நுகரும் நிறைகளை வளர்த்தல்.

**அலகு-1**

**(9 Hrs)**

**இக்காலக் கவிதைகள்-1**

- |                    |   |                                  |
|--------------------|---|----------------------------------|
| 1. பாதிபார்        | - | கண்ணன் என் சேவகன்                |
| 2. பாதிதாசன்       | - | தமிழ்ப்பேறு                      |
| 3. அத்துல் ரகுமான் | - | அவதாரம்                          |
| 4. யீரா            | - | கனவுகள் + கற்பனைகள் = காகிதங்கள் |
| 5. து.நரசிம்மன்    | - | மன்னித்துவிடு மகனே               |

**அலகு-2**

**(9 Hrs)**

**இக்காலக் கவிதைகள்-2**

- |                      |   |                                |
|----------------------|---|--------------------------------|
| 1. ராஜா சந்திரசேகர்  | - | கைவிடப்பட்ட குழந்தை            |
| 2. அனார்             | - | மேலும் சில இரத்தக் குறியீடுகள் |
| 3. கவிநாணி           | - | அம்மமா                         |
| 4. நா.முத்துக்குமார் | - | தூள்                           |

**அலகு-3**

**(9 Hrs)**

**சிற்பிலக்கியங்கள்**

- |                       |   |                                       |
|-----------------------|---|---------------------------------------|
| 1. கலிங்கத்துப் யுரணி | - | வாகுதுக்கை வான் எங்கே... (பாடல்-485)  |
| 2. அழகனின்னைவிடு தூது | - | இதமாய் மனிதருடனே... (பாடல்-45)        |
| 3. நந்திக் கலம்பகம்   | - | அம்மொன்று வில்லொழை... (பாடல்-77)      |
| 4. முக்சுடற் பள்ளா    | - | பாபும் மருதகு செடுக்கவே... (பாடல்-47) |
| 5. குற்றாலக் குறவஞ்சி | - | ஓடக் காண்பாதுமே... (பாடல்-9)          |

**காப்பியங்கள்**

2. மணிமேகலை-உலகநாவி முக்க காதை- 'மகனில் வால்ஒளி! - இந்நாள் போலும் இளங்கொடி கெடுத்தனை'. (28-அடிகள்)

**அலகு-4**

**(9 சுவிசேஷி)**

**தமிழ் இலக்கிய வரலாறு**

## Academic Curriculum and Syllabi R-2020

1. சிற்றிலக்கியம்- தேற்றமும் வளர்ச்சியும்
2. புதுக்கவிதை- தேற்றமும் வளர்ச்சியும்
3. சிறுகதை -தேற்றமும் வளர்ச்சியும்
4. புதினம் -தேற்றமும் வளர்ச்சியும்
5. உரைநடை - தேற்றமும் வளர்ச்சியும்

### உரைநடைய் பகுதி

1. உ.வே.சாமிநாதையர் - சிவதருமேந்திரர் சுவடி வற்ற வரலாறு.
2. நஞ்சாவூர் கவிராயர் - சஜாவின கோயம்.
3. இரா. பச்சிய்யன் - மாடல் மறையவை.

### அலகு 5

#### மொழியியற்சி

1. கலைச்சொல்லக்கம்
2. அகரவரிசையடுத்த்துதல்
3. மடித்தொழியுமொழி
4. கலை விமர்சனம்
5. நோக்காணல்

### உரைநடை நூல்கள்

1. சத்திவேல், சு., தமிழ் மொழி வரலாறு, மாணிக்கவாசகர் பதிப்பகம், சிதம்பரம், 1988.
2. சிற்றி பாசுபரமணியம் மற்றும் நிலைமநாபன், புதிய தமிழ் இலக்கிய வரலாறு, தொகுதி-1, 2, 3, சாகித்திய அகாமி, புதுடெல்லி, 2013.
3. பாரதியார், பாரதியார் கவிதைகள், குமரன் பதிப்பகம், சென்னை, 2011.

### பார்வை நூல்கள்

1. கைலாசபதி, சு., தமிழ் நாவல் இலக்கியம், குமரன் பதிப்பகம், வடபழனி, 1968.
2. சுந்தராஜன், டி.கே. சிவாநாதசுந்தரம். சே., தமிழ்ப்பில் சிறுகதை வரலாறும் வளர்ச்சியும், க்ரியா, சென்னை, 1989.
3. பாரதாமமாள், அ.கி., நல்ல தமிழ் எழுத வேண்டுமா, பாரி நிலையம், சென்னை, 1998.
4. பாக்கியமணி, வகைமை நோக்கில் தமிழ் இலக்கிய வரலாறு, என். சி.எச். பதிப்பகம், சென்னை, 2011.
5. வல்லிக்கண்ணன், புதுக்கவிதையின் தேற்றமும் வளர்ச்சியும், அன்னம், சிவகங்கை, 1992.

### இணையத்தளங்கள்

- . <http://www.tamilkodal.com>
- . <http://www.languagelab.com>
- . <http://www.tamilweb.com>

(9 சஷிஷெவி)

**A20FRT101** ( Common to B.A., B.Sc., B.Com., B.B.A. & B.C.A )

**FRENCH - I**

**L T P C Hrs**  
**3 0 0 3 45**

**OBJECTIVES**

- To enable the students read, understand, and write simple sentences.
- To grasp relevant grammar for communication
- To learn about the land, people and culture of France.

**UNITÉ – 1 (9Hrs)**

Je m'appelle Elise. Et Vous ?

Vous Dansez ? D'accord

Monica, Yukiko et compagnie

**UNITÉ - 2 (9Hrs)**

Les Voisins de Sophie

Tu vas au Luxembourg ?

**UNITÉ – 3 (9Hrs)**

Nous Venons pour l'inscription

A Vélo, en tain, en avoin

Pardon, monsieur, le BHV s'il vous plait ?

**UNITÉ - 4(9Hrs)**

Au marche

On déjeune ici ?

**UNITÉ - 5(9Hrs)**

On va chez ma copine ?

Chez Susana

**TextBook**

Prescribed Textbook : *FESTIVAL 1* - Méthode de Français

Authors : Sylvie POISSON-QUINTON

Michèle MAHEO-LE COADIC

Anne VERGNE-SIRIEYS

Edition : CLE International, Nouvelle Édition révisée : 2009.

**Reference Book** : Festival 1

<b>A20GET101</b>	<b>GENERAL ENGLISH I</b> (Common to B.A., B.Sc. and B.C.A.)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>45</b>

**Course Objectives**

- To recognize the rhythms, metrics and other musical aspects of poetry.
- To read a variety of texts critically and proficiently.
- To enable the students to enjoy the flair of literature through the work of great writer.
- To make the students to know the functions of basic grammar and frame sentences without grammatical error.
- To enable them understanding the intrinsic nuances of writing in English language.

**Course Outcomes**

**After the completion of this course, the students will be able to**

- CO1** – Comprehend and discuss the various facets of selected poems.
- CO2** – Analyze and interpret texts written in English.
- CO3** – Read drama with graduate-level interpretive and analytical proficiency.
- CO4** – Improve the fluency and formation of grammatically correct sentence.
- CO5** – Enhance the writing skills for specific purposes.

**UNIT I POETRY (9Hrs)**

1. John Milton: On His Blindness
2. William Wordsworth: Daffodils
3. Percy Bysshe Shelly: Ozymandias
4. Emily Dickinson: Because I could not stop for Death
5. Sarojini Naidu: The Queen’s Rival

**UNIT II PROSE (9Hrs)**

1. Francis Bacon: Of Love
2. Charles Lamb: A Dissertation upon Roast Pig

**UNIT III DRAMA (9Hrs)**

1. Oscar Wilde: Lady Windermere’s Fan

**UNIT IV GRAMMAR (9Hrs)**

1. Parts of Speech
2. Tenses
3. Subject-Verb Agreement

**UNIT V COMPOSITION (9Hrs)**

1. Essay Writing
2. Email



**Text Books:**

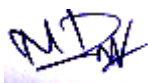
1. James Barrett, "Brookside Musings: A Selection of Poems and Short Stories: Board of Editors", Orient Longman Limited, 2009.
2. Wilde Oscar, "Lady Windermere's Fan. Published in The Importance of Being Earnest and Other Plays", London: Penguin, 1940.
3. Wren & Martin, "High School English Grammar & Composition". Blackie ELT Books, 2017.

**Reference Books:**

1. Lalitha Natarajan and Sasikala Natesan, "English for Excellence: Poetry", Anuradha Publications, 2015.
2. Charles Lamb, "Selected Prose", Penguin Classics. United Kingdom, 2013.
3. Usha Mahadevan, "Sunbeams: Empower with English", Emerald Publishers, Chennai. 2016.

**Web references:**

1. <https://www.englishcharity.com/of-love-by-francis-bacon-explanation/>
2. [https://www.poetry-archive.com/n/the\\_queens\\_rival.html](https://www.poetry-archive.com/n/the_queens_rival.html)
3. <https://www.gradesaver.com/lady-windermere-fan/study-guide/summary-act-i>



A20BTT101

**CELL BIOLOGY**

L	T	P	C	Hrs
4	0	0	4	60

**(Common to B.Sc.Biotechnology, B.Sc. Microbiology and B.Sc. Biochemistry)**  
**Course Objectives**

- To understand the Fundamentals of Cells and its types.
- To study the cell structure and cellular organization.
- To understand the structure and Functions of cell organelles.
- To understand the Structure and organization of nucleus.
- To study about Cell division.

**Course Outcomes**

**After completion of the course, the students will be able to**

- CO1** - Understand the cells are the basic unit of life and various types of cells.  
**CO2** - Know the basic cell structure and basement membrane in cells.  
**CO3** - Understand the structure and functions of cellular organelles.  
**CO4** - Understand the structure and functions of nucleus.  
**CO5**- Understand the basic mechanisms cell division.

**UNIT – I****(10 hours)**

History of cell Biology, cell as basic unit of life, Cell theory, Protoplasm theory, Organismal theory, Classification & characterization of cell types – Prokaryotes & Eukaryotes, Organization, Ultrastructure of plant cell, animal cell, bacterial cell and viruses.

**UNIT – II****(10 hours)**

Structure and function of cell wall - Bacterial and Plant. Ultrastructure of plasma membrane - fluid mosaic model, membrane fluidity, Transport across membranes - Symport, antiport, uniport, active and passive transport, Intra cellular communication, Differentiation of cell surface: Basement membrane, tight junction, gap junctions, Desmosomes, hemidesmosomes. Cytoskeletal structures - microtubules, microfilaments (actin, myosin), Intermediate filament.

**UNIT –III****(10 hours)**

Structure & Functions of cell organelles: Endoplasmic Reticulum (SER & RER), golgi apparatus, lysosomes, microbodies (peroxysomes and glyoxysomes), ribosomes and its types, centrioles, basal bodies. Structure and functions of mitochondria, chloroplast, organization of respiratory chain in mitochondria, photophosphorylation in chloroplast.

**UNIT – IV****(15 hours)**

Structure and organization of nucleus, nuclear membrane, organization of chromosomes - structural organization of chromatids, centromere, chromatin, telomere, nucleosomes, euchromatin and heterochromatin, specialized structures- polytene and lambrush chromosomes

**UNIT – V****(15 hours)**

Cell division - Cell cycle, mitosis and meiosis, regulations of cell cycle and check points and enzymes involved in cell cycle check points. Basics in cell signaling- signaling molecules and receptors, G protein coupled receptors, receptor protein tyrosin kinases, apoptosis and necrosis.

**Text Books:**

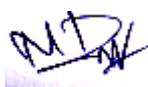
1. E.D. P. De Robertis and E.M.F. De Robertis, Jr. 2012 Cell and Molecular Biology (Eighth edition). B.I. Waverly Pvt.Ltd. New Delhi.
2. Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell, 2009. Molecular Cell Biology (Fourth Edition). Media Connected – W.H.Freeman and Company.
3. P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology. S.Chand & Company Ltd., New Delhi;

**Reference Books:**

1. D.E Sadava, 1993. Cell Biology - Organelle Structure and Function. Jones and Bartlett Publishers
2. B Alberts, 2009 Essential Cell Biology (Third Edition), Garland Science; publishers
3. Alberts Bruce, 2008 Molecular Biology of the Cell (Fifth Edition), Garland Science; publishers

**Web references:**

1. <https://www.google.com/search?q=History+of+cell+Biolog>
2. <https://www.google.com/search?q=structure+and+function+of+cell+wall+ppt&sxsrf>
3. <https://www.toppr.com/guides/biology/the-fundamental-unit-of-life/cell-organelle/>
4. <https://www.microscopemaster.com/nucleus.html>
5. [https://www.tutorialspoint.com/cell\\_cycle\\_and\\_cell\\_division/index.asp](https://www.tutorialspoint.com/cell_cycle_and_cell_division/index.asp)



	L	T	P	C	Hrs
<b>A20BTT102</b>					
<b>BIOCHEMISTRY- I BIOMOLECULES</b>					
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

**(Common to B.Sc.Biotechnology, B.Sc. Microbiology and B.Sc. Biochemistry)**

### Course Objectives

- To understand the fundamentals of carbohydrate.
- To study about the classification, structure and properties of amino acids
- To understand the classification, Structures and Biological importance of enzyme.
- To understand the classification, Structures and Biological importance of lipid.
- To study about composition, structure and biological importance of genetic material.

### Course Outcomes

**After completion of the course, the students will be able to**

- CO1** - Develop the fundamental idea about carbohydrate.  
**CO2** - Understand about the role and properties of amino acids.  
**CO3** - Understand about enzymes and its role in biological system.  
**CO4** - Understand the role of lipid and its structure.  
**CO5** - Understand about composition, structure and biological importance of genetic material.

#### UNIT-I (10 hours)

**Carbohydrates:** Classification of carbohydrates, Occurrence and structure of mono, di and polysaccharides (homo and heteropolysaccharides), asymmetry, stereo- isomerism and optical isomerism of sugars, anomeric form and mutarotation. Biological importance of carbohydrates (starch, cellulose, chitin)

#### UNIT-II (15 hours)

**Amino acids & Proteins:** Classification, structure and Properties of amino acids, Essential and non-essential amino acids, peptide bond and chemical bonds involved in protein structure - Protein classification based on solubility, shape, composition and function, Structure of proteins (Primary, secondary tertiary and quaternary), Biologically important peptides (insulin, glutathione, vasopressin).

#### UNIT-III (15 hours)

**Enzymes:** Definition, Classification & nomenclature of enzymes - Specificity of enzyme action - Fischer's Lock and Key Hypothesis & Koshland's Induced Fit Hypothesis - Active site - coenzyme - Enzyme kinetics, Michaelis-Menten equation and Lineweaver-burk plot) - significance of  $K_m$  and  $V_{max}$  - enzyme inhibitors (reversible, irreversible and feedback inhibitions), Modes of enzyme inhibition, Regulatory enzymes (Allosteric & covalently modulated enzymes). Biological importance of enzymes (ribonuclease and chymotrypsin)

#### UNIT-IV (10 hours)

**Lipids:** Classification, nomenclatures, structure and functions of Simple, Compound and Derived lipids, Structure and functions of fatty acids (Essential Fatty Acids), Tri- acyl glycerol, phospholipids, sphingolipids, Glycolipids and Gangliosides. Biological importance of lipids (PUFA)

#### UNIT-V (10 hours)

**Nucleic acid:** Structure, Properties and types of nucleic acid, Composition of DNA and RNA - Watson and Crick model of DNA, Structure of purines and pyrimidines, Structure of Nucleosides and Nucleotides. Structural forms of DNA, Biological importance of Nucleic acids

**Text Books:**

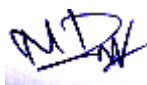
1. Nelson and Cox, Lehninger. Principles of Biochemistry (7<sup>th</sup> Edition), W.HFreeman Publishers (2010).
2. Roy Tasker, Carl Rhodes. Stryer's Biochemistry (7<sup>th</sup> Edition) W. H. Freeman publishers(2012).
3. Voet D. Biochemistry (4<sup>th</sup> Edition), Academic Press (2012).

**Reference Books:**

1. Zubey G. Principles of Biochemistry, Oscar Publication (2000).
2. Devlin T. M. Text Book of Biochemistry with Clinical Correlations (4<sup>th</sup> Edition) Wiley & Sons Publication (2005).

**Web references:**

1. <https://www.toppr.com/guides/chemistry/biomolecule/carbohydrates/>
2. [https://www.tutorialspoint.com/cach3.com/class\\_11th\\_proteins/protein\\_amino\\_acids.asp.html](https://www.tutorialspoint.com/cach3.com/class_11th_proteins/protein_amino_acids.asp.html)
3. <https://byjus.com/biology/enzymes/>
4. <https://sciencemusicvideos.com/ap-biology/module-6-menu-biochemistry/biochemistry-3-lipids-interactive-tutorial/>
5. <https://www.britannica.com/science/nucleic-acid/Deoxyribonucleic-acid-DNA>



	L	T	P	C	Hrs
<b>A20BTD101</b>					
<b>CHEMISTRY- I</b>					
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

**(Common to B.Sc.Biotechnology, B.Sc. Biochemistry)**

### Course objectives

- To study about Atomic Structure and Chemical Bonding.
- To know about Chemical Thermodynamics, Energetics & Kinetics.
- To learn about Chemical Equilibrium and Redox Reactions.
- To learn about various types of solutions and preparations.
- To study about the classification of solvents.

### Course Outcomes

**After completion of the course, the students will be able to**

- CO1** – Acquire the knowledge about Atomic Structure and Chemical Bonding.  
**CO2** – Understand about Chemical Thermodynamics, Energetics & Kinetics.  
**CO3** – Understand the use of Integrals and able to apply it.  
**CO4** – Acquire the knowledge prepare various types of solutions.  
**CO5** – Understand about various types of solvents.

#### UNIT-I

**(10 hours)**

**Atomic Structure and Chemical Bonding:** Atoms, elements, compounds and molecules. Electronic configuration of atom, Quantum mechanical model. Chemical bonding: classification, ionic bonding, covalent bonding, co-ordinate – covalent bonding, VSEPR, bond theory, shape of molecules, atomic orbital's,  $\sigma$ ,  $\pi$  bonds, hybridization, resonance, bond properties, molecular orbital theory, metallic bonding, Intermolecular forces. Hydrogen bonds, Van der Waals forces.

#### UNIT-II

**(15 hours)**

**Chemical Thermodynamics, Energetics & Kinetics:** Basic concepts of thermodynamics, I law of thermodynamics, heat capacity & specific heat capacity, Enthalpy changes, bond enthalpies, Entropy and II law of thermodynamics, Entropy changes, Gibbs energy & its changes. Rate of chemical reaction, rate constant & order of reaction – zero order, 1<sup>st</sup> order, pseudo 1<sup>st</sup> order, determination of order of reaction, theories of chemical kinetics, mechanism of reaction.

#### UNIT-III

**(10 hours)**

**Chemical Equilibrium and Redox Reactions:** Equilibrium in chemical and physical processes, dynamic equilibrium & equilibrium constant homogeneous & heterogeneous, equilibria, Equilibrium constant units & application, factors affecting equilibrium. Redox reactions: rate of electrons in redox reactions, oxidation number balancing chemical equation, stoichiometry of redox reactions.

#### UNIT-IV

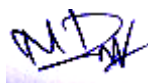
**(15 hours)**

**Solutions- I:** Types of solutions, concentration of solutions, colligative properties, acids & bases, Bronsted-Lowry concept of acid and bases, ionization, acid-base titration, strong and weak electrolytes, degree of dissociation, hydrolysis, pH, pH scale, pH electrode, ionic strength. Equivalent & molecular mass, mole concepts, expressing concentration of solutions - mole fraction, molarity, molality, normality, molar volume, mass of substance, Mass - mole conversion, percent compositions, empirical & molecular formula, chemical stoichiometry.

#### UNIT-V

**(10 hours)**

**Solutions- II:** Solvation energy, Polar and non-polar solvents, properties of water, Polarity of solvents, factors affecting solubility, dielectric constant of solvents, classification of solvents, dilution factor, serial dilution, solvent – solvent interaction, solute – solvent interaction in



**Text Books:**

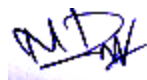
1. B.R Puri., L.R Sharma and K. C Kalia. 31<sup>st</sup> edition *Advanced Inorganic Chemistry*. Delhi:Shoban Lal Nagin Chand and Sons, 2011.
2. B.R Puri., L.R Sharma and Pathania. 46<sup>th</sup> edition *Principles of Physical Chemistry*. VishalPublishing Company, 2012.
3. Chang Raymond *Chemistry*. 6<sup>th</sup> ed.2008.

**Reference Books:**

1. R. M. Verma *Analytical Chemistry- Theory and Practice*, 3<sup>rd</sup> edition CBS Publishers andDistributors Pvt. Ltd., 2007
2. Skoog, West, Holler and Crouch, *Fundamentals of analytical chemistry*, 8<sup>th</sup> edition, ThomsonAsia Pvt. Ltd, 2004.

**Web references:**

1. [https://www.tutorialspoint.com/semiconductor\\_devices/semiconductor\\_devices\\_atomic\\_combinations.htm](https://www.tutorialspoint.com/semiconductor_devices/semiconductor_devices_atomic_combinations.htm)
2. <https://www.learner.org/series/chemistry-challenges-and-solutions/the-energy-in-chemical-reactions-thermodynamics-and-enthalpy/>
3. [https://www.google.com/search?q=Chemical+Equilibrium++tutorial+point&sxsrf=ALeKk03suQ-Ly4aZT\\_KWsMRitMAyk6INLA%3A162710397](https://www.google.com/search?q=Chemical+Equilibrium++tutorial+point&sxsrf=ALeKk03suQ-Ly4aZT_KWsMRitMAyk6INLA%3A162710397)
4. <https://www.toppr.com/guides/chemistry/solutions/types-of-solutions/>
5. <https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/7.2/primary/lesson/solute-and-solven>





<b>A20AET101</b>	<b>ENVIRONMENTAL STUDIES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
	<b>(Common for all B.A., B.Sc.,B.Com., B.B.A, B.C. A.)</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>30</b>

**Course Objectives**

- To gain knowledge on the importance of natural resources and energy.
- To know the structure and function of an ecosystem
- To imbibe an aesthetic value with respect to biodiversity, understand the threats and its conservation and appreciate the concept of interdependence
- To know the causes of types of pollution and disaster management
- To observe and discover the surrounding environment through field work.

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand about the various resources

**CO2** - Learn about the biodiversity

**CO3** - Learn the different types of pollution and to prevent the pollution

**CO4** - Know about the pollution Act

**CO5** - Observe various environmental issues in surroundings

**UNIT I INTRODUCTION TO ENVIRONMENTAL SCIENCES: NATURAL RESOURCES (6 Hrs)**

Environmental Sciences - Relevance - Significance - Public awareness - Forest resources - Water resources -Mineral resources - Food resources - conflicts over resource sharing - Exploitation - Land use pattern - Environmental impact - fertilizer - Pesticide Problems - case studies.

**UNIT II ECOSYSTEM, BIODIVERSITY AND ITS CONSERVATION (6 Hrs)**

Ecosystem - concept - structure and function - producers, consumers and decomposers - Food chain - Food web -Ecological pyramids - Energy flow - Forest, Grassland, desert and aquatic ecosystem. Biodiversity - Definition - genetic, species and ecosystem diversity - Values and uses of biodiversity - biodiversity at global, national (India) and local levels - Hotspots, threats to biodiversity - conservation of biodiversity -In situ&Ex situ.

**UNIT III ENVIRONMENTAL POLLUTION AND MANAGEMENT (6 Hrs)**

Environmental Pollution - Causes - Effects and control measures of Air, Water, Marine, soil, solid waste, Thermal, Nuclear pollution and Disaster Management - Floods, Earth quake, Cyclone and Landslides. Role of individuals in prevention of pollution - pollution case studies.

**UNIT IV SOCIAL ISSUES - HUMAN POPULATION (6 Hrs)**

Urban issues - Energy - water conservation - Environmental Ethics - Global warming - Resettlement and Rehabilitation issues - Environmental legislations - Environmental production Act. 1986 - Air, Water, Wildlife and forest conservation Act - Population growth and Explosion - Human rights and Value Education - Environmental Health - HIV/AIDS - Role of IT in Environment and Human Health - Women and child welfare - Public awareness - Case studies.

**UNIT V FIELD WORK (6 Hrs)**

Visit to a local area / local polluted site / local simple ecosystem - Report submission

**Text Books:**

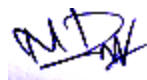
1. Bharucha Erach, "Textbook of Environmental Studies for Undergraduate Courses",  
Telangana, India:Orient Black Swan, 2<sup>nd</sup> Edition, 2013,
2. BasuMahua, Savarimuthu Xavier, "SJ Fundamentals of Environmental Studies".  
Cambridge,United Kingdom: Cambridge University Press , 2017.
3. Agarwal, K.C "Environmental Biology", Nidi Publ. Ltd. Bikaner, 2001 .

**Reference Books:**

1. Kumarasam.K., A. Alagappa Moses AND M.Vasanthy, "Environmental studies",  
Bharathidasanuniversity pub, 1, trichy2004.
2. Rajamannar, "Environmental studies", EVR College PUB, Trichy2004
3. Kalavathy, S. (ED.) , "Environmental Studies", Bishop Heber College PUB., Trichy 2004.

**Web references:**

1. <https://www.youtube.com/watch?v=78prsPYm98g>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2792934/>
3. <https://www.frontiersin.org/articles/505570>



<b>A20BTL103</b>	<b>CELL BIOLOGY PRACTICAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

(Common to B.Sc. Biotechnology, B.Sc. Microbiology and B.Sc. Biochemistry)

### Course Objectives

- To gain the practical skills about cell Biology by experimenting microscope, micrometer, mitosis, meiosis, cell counting and dicot leaf section.

### Course Outcomes

#### After completion of the course, the students will be able to

- Carryout cell Biology practical like microscope, micrometer, mitosis, meiosis, cell counting and dicot leaf section.

1. The Microscope
2. Micrometer
3. Permanent slide preparation
4. Mitosis in onion root tip cells
5. Meiosis in grasshopper testis
6. Cell counting and viability
7. Mitochondrial isolation
8. Blood smear preparation
9. Preparation of microscopic slide for dicot leaf section

### Text Books:

1. Laboratory Manual of Cell Biology ( Rina Majumdar, Rama Sisodia)
2. Student Solutions Manual for Molecular Cell Biology: Solutions Manual (Lodish Harvey), Publisher: Macmillan Learning
3. Laboratory manual on cell biology and microbiology (Dr. N. Banu, Ms. Pavithra. S), Publisher: Sara Book Publication

### Reference Books:

1. Practical laboratory manual- CELL BIOLOGY (Gupta Amit), Publisher: LAP Lambert Academic Publishing.

### Web references:

1. <https://vulms.vu.edu.pk/Courses/BIO201/Downloads/paractical%20manual%20of%20cell%20bio%20201%2025-4-17.pdf>
2. [http://www.ihcworld.com/\\_protocols/lab\\_protocols/cell-biology-lab-manual-heidcamp.htm](http://www.ihcworld.com/_protocols/lab_protocols/cell-biology-lab-manual-heidcamp.htm)

<b>A20BTL103</b>	<b>BIOMOLECULES PRACTICAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

(Common to B.Sc.Biotechnology, B.Sc. Microbiology and B.Sc. Biochemistry)

**Course Objectives**

- To gain the practical skills about Analysis of various Biomolecules such as Protein, Amino acid, Carbohydrate etc.

**Course Outcomes**

**After completion of the course, the students will be able to**

- Perform the Analysis of various Biomolecules Such as Protein, Amino acid, Carbohydrate etc.

1. Qualitative Analysis of Proteins
2. Qualitative Analysis of Aromatic amino and Sulphur containing amino acids
3. Qualitative Analysis of Carbohydrates
4. Qualitative Analysis of Fats
5. Extraction of Starch from Potatoes
6. Extraction of Ovalbumin from Egg
7. Extraction of Lactalbumin from Milk
8. Extraction of RNA
9. Extraction of DNA

**Text Books:**

1. Manual of Practical Biochemistry (Mohammed Rafi), Publisher: Orient Blackswan Pvt Ltd
2. Biochemistry practical manual (Rajendiran Soundravally), Publisher: Elsevier
3. Practical Biochemistry (K Geetha Damodaran), Publisher: Jaypee Brothers Medical

**Reference Books:**

1. Practical Manual of Biochemistry (Kaushik G.G.) Publisher: CBS Publishers & Distributors

**Web references:**

1. [https://bio.libretexts.org/Bookshelves/Biotechnology/Lab\\_Manual%3A\\_Introduction\\_to\\_Biotechnology/01%3A\\_Techniques/1.09%3A\\_Biomolecule\\_Detection](https://bio.libretexts.org/Bookshelves/Biotechnology/Lab_Manual%3A_Introduction_to_Biotechnology/01%3A_Techniques/1.09%3A_Biomolecule_Detection)
2. [https://www.researchgate.net/publication/301647645\\_PRACTICAL\\_BIOCHEMISTRY](https://www.researchgate.net/publication/301647645_PRACTICAL_BIOCHEMISTRY)

<b>A20BTD202</b>	<b>CHEMISTRY- I PRACTICAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>30</b>

(Common to B.Sc.Biotechnology, B.Sc. Biochemistry)

### Course Objectives

- To gain the practical skills about Calibration of fractional weights, Measurement of pH, Acid-Base Titration, Analysis of Dissolved Oxygen etc.

### Course Outcomes

**After completion of the course, the students will be able to**

- Perform Calibration of fractional weights, Measurement of pH, Acid-Base Titration, Analysis of Dissolved Oxygen etc.
  - Calibration of fractional weights, pipettes and burettes, Preparation of standards Solutions of different molarity and normality, Dilution - 0.1 M to 0.001 M solutions.
  - Measurement of pH of Solutions
  - Acid-Base Titration and Comparison of Strengths of Acids and Bases,
  - Determination of Order of a reaction.
  - Preparation of standard solution of oxalic acid and standardization of (a) NaOH solution and (b) KMnO<sub>4</sub> solution.
  - Analysis of Dissolved Oxygen.
  - Preparation and Purification of Colloidal Sols by dialysis.
  - To determine the density of the liquid.

### Text Books:

- R. M. Verma *Analytical Chemistry- Theory and Practice*, 3<sup>rd</sup> edition CBS Publishers and Distributors Pvt. Ltd., 2007
- Skoog, West, Holler and Crouch, *Fundamentals of analytical chemistry*, 8<sup>th</sup> edition, Thomson Asia Pvt. Ltd, 2004.
- Rageeb Md. Usman, Dr. Sunila T, "Practical Hand Book of Systematic Organic Qualitative Analysis", Unicorn Publication Pvt. Ltd, 1<sup>st</sup> Edition, 2015.
- Israel Arthur Vogel, "Vogel's Textbook of Practical Organic Chemistry", Wiley Edition: 1<sup>st</sup> Edition, 1989.
- Arthur Israel Vogel, "Elementary Practical Organic Chemistry" Prentice Hall Press; 3<sup>rd</sup> Edition, 1980.

### Reference Books:

- Venkateswaran. V, Veeraswamy. R, Kulandaivelu. A.R., "Basic Principles of Practical Chemistry", New Delhi, Sultan Chand and Sons. 2<sup>nd</sup> Edition, 1997.
- Mendham. J, Denney. R.C, Barnes. J.D, and Thomas, M. "Vogel's Text book of Quantitative Analysis", Pearson Education, 1<sup>st</sup> Edition, 1989.
- Gopalan.R, Subramaniam.P.S and Rengarajan.K, "Elements of Analytical Chemistry", Sultan Chand and Sons, 1<sup>st</sup> Edition, 2004.

### Web references:

- [https://assets.cambridge.org/97805212/91125/frontmatter/9780521291125\\_frontmatter.pdf](https://assets.cambridge.org/97805212/91125/frontmatter/9780521291125_frontmatter.pdf)
- [https://www.csub.edu/chemistry/organic/manual/Lab14\\_QualitativeAnalysis.pdf](https://www.csub.edu/chemistry/organic/manual/Lab14_QualitativeAnalysis.pdf)
- <http://rushim.ru/books/praktikum/Mann.pdf>

**Course Objectives**

- To improve the students 'speed in reading.
- To decode the correspondence between sound and spelling in English.
- To train students to organize, revise and edit ideas to write clearly and effectively.
- To enhance the sense of social responsibility and accountability of the students.
- To expound the significance of time and stress management.

**Course Outcomes**

**After the completion of the course, the students will be able to**

**CO1-** Understand the pattern to communicate effectively.

**CO2-** Impart Speaking skills with confidence.

**CO3-** Use writing strategies to improve the drafting skills and comprehending of articles.

**CO4-** Demonstrate leadership qualities to Participate in Group Discussion and Interview efficiently.

**CO5-** Expertise in Managerial skills.

**UNIT I                      COMMUNICATIONSKILLSPEAKING                      (6Hrs)**

Aspects of speaking - Process and techniques of effective speech - Presentations - topic to be given to students for short speech.

**UNIT II                      SELF-MANAGEMENTSKILLS                      (6Hrs)**

Time Management - Stress management - Perseverance - Resilience - Mind mapping-Self-confidence

**UNIT III                      COMMUNICATIONSKILL-READING                      (6Hrs)**

Phonics- Self-Introduction -Vocabulary-Comprehension-skimming and scanning.

**UNIT IV                      SOCIALSKILLS                      (6Hrs)**

Negotiation and Persuasion -Leadership-Teamwork-Problem solving -Empathy-Decision making.

**UNIT V                      COMMUNICATIONSKILL-WRITING                      (6Hrs)**

Descriptive -Narrative-Persuasive-Expository-Picture composition

### **Text Books**

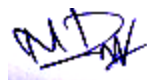
1. Syamala,V,"EffectiveEnglishCommunicationforyou",Chennai:EmeraldPublishers,2002
2. Balasubramanian, T," A Textbook of English Phonetics for Indian Students",New Delhi: Trinity Press 1981
3. Sardana,C.K.,"The Challenge of Public Relations",New Delhi: Har-AnandPublications,1995.

### **Reference Books**

1. Morley, David and Philip Neilson, editors", The Cambridge Companion to Creative Writing",Cambridge:2012.
2. Eastwood,John,"Oxford Grammar",Oxford UniversityPress,1999.
3. Prasad,HariMohan,"AHandbookofSpottingErrors:"McGrawHillEducation, 2010.
4. Murphy,JohnJ,"PullingTogether:10RulesforHigh-PerformanceTeamwork", SimpleTruths,2016.

### **Web references**

1. [www.softwaretestinghelp.com>how-to-crack-the-gd](http://www.softwaretestinghelp.com/how-to-crack-the-gd)
2. [www.businessballs.com>communication-skills>prese...](http://www.businessballs.com/communication-skills/prese...)
3. [www.teachingenglish.org.uk>article>public-speaking...](http://www.teachingenglish.org.uk/article/public-speaking...)
4. [www.teachingenglish.org.uk>article>public-speaking...](http://www.teachingenglish.org.uk/article/public-speaking...)
5. [www.monster.com>career-advice>article>boost-you...](http://www.monster.com/career-advice/article/boost-you...)



**மொழித்தாள்**  
**தமிழ்- II**

(B.A., B.Sc., B.Com., B.B.A., & B.C.A., பாடப்பிரிவுகளுக்கும்மான வாயுத்தாள்)

**L T P C Hrs**  
**3 0 0 3 45**

**A20TAT202**

**பாத்திரத்தின் நோக்கம்**

இரண்டாம் ஆண்டுகால தமிழின் நான்மையையும் வரலாற்றையும் அதன் விழுமியங்களையும் பண்பாட்டையும் எடுத்துரைப்பதாக இப்பாத்திரம் அமைக்கப்பட்டுள்ளது. தமிழ் இலக்கியம் உள்ளடக்கத்திலும், வடிவத்திலும் பெற்ற மாற்றங்கள், அதன் சிந்தனைகள், அடையாளங்கள் ஆகியவற்றைக் காலந்தோறும் எழுதப்பட்ட இலக்கியங்களின் வழியாகக் கற்றுக்கொடுக்கும் இப்பாத்திரம் அமைக்கப்பட்டுள்ளது. மொழியின் கட்டமைப்பைப் பற்றி கொள்வதற்கும் பாத்திரம் வடிவமைக்கப்பட்டுள்ளது. வாழ்வியல் சிந்தனைகள், ஒழுக்கவியல் கோட்பாடுகள், சமத்துவம், சூழலியல் என்ப பல கருவிகளை மாணவர்களுக்கு எடுத்துரைக்கும் விதத்தில் இப்பாத்திரம் உருவாக்கப்பட்டுள்ளது. சிந்தனை ஆற்றலைப் பெருக்குவதற்குத் தாய்மொழியின் பங்களிப்பினை உணர்த்த இப்பாத்திரம் அமைக்கப்பட்டுள்ளது.

**பாத்திரத்தின் வெளியடிகள்**

- CO1** - இலக்கியங்கள் காட்டும் வாழ்வியல் நெறிமுறைகளைப் பேணிநடத்தல்.  
**CO2** - நமது எண்ணத்தை வெளிப்படுத்தும் கருவியாகத் தாய்மொழியைப் பயன்படுத்துதல்.  
**CO3** - தகவல் தொடர்புக்குத் தாய்மொழியின் முக்கியத்துவத்தை உணர்தல்.  
**CO4** - தாய்மொழியின் சிறப்பை அறிதல்.  
**CO5** - இலக்கிய இன்பங்களை நுகரும் திறன்களை வளர்த்தல்.

**அனுகூலம்**

(9 Hrs)

**எடுத்தொகை:**

1. குறுந்தொகை (புடல்-130),
2. நற்றிணை (புடல்-27),
3. அகநானூறு (புடல்-86)
4. ஐங்குறுநூறு (புடல்-203)
5. கலித்தொகை- பாலைத்திணை (புடல்-9)
6. புறநானூறு (புடல்-235)

**புத்தியம்:**

1. சிறுபாணாற்றுப்படை (அடிகள்-126-143)
2. முல்லைப்பாட்டு ( 6-21)

**அனுகூலம்-2**

(9 Hrs)

**பரிசீலனைக் கீழ்க்கணக்கு:**

1. திருக்குறள்- வெகுளாமை (அடிகள்-3), காதல் சிறப்புரைத்தல் (அடிகள்-13)
2. நாலடியார் - நல்மார் எனத்தான் (221)
3. திரிகடகம்- காலஞ்சி வாழும் குடியும் (33)
4. இனியவை நார்ப்பது- குழனி தளர்நடை (14)
5. கார் நார்ப்பது- நலமிரு கார்த்திகை (26)
6. களவழி நார்ப்பது-கவளங்கொள் யானை (14)

**அனுகூலம்-3**

(9 Hrs)

**காவம்- பன்னிரு திருமுறைகள்**

- |                     |   |  |
|---------------------|---|--|
| 1. திருஞானசம்பந்தர் | - | வாயுறு நூளியங்கள் (இரண்டாம் திருமுறை)    |
| 2. திருநாவுக்கரசர்  | - | மனமெனும் தோணரி (நான்காம் திருமுறை)       |
| 3. சுந்தரர்         | - | ஏட்டுசெய்யப் இசைப்பண்பு (ஏழாம் திருமுறை) |



## Academic Curriculum and Syllabi R-2020

4. மாணிக்கவாசகர்	—	ஆதிபும் அந்தமும் இல்லா (திருவெம்பாவை)
5. திருமுல்லை	—	அன்பு சிவம் இரண்டு (திருமுத்தூர்)

### வைணவம் - நானாதித் திவ்வியப் பிரபந்தம்

1. லயாழ்வார்	—	திருக்கண்ணீரின் ஷான்மணி....
2. வரையாழ்வார்	—	கருங்கண் தோகை மயிற் பீலி....
3. தொண்டரபுரம்வாடி ஆழ்வார்	—	பச்சைமாமலை போல்...
4. ஆண்டாள்	—	கருப்பும் நானாமோ? கமலப்பூ...
5. திருமங்கையாழ்வார்	—	வாழ்வேன் வாடி வகுந்தீனேன்....

### இஸ்லாமியம்

கீழ்க்கண்ட மாடல் நின்ற விண்ண மாணுக்கும்...5 மாடல்கள் (மாடல் எண்கள் 61-65)

### சிறுத்துவம்

இரட்சணிய யாத்ரீகம் - கடைதிறப்பு மலம் -5 மாடல்கள் (மாடல் எண்கள்: 3,9,10,15,16)

### அலகு - 4

#### தமிழ் இலக்கிய வரலாறு

1. சங்க இலக்கியங்கள்
2. நீதி இலக்கியங்கள்
3. பக்தி இலக்கியங்கள்
4. காப்பியங்கள்

(9 Hrs)

### அலகு-5

#### சிறுகதைகள்

1. புதுமைநித்தன்	—	அகலிகை
2. நா. விச்சமுர்த்தி	—	வேப்பமரம்
3. அகிலன்	—	ஒரு வேளைச்சோறு
4. ஜி.நாகராஜன்	—	பச்சக் குதிரை
5. கி.ராஜநாராயணன்	—	கதவு
6. சா.கந்தசாமி	—	தக்கையின் மீது நான்கு கண்கள்

(9 Hrs)

### பார்வை நூல்கள் :

1. அழக, வி., இருபதாம் நூற்றாண்டு சிறுகதைகள் நூறு, அடையாளம் பதிப்பகம், திருச்சி, 2013.
2. அருணாச்சலம், மா., பக்தி இலக்கியங்கள், பாதி நிலையம், சென்னை, 2010.
3. தமிழன்னை, புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தக நிலையம், மதுரை, 2000.
4. பாக்கியமணி, வகைமை நோக்கில் தமிழ் இலக்கிய வரலாறு, என்.சி.வி.எச். பதிப்பகம், சென்னை, 2011.
5. பசுபதி, மா. வே., செம்மொழித் தமிழ் இலக்கண இலக்கியங்கள், தமிழ் பல்கலைக்கழகம், 2010.

### உரைநடை நூல்கள் :

1. அன்பு, மா., மா.வா.சி பின் ஒரு இலக்கிய நூல்கள் ஒரு மதிப்பீடு, உலக தமிழ் ஆராய்ச்சி நிறுவனம், சென்னை, 1983.
2. பின்னை, கே.கே., தமிழக வரலாறு மக்களும் பண்பாடும், உலக தமிழ் ஆராய்ச்சி நிறுவனம், சென்னை, 2000.
3. ஜெயமோகன், நவீன இலக்கிய அறிமுகம், உயர்மைய பதிப்பகம், சென்னை, 1995.

### இணையத்தளங்கள் :

1. <http://www.tamilkodal.com>
2. <http://www.languagelab.com>
3. <http://www.tamilweb.com>

**A20FRT202**                      **FRENCH – II**  
( Common to B.A., B.Sc., B.Com., B.B.A. & B.C.A )

**L T P C Hrs**  
**3 0 0 3 45**

### OBJECTIVES

- To enable the students read, understand, and write simple sentences.
- To grasp relevant grammar for communication
- To learn about the land, people and culture of France.

#### UNITÉ - 1(9 Hrs)

Qu'est -ce qu'on leur offre ?

On solde !

Découvrir Paris en bus avec l'open Tour

#### UNITÉ - 2(9 Hrs)

Si vous gagne vous ferez quoi

Parasol ou parapluie ?

#### UNITÉ - 3(9 Hrs)

Quand il est midi á Paris

Vous allez Vivre

L'avenir du Français

#### UNITÉ - 4(9 Hrs)

Souvenirs d'enfance

j'ai fait mes études á Lyon 2

#### UNITÉ – 5(9 Hrs)

Retour des Antilles

Au voleur ! Au voleur

#### Text Books

Prescribed Text book : *FESTIVAL 1* - Méthode de Français

Authors : Sylvie POISSON-QUINTON

Michèle MAHEO-LE COADIC Anne VERGNE-SIRIEYS, Edition : CLE International, Nouvelle Édition révisée : 2009.

#### Reference Book

Festival 1

33

<b>A20GET202</b>	<b>GENERAL ENGLISH- II</b> (Common to B.A, B.Sc. and BCA)	<b>L</b> 3	<b>T</b> 0	<b>P</b> 0	<b>C</b> 3	<b>Hrs</b> 45
------------------	--	---------------	---------------	---------------	---------------	------------------

**Course Objectives**

- To recognize poetry from a variety of cultures, languages and historic periods
- To develop the intensive study of language by critical reading
- To identify the various genres and analyze the works of writers in English
- To expand the basic understanding of targeted grammatical structures
- To understand the conventions of writing in English

**Course Outcomes**

*After the completion of this course, the students will be able to*

- CO1**-Understand and appreciate poetry as a literary art form.
- CO2**-Comprehend and recognize relationship between ideas, events and facts.
- CO3**-Learn to explore characters and their conflicts,dilemmas and extend their response to stories.
- CO4**-Apply grammatical structures meaningfully and appropriately in or land written form.
- CO5**- Write effectively and coherently.

**UNIT I POETRY (9 Hrs)**

1. Lord Byron: She Walks in Beauty
2. Robert Frost: Stopping by Woods on a Snowy Evening
3. Nissim Ezekiel:Night of the Scorpion
4. RabindranathTagore: Where the Mind is Without Fear

**UNIT II PROSE (9 Hrs)**

**Ernest Hemingway-A Day's Wait**

1. Anton Chekhov: The Lottery Ticket

**UNIT III FICTION (9 Hrs)**


**Jane Austen- Prideand Prejudice**

**UNIT IV GRAMMAR (9 Hrs)**

- 1.Voice-Conditionals -Coherence

**UNIT V COMPOSITION (9 Hrs)**

1. Letter Writing
2. Report Writing

### Text Books

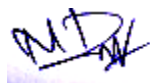
1. Wisdom and Experience: An Anthology for Degree Classes. Board of Editors", Orient Longman Limited, 2007
2. "The Approach to Life: A Selection of English Prose", Orient Longman Limited, 2009.
3. "Brookside Musings: A Selection of Poems and Short Stories: Board of Editors", Orient, Longman Limited, 2009.

### Reference Books

1. Lalitha Natarajan and Sasikala Natesan, "English for Excellence: Poetry", Anuradha Publications Literary Pursuits: Board of Editors, Orient Longman Limited, 2015.
2. S.C. Gupta, "English Grammar & Composition", Arihant, 2014
3. Rabindranath Tagore, "Where the mind is without fear", London: The India Society, 1912.
4. Raymond Murphy and Surai Pongtongcharoen, "English Grammar in Use", Cambridge University, 1985.

### Web references

1. <https://poets.org/poem/she-walks-beauty>
2. <https://www.poetryfoundation.org/poems/46467/the-flea>
3. <https://www.classicshorts.com/stories/lottery.html>
4. <http://short-storylovers.blogspot.com/2012/07/thief-by-ruskin-bond.html>
5. <http://www.gutenberg.org/files/1342/1342-h/1342-h.htm>



	L	T	P	C	Hrs
<b>A20BTT204</b>					
<b>FUNDAMENTALS OF MICROBIOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

**Course objective**

- To understand the basics of microbiology and to know the role in environment.
- To ensures the students to understand about the structure and function of microorganisms.
- To understand the Instrumentation, principles and applications of types of microscopes
- To impart practical skills of isolation and manipulating conditions for their propagation.
- To ensures the students to understand about control of microorganisms.

**Course Outcomes****After the completion of this course, the students will be able to**

**CO1** - Define the science of microbiology, its development and importance in human welfare.

**CO2** - Describe historical concept of spontaneous generation and the experiments performed to disprove.

**CO3** - Describe some of the general methods used in the study of microorganisms.

**CO4** - Recognize and compare structure and function of microbes and factors affecting microbial growth.

**CO5** - Demonstrate aseptic microbiological techniques in the laboratory and check sources of microbial contamination and their control.

**UNIT - I****(10 hours)**

**Microbial Diversity:** Basics of microbiology, History and Scope of microbiology, General features and Classification of Archaea, Bacteria, Fungi, Algae, Protozoa, Viruses and Prions. Differences between prokaryotic and eukaryotic organisms.

**UNIT- II****(15 hours)**

**Ultrastructure of Bacteria: Sub-cellular structures** - Cell wall of bacteria and its biosynthesis, Cell envelope - capsule and slime layer, Cellular appendages - pili, flagella and fimbriae, Cell membrane, inclusion bodies, Plasmid DNA and chromosomal DNA. Bacterial genetics - conjugation, transduction (generalized and specialized), and transformation.

**UNIT - III****(15 hours)**

**Microscopy: Staining** - Principles and types of staining (simple and differential) Microscopy -Instrumentation, principles and applications of light microscopes (bright field, dark field, phase contrast, fluorescent microscopes) and electron microscopes (transmission and scanning electron microscopes)

**UNIT - IV****(10 hours)**

**Microbial Nutrition:** Classification of microorganisms based on their nutritional types, Preparation of media, types of media, culturing of microbes, Microbial growth curve, viral replication: lytic and lysogenic cycles, Isolation, preservation and maintenance of microorganisms, Aerobic and Anaerobic culturing of bacteria, Effect of biotic and abiotic factors on the growth of organisms.

**UNIT – V****(10 hours)**

**Microbial Control:** Sterilization, disinfection, antisepsis, fumigation. Physical control: Temperature (moist heat, autoclave, dry heat, hot air oven and incinerators), desiccation, osmotic pressure, radiation, UV-light, electricity, ultrasonic sound waves, filtration. Chemical control: Antiseptics and disinfectants (halogens, alcohol, gaseous sterilization)

**Text Books:**

1. M.J. Pelczar Jr. E.C.S. Chan and N.R. Kreig, Microbiology (5<sup>th</sup> edition), Tata MaCraw-Hill, New Delhi;
2. R. Ananthanarayanan. and C.K.Jayaram Panickar, Text book of Microbiology (9<sup>th</sup> edition), Orient Longman Publications, New Delhi
3. Lansing M. Prescott, John. P. Harley, Donald A. Klein, 1999. Microbiology (9<sup>th</sup> edition) WCB MaCraw-Hill, New York;

**Reference books:**

1. Sundararajan S (2003). College Microbiology, revised edition, Vardhana publications, Bangalore.
2. R.C. Dubey, D.K.Maheswari, A Text book of Microbiology (2005), S.Chand & Company Ltd. New Delhi

**Web references:**

1. [https://www.tutorialspoint.com/biological\\_classification/index.asp](https://www.tutorialspoint.com/biological_classification/index.asp)
2. <https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/bacterial-ultrastructure>
3. <http://www.auburn.edu/academic/classes/biol/4101/estridge2/tutorial1a.pdf>
4. <https://www.scientistcindy.com/microbial-nutrition-and-growth.html>
5. <http://www.lamission.edu/lifesciences/lecturenote/mic20/Chap07Control.pdf>



A20BTT205	L	T	P	C	Hrs
<b>BIOCHEMISTRY- II INTERMEDIARY METABOLISM</b> (Common to B.Sc.Biotechnology, B.Sc. Biochemistry)	4	0	0	4	60

**Course Objectives**

- To understand the Fundamentals of Bioenergetics.
- To study about Carbohydrate Metabolism.
- To understand the General aspects of amino acid metabolism.
- To understand the concepts of Lipid Metabolism.
- To understand about Nucleic Acid Metabolism.

**Course Outcomes**

**After completion of the course, the students will be able to**

- CO1** - Know the law of thermodynamics, electrons and high energy compounds.  
**CO2** - Understand carbohydrate metabolism through various pathways like glycolysis and citric acid cycle.  
**CO3** - Develop the knowledge on biosynthesis of amino acids, regulation and amino acid metabolism.  
**CO4** - Understand about different types of fatty acids and its biosynthesis, absorption and transport.  
**CO5** – Understand the biosynthesis of nucleic acid, degradation and nucleotides as regulatory molecules.

**UNIT-I (10 hours)**

**Bioenergetics:** Enzyme & its forms, laws of thermodynamics, free energy change, enthalpy, entropy, equilibrium constant, flow of electrons, electron carriers, redox potential, redox coupling & ATP bioenergetics, High energy compounds.

**UNIT-II (15 hours)**

**Carbohydrate Metabolism:** Glycolysis, Fermentation, Citric acid cycle, Oxidative Phosphorylation & Electron transport chain, Gluconeogenesis, Pentose phosphate pathway, Glyoxylate shunt, Glycogen metabolism (glycogenesis and glycogenolysis)

**UNIT-III (15 hours)**

**Amino Acids Metabolism:** General aspects of amino acid metabolism, Transamination, Transamidation, Deamination, Uric acid biosynthesis, Nitrogen excretion - Urea cycle, Amino acid catabolism, Amino acid biosynthesis - Fixation of ammonia into amino acid, biosynthesis of amino acids (Tryptophan and Methionine), Regulation of amino acid biosynthesis.

**UNIT-IV (10 hours)**

**Lipid Metabolism:** Biosynthesis of fatty acids - long chain, unsaturated, Triacylglycerols, phospholipids, comparison of fatty acid synthesis and degradation; Oxidation of fatty acids – even chain saturated fatty acids, Unsaturated fatty acids, odd chain fatty acids ( $\alpha$ ,  $\beta$ ,  $\omega$ ), ketone bodies, cholesterol metabolism, dietary absorption of lipids, Transport forms (VLDL, LDL, HDL, chylomicron).

**UNIT-V (10 hours)**

**Nucleic Acid Metabolism:** Biosynthesis of purines and pyrimidines, feedback inhibition of purine & pyrimidine biosynthesis, NMP conversion to NTP, Nucleotide degradation, salvage pathways, degradation of purine and pyrimidines to uric acid & urea, nucleotides as regulatory molecules, non-enzymatic transformation of nucleotides & nucleic acids.

**Text Books:**

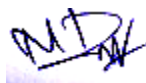
1. Voet. D. Biochemistry (4<sup>th</sup> Edition), Academic Press 2012.
2. Zubey. G - Principles of Biochemistry (4<sup>th</sup> edition) Oscar Publication 2000.
3. Wilson and Walker Principles and Techniques of Practical Biochemistry, (7<sup>th</sup> edition), Cambridge University Press 2010.

**Reference books:**

1. Nelson and Cox, Lehninger. Principles of Biochemistry (7<sup>th</sup> Edition), W.H Freeman Publishers 2010
2. Roy Tasker, Carl Rhodes. Stryer's Biochemistry (7<sup>th</sup> Edition). W. H. Freeman publishers 2012.

**Web References:**

1. [http://www.nmr.sinica.edu.tw/~thh/lectures/Biophysics/Chap\\_3Bioenerget](http://www.nmr.sinica.edu.tw/~thh/lectures/Biophysics/Chap_3Bioenerget)
2. <https://global.oup.com/us/companion.websites/fdscontent/uscompanion/us/static/companion.websites/9780199730841/McKe>
3. <https://www.lecturio.com/magazine/metabolism-amino-acids/>
4. <https://opentextbc.ca/anatomyandphysiologyopenstax/chapter/lipid-metabolism/>
5. [https://chem.libretexts.org/Bookshelves/Environmental\\_Chemistry/Toxicology\\_MSDT/02%3A\\_Biochemistry\\_and\\_Molecular\\_Genetics/2](https://chem.libretexts.org/Bookshelves/Environmental_Chemistry/Toxicology_MSDT/02%3A_Biochemistry_and_Molecular_Genetics/2)





A20CHD203	L	T	P	C	Hrs
<b>CHEMISTRY- II</b>	4	0	0	4	60

(Common to B.Sc.Biotechnology, B.Sc. Biochemistry)

### Course Objectives

- To understand the Fundamentals of Organic Chemistry
- To understand stereochemistry of organic molecules
- To gain knowledge about Electrochemistry
- To understand the chemical analysis
- To study about Bioinorganic Chemical analysis

### Course Outcomes

*After completion of this course, the students will be able to*

**CO1**-Develop the basicknowledge about Organic Chemistry

**CO2**- Understand stereochemistry of organic molecules

**CO3** –Understand electrochemistry

**CO4**- Understand about chemical analysis

**CO5**–Understand the Bioinorganic Chemical analysis

### UNIT I FUNDAMENTALS OF ORGANIC CHEMISTRY

(12 Hrs)

**Classification of organic compounds** – Nomenclature, tetravalency of carbon, - Classification of reagents - electrophiles, nucleophiles and free radicals - Classification of reactions - addition, substitution, elimination, condensation and polymerisation **Polar Effects**-Inductive effect, resonance, hyper-conjugation, steric effect – Keto-enoltautomerism – electrophilic substitution mechanism in benzene (Nitration and Sulphonation)

### UNIT II STEREOCHEMISTRY

(12 Hrs)

Classifications -Types of isomerism -structural isomerism – chain, position, functional,metamerism – tautomerism – stereo isomerism – Geometrical and optical isomerism.Enantiomerism, Diastereomerism and Meso compounds. D and Lconfigatrion; cis – trans nomenclature,R/ S (for only one chiral carbon atoms) and E / Z Nomenclature (for ethene).Chirality of organic compounds with special reference to amino acids and sugar

### UNIT III ELECTROCHEMISTRY

(12 Hrs)

**Electrochemistry-I:** Strong and weak electrolytes, common ion effect, pH, buffer solutions,Henderson equation and buffer action in biological systems. **Electrochemistry-II:** Galvanic cells: EMF, standard electrode potentials, reference electrodes (NHE and Calomel).

### UNIT IV CHEMICAL ANALYSIS

(12Hrs)

Gravimetric analysis – Introduction- Gravimetric analysis by precipitation, Optimum conditions for good precipitation, Physical nature of precipitate, Purity of precipitate: co-precipitation, post-precipitation, Organic precipitants and their applications. Volumetric analysis - principles of Volumetric analysis, Acid – base titration, redox and metal ion indicators.

### UNIT V BIO INORGANIC CHEMISTRY

(12 Hrs)

Essential & Trace element in Biological process, Metalloporphyrins and with special reference to Haemoglobin and Myoglobin, Biological role of alkali and alkali earth metals with special reference to Ca<sup>2+</sup>

**Text Books:**

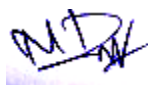
1. Bhupinder Mehta, Manju Mehta, "Organic Chemistry", Prentice Hall of India Pvt Ltd. New Delhi. 1<sup>st</sup> Edition, 2015.
2. B.S. Bahl and Arun Bahl, "Advanced Organic Chemistry", S. Chand and Company Ltd, New Delhi. 1<sup>st</sup> Edition, 1998.
3. B.B.L Srinivasata, Amarnath Mishra, "Fundamental of Analytical Chemistry", IP Innovative Publication Pvt. Ltd., 1<sup>st</sup> Edition, 2016.

**Reference Books:**

1. I.L. Finar, "Organic chemistry Vol 1", Pearson Edition, Singapore, 6<sup>th</sup> Edition, 2005.
2. R.T. Morrison and R.N. Boyd, "Organic chemistry", Prentice Hall Private Limited, New Delhi, 6<sup>th</sup> Edition, 1997.
3. P.L. Soni, "Text Book of Organic Chemistry", Sultan Chand, New Delhi, 1<sup>st</sup> Edition, 2005.

**Web references:**

1. <https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/nomen1.htm>
2. <https://www.toppr.com/guides/chemistry/organic-chemistry/isomerism/>
3. <https://www.chemguide.co.uk/organicprops/alkanes/background.html>



	L	T	P	C	Hrs
<b>A20AET202</b>					
<b>PUBLIC ADMINISTRATION</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>30</b>

*(Compulsory Course designed as per the directions issued by Government of India, MHRD,)*  
**Department of Higher Education (Central University Bureau)**

**F.No.19-6.2014-Desk U Dated 19-05-2014)**

### **Course Objectives**

- To introduce the elements of public administration
- To help the students obtain a suitable conceptual perspective of public administration
- To introduce them the growth of institution devices to meet the need of changing times
- To instill and emphasize the need of ethical seriousness in contemporary Indian Public Administration

### **Course Outcomes**

**After completion of the course, the students will be able to**

- CO1** - Understand the concepts and evolution of Public Administration.  
**CO2** - Be aware of what is happening in the Public Administration in the country.  
**CO3** - Explain the Territory Administration in the State and the Centre.  
**CO4** - Appreciate emerging issues in Indian Public Administration.

### **UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION (7 Hrs)**

Meaning, nature and Scope of Public Administration and its relationship with other disciplines- Evolution of Public Administration as a discipline – Woodrow Wilson, Henry Fayol , Max Weber and others - Evolution of Public Administration in India - Arthashastra - Colonial Administration upto 1947

### **UNIT II PUBLIC ADMINISTRATION IN INDIA (8 Hrs)**

Enactment of Indian Constitution - Union Government - The Cabinet - Central Secretariat -- All India Services - Training of Civil Servants - UPSC - NitiAyog - Statutory Bodies: The Central Vigilance Commission - CBI - National Human Rights Commission - National Women's Commission -CAG

### **UNIT III STATE AND UNION TERRITORY ADMINISTRATION (8 Hrs)**

Differential Administrative systems in Union Territories compared to States Organization of Secretariat: - Position of Chief Secretary, Functions and Structure of Departments, Directorates - Ministry of Home Affairs supervision of Union Territory Administration - Position of Lt.Governor in UT - Government of Union Territories Act 1963 - Changing trend in UT Administration in Puducherry and Andaman and Nicobar Island

### **UNIT IV EMERGING ISSUES IN INDIAN PUBLIC ADMINISTRATION (7 Hrs)**

Changing Role of District Collector - Civil Servants - Politicians relationship - Citizens Charter - Public Grievance Redressal mechanisms – The RTI Act 2005 - Social Auditing and Decentralization - Public Private partnership.

**Text Books:**

1. Avasthi and Maheswari, "Public Administration", Lakshmi Narain Agarwal, 1<sup>st</sup> Edition, 2016.
2. Ramesh K.Arora, "Indian Public Administration: Institutions and Issues", New Age International Publishers, 3<sup>rd</sup> Edition, 2012.
3. RumkiBasu, "Public Administration: Concept and Theories", Sterling, 1<sup>st</sup> Edition, 2013.

**Reference Books:**

1. Siuli Sarkar, "Public Administration in India", Prentice Hall of India, 2<sup>nd</sup> Edition, 2018.
2. M. Laxmikanth, "Public Administration", McGraw Hill Education, 1<sup>st</sup> Edition, 2011.
3. R.B.Jain, "Public Administration in India, 21<sup>st</sup> Century Challenges for Good Governance", Deep andDeepPublications, 2002.

**Web references:**

1. <http://cic.gov.in/>
2. <http://www.mha.nic.in/>
3. <http://rti.gov.in/>
4. <http://www.cvc.nic.in/>



	<b>FUNDAMENTALS OF MICROBIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
	<b>PRACTICAL</b>					
<b>A20BTL206</b>		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### Course objective

- To learn the sterilization techniques, culture media preparation, culture method, staining techniques and the characterization experiments.

### Course Outcomes

#### After the completion of this course, the students will be able to

- Perform the sterilization techniques, culture media preparation, culture method, staining techniques and microbial characterization experiments.
  1. Sterilization Techniques & sterilization of Media, Glass wares
  2. Media Preparation (solid & liquid)
  3. Types of culture method Streak plate, Pour plate & Spread plate
  4. Isolation & Enumeration of Microorganism from water and Soil
  5. Staining Techniques-Simple, Gram's & Spore Staining
  6. Motility of bacteria by Hanging drop technique
  7. Characterization of microorganisms -IMVIC tests
  8. Measurement of Growth rate of bacteria - Turbidometric method
  9. Antibiotic sensitivity Test - Kirby Bauer method.

### Text Books:

1. Microbiology Practical Manual, 1st Edition (Jain Amita) Elsevier India
2. Practical and applied microbiology (Anuradha De) 5<sup>th</sup> edition, Publisher: The National Book Book Depot
3. Mackie & McCartney Practical Medical Microbiology, Publisher: Elsevier India 14<sup>th</sup> edition
4. Practical Manual for Undergraduates Microbiology ( Mukesh Kumar) Publisher: Jain Brothers

### Reference Books:

1. Practical Handbook of Microbiology (Emanuel Goldman, Lorrence H Green) Publisher: Taylor & Francis Inc.

### Web references:

1. <https://www.cdc.gov/infectioncontrol/guidelines/disinfection/sterilization/index.html>
2. <https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html>



<b>A20BTL206</b>	<b>INTERMEDIARY METABOLISM PRACTICAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### Course objective

- To learn the techniques to estimate various type of Biomolecules such as carbohydrate, protein, amino acid DNA and RNA.

### Course Outcomes

#### After the completion of this course, the students will be able to

- To perform the techniques to estimate various type of Biomolecules such as carbohydrate, protein, amino acid DNA and RNA.

1. Estimation of carbohydrates by Anthrone method
2. Estimation of proteins by Lowry method
3. Estimation of protein by Bradford method
4. Estimation of reducing sugars by DNS method
5. Estimation of total and HDL Cholesterol
6. Estimation of free amino acids by Ninhydrin method
7. Estimation of DNA by DPA method
8. Estimation of RNA by Orcinol method

### Text Books:

1. Manual of Practical Biochemistry (Mohammed Rafi), Publisher: Orient Blackswan Pvt Ltd
2. Biochemistry practical manual (Rajendiran Soundravally), Publisher: Elsevier
3. Practical Biochemistry (K Geetha Damodaran), Publisher: Jaypee Brothers Medical

### Reference Books:

1. Practical Manual of Biochemistry (Kaushik G.G.) Publisher: CBS Publishers & Distributors

### Web references:

1. <http://amrita.olabs.edu.in/?sub=79&brch=17&sim=205&cnt=2>
2. <https://www.onlinebiologynotes.com/ninhydrin-test-principle-requirements-procedure-and- result/>
3. <https://www.slideshare.net/jeevithaseyan/estimation-of-dna-by-diphenylamine-method>



<b>A20CHL224</b>	<b>CHEMISTRY- II PRACTICAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>30</b>

(Common to B.Sc.Biotechnology, B.Sc. Biochemistry)

### Course objective

- To learn the Qualitative analysis of organic samples, Separation of organic compounds, Hardness of water.

### Course Outcomes

**After the completion of this course, the students will be able to**

- To perform the Qualitative analysis of organic samples, Separation of organic compounds, Hardness of water.

1. Qualitative analysis of Alcohol
2. Qualitative analysis of Aldehydes
3. Qualitative analysis of Nitro Compounds
4. Qualitative analysis of Carboxylic acid (mono)
5. Qualitative analysis of Carbohydrates
6. Determination of Hardness of water.
7. Determination of acetic acid in commercial vinegar using NaOH
8. Determination of alkali content – antacid tablet using HCl

### Text Books:

1. Rageeb Md. Usman, Dr. Sunila T, "Practical Hand Book of Systematic Organic Qualitative Analysis", Unicorn Publication Pvt. Ltd, 1<sup>st</sup> Edition, 2015.
2. Israel Arthur Vogel, "Vogel's Textbook of Practical Organic Chemistry", Wiley Edition: 1<sup>st</sup> Edition, 1989.
3. Arthur Israel Vogel, "Elementary Practical Organic Chemistry" Prentice Hall Press; 3<sup>rd</sup> Edition, 1980.

### Reference Books:

1. Venkateswaran. V, Veeraswamy. R, Kulandaivelu. A.R., "Basic Principles of Practical Chemistry", New Delhi, Sultan Chand and Sons. 2<sup>nd</sup> Edition, 1997.
2. Mendham. J, Denney. R.C, Bames. J.D, and Thomas, M. "Vogel's Text book of Quantitative Analysis", Pearson Education, 1<sup>st</sup> Edition, 1989.
3. Gopalan.R, Subramaniam.P.S and Rengarajan.K, "Elements of Analytical Chemistry", Sultan Chand and Sons, 1<sup>st</sup> Edition, 2004.

### Web references:

1. [https://assets.cambridge.org/97805212/91125/frontmatter/9780521291125\\_frontmatter.pdf](https://assets.cambridge.org/97805212/91125/frontmatter/9780521291125_frontmatter.pdf)
2. [https://www.csub.edu/chemistry/organic/manual/Lab14\\_QualitativeAnalysis.pdf](https://www.csub.edu/chemistry/organic/manual/Lab14_QualitativeAnalysis.pdf)
3. <http://rushim.ru/books/praktikum/Mann.pdf>



A20BTS202	MEDICAL LABORATORY TECHNOLOGY	L	T	P	C	Hrs
		0	0	4	2	30

### Course Objectives

- To gain basic knowledge on medical laboratory procedures
- To understand methods of measurable clinical parameters
- To understand basics of histopathology
- To understand the principles of biomedical equipment used in diagnosis
- To understand the principles of Diagnostic Methods

### Course Outcomes

After completion of the course, the students will be able to

- CO1 - Understand the concepts of Organization of clinical laboratory and Safety measures.
- CO2 - Understand Collection, processing.
- CO3 - Describe methods of histopathological studies
- CO4 - Preservation of blood and clinical samples.
- CO5 - Define diagnostic principles and methods

#### UNIT I

(6 hours)

Basic laboratory principles -Organization of clinical laboratory and Safety measures - personnel hygiene, code of conduct. Overview of Lymphatic system, Urinary system, respiratory system and circulatory system.

#### UNIT II

(6 hours)

Sample collection - Urine, sputum, Blood. Types of blood collection: capillary puncture-venipuncture, Anticoagulants. Composition of blood. Outline of Hematopoiesis. ABO blood grouping, Rh typing. Blood transfusion- Donor selection, Screening of donor (history, age, weight, Hb, pulse, BP, temperature, interval, registration), Post donation care, Preservation of samples.

#### UNIT III

(6 hours)

Blood cells count: Total count, differential cell count, platelet count, Hemoglobin Estimation, Packed cell volume (PCV) , Erythrocyte Sedimentation Rate [E.S.R.] – Westergren's Method, Bleeding time, clotting time, Latex agglutination test. Pregnancy test.

#### UNIT IV

(6 hours)

Introduction to Histopathology, Tissue preparation, labeling, Fixation – Simple fixative, compound fixative, histochemical fixative, Dehydration- Ethyl alcohol - Acetone, Clearing, impregnation, embedding- Paraffin wax, sectioning. Microtome and its application. Staining of tissues - H&E Staining. Bio-Medical waste management- an overview.

#### UNIT V

(6 hours)

Diagnostic Methods- Outline of Radio imaging, X-Ray, MRI, CT, Ultra sound scan, Mamography, ECG, EEG, Nephelometry, sphygmomanometer. Autoanalyser-Types of AutoAnalysers-Semi and Fully automated Electrolyte Analyser (ISE). Need for Automation, Advantages of Automation.





### Practical

1. Blood collection
2. Differential count of Leucocyte
3. Estimation of Haemoglobin
4. Packed Cell Volume [PCV]
5. Erythrocyte Sedimentation rate [ESR]
6. Bleeding Time, Clotting Time.
7. Latex Agglutination
8. Liver function tests (SGPT, SGOT)
9. Pregnancy test

### Reference books:

1. Gradwohl, Clinical Laboratory-methods and diagnosis, Vol-I Kanai L. Mukherjee, Medical Laboratory Technology Vol. I. Tata McGraw Hill 1996, New Delhi.
2. Gradwohls, 2000. Clinical Laboratory Methods and Diagnosis. (ed) Ales C.3. Sonnenwirth and Leonard Jarret, M.D. B.I. Publications, New Delhi
4. Sood Ramnik, (2015), Text book of Medical Laboratory Technology, 2nd edition, Jaypee Publications
5. Bernadette F. Rodak, George A. Fritsma, Kathryn Doig (2007) Hematology: Clinical Principles and Applications 3rd Ed, Elsevier Health Sciences.
6. Ramanic Sood, Laboratory Technology (Methods and Interpretation) 4th Ed. J.P. Bros, New Delhi
7. Mukharji, Medical Laboratory Techniques, Vol - I, II & III, 5th Edn. Tata McGraw Hill, Delhi.

### Web references:

1. <https://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf>
2. [file:///C:/Users/admin/Downloads/IARC%20Sci%20Pub%20163\\_Chapter%203.pdf](file:///C:/Users/admin/Downloads/IARC%20Sci%20Pub%20163_Chapter%203.pdf)
3. <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/blood-cell-count>
4. <https://histologylab.cml.columbia.edu/HistologyLabManual.pdf>
5. <https://scert.kerala.gov.in/wp-content/uploads/2020/06/16-mlt.pdf>



<b>NATIONAL SERVICE SCHEME</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
<b>A20EAL201</b>	<b>(Common to all B.A., B.Sc., B.Com., B.B.A., B.C.A.)</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

**Course Objectives**

- To introduce about various activities carried out by national service scheme.
- To gain life skills through community service.
- To gain awareness about various service activities performed in higher educational institutions.
- To give exposure about the use of technology to uplift the living standards of rural community.
- To induce the feeling of oneness through harmony of self and society.

**Course Outcomes**

**After the end of the course, the students will be able to**

**CO1** – Recognize the importance of national service in community development.

**CO2** – Convert existing skills into socially relevant life skills.

**CO3** – Differentiate various schemes provided by the government for the social development.

**CO4** – Identify the relevant technology to solve the problems of rural community.

**CO5** – Associate the importance harmony of nation with long term development.

**UNIT I INTRODUCTION TO NATIONAL SERVICE SCHEME (6 Hrs)**

History and objectives, NSS symbol, Regular activities, Special camping activities, Village adaptation programme, Days of National and International Importance, Hierarchy of NSS unit in college. Social survey method and Data Analysis. NSS awards and recognition. Importance of Awareness about Environment, Health, Safety, Gender issues, Government schemes for social development and inclusion policy etc.,

**UNIT II LIFE SKILLS AND SERVICE LEARNING OF VOLUNTEER (6 Hrs)**

Communication and rapport building, problem solving, critical thinking, effective communication skills, decisionmaking, creative thinking, interpersonal relationship skills, self-awareness building skills, empathy, coping with stress and coping with emotions. Understanding the concept and application of core skills in social work practice, Team work, Leadership, Event organizing, resource planning and management, time management, gender equality, understanding rural community and channelizing the power of youth.

**UNIT III EXTENSION ACTIVITIES FOR HIGHER EDUCATIONAL INSTITUTIONS (6 Hrs)**

Objective and functions of Red Ribbon Club, Swatchh Bharath Abhiyan, Unnat Bharat Abhiyan, Jal Shakthi Abhiyan, Road Safety Club, Environmental club and Electoral literacy club.

**UNIT IV USE OF TECHNOLOGY IN SOLVING ISSUES OF RURAL INDIA (6 Hrs)**

Understanding community issues, economic development through technological development. Selection of appropriate technology, Understanding issues in agriculture, fishing, artisans, domestic animals, health and environment.

**UNIT V NATIONAL INTEGRATION AND COMMUNAL HARMONY (6 Hrs)**

The role of Youth organizations in national integration, NGOs, Diversity of Indian Nation, Importance of National integration communal harmony for the development of nation, Indian Constitution, Building Ethical human Relationships, Universal Human Values, Harmony of self and Harmony of nation.



**Reference Books:**

1. Joseph, Siby K and Mahodaya Bharat (Ed.), "Essays on Conflict Resolution", Institute of Gandhian Studies, Wardha, 2007.
2. Barman Prateeti and Goswami Triveni (Ed.), "Document on Peace Education", Akansha Publishing House, New Delhi, 2009
3. Sharma Anand and G. Davi, "Gandhian Way, Academic Foundation", New Delhi Myers Social Psychology. New Delhi: Tata Mc.Graw Hill, 2007.
4. Taylor E. Shelly et.al, "Social Psychology", 12<sup>th</sup> Edition New Delhi, Pearson Prentice Hall Singh, 2006.
5. Madhu, "Understanding Life Skills, background paper prepared for education for all: The leap to equality, Government of India report", New Delhi, 2003.
6. Sandhan "Life Skills Education, Training Module, Society for education and development", 2005.
7. Jaipur. Radakrishnan Nair and Sunitha Rajan, "Life Skill Education: Evidences from the field", RGNIYD publication, Sriperumbudur, 2012.
8. National Service Scheme Manual (Revised), Government of India, Ministry of Youth Affairs and Sports, New Delhi.
9. M. B. Dishad, "National Service Scheme in India: A Case study of Karnataka, trust Publications, 2001.

**Web References:**

1. <http://www.thebetterindia.com/140/national-service-scheme-nss/>
2. <http://en.wikipedia.org/wiki/national-service-scheme> 19=<http://nss.nic.in/adminstruct>
3. <http://nss.nic.in/propexpan>
4. <http://nss.nic.in>
5. <http://socialworknss.org/about.html>



<b>A20BTT307</b>	<b>MOLECULAR BIOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		4	0	0	4	60

**(Common to B.Sc.Biotechnology, B.Sc. Microbiology, B.Sc. Biochemistry)**

**Course Objectives**

- To understand the Fundamentals of Molecular Biology.
- To study the Mechanism of DNA replication.
- To understand the Mechanism of Transcription and Translation.
- To understand the Genetic code.
- To study the Mutation and its types.

**Course Outcomes**

**After completion of the course, the students will be able to**

- CO1** - Understand the Fundamentals of Molecular Biology.  
**CO2** - Know the basic of Mechanism of DNA replication.  
**CO3** - Understand the Mechanism of Transcription and Translation.  
**CO4** - Understand the Genetic code.  
**CO5** - Understand the Mutation and its types.

**UNIT – I (10 hrs)**

Introduction to Molecular Biology, Types of genetic materials- Experiments of Griffith, Avery, MacLeod and McCarty, Hershey and chase, Lederberg and Tatum, Central dogma of life.

**UNIT- II (10 hrs)**

Replication of DNA - Models of DNA replication, Mechanism of DNA replication in prokaryotes and eukaryotes (initiation, elongation, replication fork, replication machinery, termination), Enzymes and proteins involved in DNA replication (nucleases, DNA polymerases, DNA helicases, gyrases, SSCP, topoisomerase, primase).

**UNIT – III (15 hrs)**

Transcription and Translation - Mechanism of transcription in prokaryotes and eukaryotes, post transcriptional modification, Mechanism of translation in Prokaryotes and Eukaryotes, Post-translational modification of Proteins. Inhibitors of transcription.

**UNIT- IV (15 hrs)**

Genetic code - characteristics and properties, Wobble hypothesis. Protein biosynthesis in prokaryotes and eukaryotes, protein degradation, Inhibitors of protein synthesis. Regulation of gene expression (*lac*, *trp* and *gal* operons).

**UNIT- V (10 hrs)**

Mutation and its types- spontaneous, induced, reverse, suppressor mutations; chemical mutagens- alkylating agent, nitrous acid, hydroxylamine; physical mutagen- radiation. DNA repair- mismatch repair, excision repair, direct repair and SOS repair.



**Text Books:**

1. Ajoy Paul. 2011. Textbook of Cell and Molecular Biology. Books and Allied Ltd.
2. P.S. Verma and V.K. Agarwal, 2012, Concepts of Cell Biology. S.Chand & Company Ltd., New Delhi. 2012
3. Dr. David A Thompson. 2011. Cell and Molecular Biology Lab Manual.
4. Lodish. H, Berk. A, Lawrence, A, Matsudaira. A, Baltimore. D and Darnell. J. Molecular Cell Biology (Fourth Edition). Media Connected - W.H.Freeman and Company. 2009
5. Cooper G M & Hausman E, The Cell - A Molecular Approach. (6<sup>th</sup> edition), Sinauer Associates 2013

**Reference Books:**

6. Lewin. B , GENES X, (10<sup>th</sup> edition), Jones & Bartlett Learning, 2011
7. George M. Malacinski. 2013. Freifeder's Essentials of Molecular Biology. Norosa Publishing House.
8. Bruce Alberts, Alexander Johnson. Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter. 2014. Molecular Biology of Cell. Garland Science publication.

**Web references:**

1. [https://www.cs.princeton.edu/courses/archive/spr07/cos424/scribe\\_notes/0424.pdf](https://www.cs.princeton.edu/courses/archive/spr07/cos424/scribe_notes/0424.pdf)
2. <https://microbenotes.com/dna-replication/>
3. <https://atdbio.com/nucleic-acids-book/Transcription-Translation-and-Replication>
4. <https://www.britannica.com/science/genetic-code>
5. <https://www.onlinebiologynotes.com/mutation-and-types-of-mutation/>



		L	T	P	C	Hrs
A20BTT308	<b>ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY</b>	4	0	0	4	60

### Course Objectives

- To understand the Principle of microscopy.
- To study the Principle and types of law of spectrophotometry.
- To understand the principle and types of chromatography.
- To understand the principle of electrophoresis .
- To study about Centrifugation.

### Course Outcomes

**After completion of the course, the students will be able to**

- CO1 - Understand the Principle of microscopy .
- CO2 - Know the the Principle and types of law of spectrophotometry
- CO3 - Understand the principle and types of chromatography .
- CO4 - Understand the principle of electrophoresis and its applications.
- CO5- Understand the Centrifugation.

#### UNIT I (10 Periods)

Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy.

#### UNIT II (10 Periods)

Beer-Lamberts law, Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared)

#### UNIT III (15 Periods)

Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity chromatography, ion exchange chromatography, gas chromatography and HPLC.

#### UNIT IV (15 Periods)

Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, Western blotting ,isoelectric focusing.

#### UNIT V (10 Periods)

Centrifugation - Principle & types, sedimentation co-efficient, sedimentation velocity, ultra centrifugation, separation of macromolecules, subcellular fractionation. ntroduction to Biosensors and Nanotechnology and their applications.



**Text Books:**

1. Upadhyay., Biophysical Chemistry-, Himalaya Publication, Edition III
2. Ghatak, K.L., 2003. Techniques and Methods In Biology. PHI Learning Private Ltd. New Delhi
3. Zubay.G.L., 1993. Biochemistry, 4<sup>th</sup>Edi. WmC. Brown Publishers.

**Reference Books:**

4. Joseph Sambrook and David. W. Russel, Molecular Cloning- A laboratory manual, 4<sup>th</sup> edition, 2012, Cold spring harbor press.
5. Physical Biochemistry, Applications to Biochemistry and Molecular Biology -D, Freifelder.
6. H.V. Volkones., General Biophysics, Voll&II
7. Wilson, K. and Walker, J. Practical Biochemistry - Principles and techniques 7<sup>th</sup> editic 2010, Cambridge University Press,
8. Brawer, I M., Perce, A.M., Experimental techniques in Biochemistry. Prentice Hall Foundation, New York 2012.
9. S.Mahesh., 2003 Biophysics New Age International Private Ltd.

**Web references:**

1. <https://microbiologynotes.org/microscopy-overview-principles-and-its-types/>
2. <https://microbenotes.com/uv-spectroscopy-principle-instrumentation-applications/>
3. <https://microbenotes.com/chromatography-principle-types-and-applications/>
4. <https://microbiologynotes.org/electrophoresis-overview-principles-and-types/>
5. <https://microbenotes.com/centrifuge-and-centrifugation/>



	<b>APPLIED MICROBIOLOGY</b>				
	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
<b>A20BTD304</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

### Course Objectives

- To understand about microbes used in Industry
- To study about the industrial Production of organic acids using microbes.
- To understand the industrial Production of antibiotics.
- To understand the role of Microbes in cheese production .
- To study about Production of therapeutic and diagnostic proteins.

### Course Outcomes

**After completion of the course, the students will be able to**

**CO1** - Understand about microbes used in Industry

**CO2** - Know about the industrial Production using microbes.

**CO3** - Understand the industrial Production of antibiotics.

**CO4** - Understand the role of Microbes in cheese production .

**CO5**- Understand the Production of therapeutic and diagnostic proteins .

### **UNIT I (10 Periods)**

History and development-Growth phase, Isolation, Preservation Screening of microbes used in Industry: Strain improvement by mutation, selection and enrichment. Bioreactors-types. Air lift, cavitator, acetator, fluid Bed reactors.

### **UNIT II (10 Periods)**

Production of beverage and industrial alcohols, wine, beer. Production of organic acids -lactic acid, acetone-butanol, citric acid and acetic acid. Production of microbial biomass –SCP.

### **UNIT III (15 Periods)**

Industrial Production of antibiotics- Penicillin, erythromycin and streptomycin; Bacterial production of enzymes- protease, cellulase, amylase, glucose isomerase, etc, Immobilization of enzymes and development of biosensors.

### **UNIT IV (15 Periods)**

Role of Microorganisms in cheese production –cheddar cheese, blue cheese, Swiss cheese, camembert cheese, yogurt, buttermilk , sour cream, koumiss, kefir manufacturing. Leather processing.

### **UNIT V (10 Periods)**

Production of therapeutic and diagnostic proteins –Interferon, somatotropin, cytokines, insulin, growth factors and steroids. Microbial leaching of ores.





**Text Books:**

1. Gerald (Ed.) Reed. Prescott and Dunn's Industrial Microbiology, Fourth Edition, CBS Publishers and Distributors, 2004.
2. Glick BR and Pasternak JJ. Molecular Biotechnology - Principles & applications of Recombinant DNA. ASM Press, 2009
3. Alani, DI. Murray MY. Perspectives in Biotechnology and applied Microbiology. Elsevier Publication. 1986.
4. Ketchun PA. Applied Microbiology, Microbiology- Concepts and applications. Cassida Jr. Tata McGraw hill Publications, 1994.

**References Books:**

1. Glick BR and Pasternak JJ. Molecular Biotechnology - Principles & applications of Recombinant DNA. ASM Press, 2006.
2. Staneberry et al. Fermentation Technology, 1998.

**Web references:**

1. <http://shintarosalia.lecture.ub.ac.id/files/2018/09/ISOLATION-SCREENING-.pdf>
2. <https://www.basu.org.in/wp-content/uploads/2020/06/18th-PPT-of-Foods-and-Industrial-MicrobiologyCourse-No.-DTM-321.pdf>
3. <https://www.biotechnologynotes.com/antibiotics/production/production-of-antibiotics-by-fermentation-bacteria-fungi-and-penicillin/13886>
4. [https://microbewiki.kenyon.edu/index.php/Microbial\\_processes\\_of\\_cheese\\_production](https://microbewiki.kenyon.edu/index.php/Microbial_processes_of_cheese_production)
5. <https://medcraveonline.com/JMEN/natural-useful-therapeutic-products-from-microbes.html>



<b>A20BTL309</b>	<b>MOLECULAR BIOLOGY PRACTICAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### Course objective

- To learn the molecular Biology Practicals.

### Course Outcomes

**After the completion of this course, the students will be able to**

- To perform the molecular Biology Practicals.
  1. Chromosomal DNA isolation from Bacteria
  2. Plasmid DNA isolation from Bacteria
  3. RNA isolation from Bacteria
  4. Protein extraction from *E.coli*
  5. SDS - PAGE
  6. Isolation of antibiotic resistant mutant
  7. Agarose gel electrophoresis.
  8. Bacterial mutagenesis by physical method
  9. Bacterial mutagenesis by chemical method

### Text Books:

1. Molecular Biology A Practical Manual Paperback – 1 November 2021 by P V G K Sarma
2. Basic Techniques in Biochemistry and Molecular Biology Paperback – 25 June 2020 by R.K. Sharma (Author), S.P.S. Sangha (Author)
3. Advanced Lab Practices in Biochemistry & Molecular Biology Paperback – 1 November 2019 by Suphiya khan Swati Agarwal (Author)

### References Books:

1. Essential Molecular Biology: Volume I: A Practical Approach Volume I: Practical Approach Series) Paperback – Illustrated, 5 October 2000 by T A Brown.
2. Analytical Techniques in Biochemistry and Molecular Biology Hardcover – Illustrated, 23 July 2011 by Rajan Katoch , springer.

### Web references:

1. [https://s3-us-west-2.amazonaws.com/oww-files-public/d/d9/IT-5B\\_\(Basic\)\\_Laboratory\\_Techniques\\_\(in\\_Molecular\\_Biology\).pdf](https://s3-us-west-2.amazonaws.com/oww-files-public/d/d9/IT-5B_(Basic)_Laboratory_Techniques_(in_Molecular_Biology).pdf)
2. <https://www.jove.com/education/2/basic-methods-in-cellular-and-molecular-biology>
3. <https://study.com/academy/topic/basic-molecular-biology-laboratory-techniques.html>



	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
<b>A20BTL309</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### **ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY PRACTICAL**

#### **Course objective**

- To learn the Analytical techniques used in Biotechnology.

#### **Course Outcomes**

**After the completion of this course, the students will be able to**

- perform the Analytical techniques in Biotechnology
- pH meter and Preparation of Buffer - Acidic and Basic
  - molarity and normality solution preparation
  - Isolation of sub-cellular organelles.
  - Density gradient centrifugation
  - Spectrophotometry (visible & UV)
  - Paper chromatography
  - Thin layer chromatography
  - Column chromatography
  - Affinity chromatography

#### **Text Books:**

- Analytical Techniques in Biotechnology by Suzy Hill, Syrawood Publishing House
- A Handbook of Techniques in Biochemistry and Molecular Biology by Dr.Goutham, Laxmi Publications.

#### **References Books:**

- Basic tools and techniques in Biotechnology by Sharma Jitendra, LAP Lambert Academic Publishing.

#### **Web References:**

- <https://scialert.net/fulltext/?doi=ajbmb.2014.1.7>
- [https://www.researchgate.net/publication/322789684\\_](https://www.researchgate.net/publication/322789684_)
- <https://www.ispybio.com/search/protocols/purification%20protocol12.pdf>
- <https://www.sigmaaldrich.com/IN/en/support/calculators-and-apps/molarity-calculator>
- <https://www.thermofisher.com/in/en/home/life-science/protein-biology/protein-biology-learning-center/protein-biology-resource-library/pierce-protein-methods/cell-fractionation-organelle-isolation.html>



**APPLIED MICROBIOLOGY PRACTICAL****A20BTL323**

L	T	P	C	Hrs
0	0	2	2	30

**Course objective**

- To learn the applied microbiology practicals.

**Course Outcomes****After the completion of this course, the students will be able to**

- To perform the applied microbiology practicals.

1. Screening of antibiotic producing microbes from soil
2. Isolation of Growth factor producing microbes
3. Isolation of Amylase producing microbes
4. Enrichment culture techniques
5. Citric acid production by fungal culture
6. Wine production
7. Mushroom Cultivation
8. Production of Microbial Biomass(SCP)
9. Immobilization of Yeast cells

**Text Books:**

1. Practical manual cum work book Industrial Microbiology by T.C.K.Sugitha, P.Raja, R.Rajesh and U. Sivakumar, October 2020, Publisher: Tamil Nadu Agricultural University, ISBN: ISBN:978-93-87443-16-7.
2. Gerald (Ed.) Reed. Prescott and Dunn's Industrial Microbiology, Fourth Edition, CBS Publishers and Distributors, 2004.
3. Glick BR and Pasternak JJ. Molecular Biotechnology - Principles & applications of Recombinant DNA. ASM Press, 2009
4. Alani, DI. Murray MY. Perspectives in Biotechnology and applied Microbiology. Elsevier Publication. 1986.
5. Ketchun PA. Applied Microbiology, Microbiology- Concepts and applications. Cassida Jr. Tata McGraw hill Publications, 1994.

**References Books:**

1. Glick BR and Pasternak JJ. Molecular Biotechnology - Principles & applications of Recombinant DNA. ASM Press, 2006.
2. Staneberry et al. Fermentation Technology, 1998.

**Web references:**

1. <http://shintarosalia.lecture.ub.ac.id/files/2018/09/ISOLATION-SCREENING-.pdf>
2. <https://www.basu.org.in/wp-content/uploads/2020/06/18th-PPT-of-Foods-and-Industrial-MicrobiologyCourse-No.-DTM-321.pdf>



**A20BTE301**

**GENETICS**

L	T	P	C	Hrs
3	0	0	3	45

**Course Objectives**

- To understand the History of Classical and Modern Genetics .
- To study the laws of inheritance .
- To understand the alterations of chromosome .
- To understand the Microbial Genetics .
- To study about Cytogenetics .

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand the History of Classical and Modern Genetics

**CO2** - Know the basic laws of inheritance .

**CO3** - Understand the alterations of chromosome

**CO4** - Understand the Microbial Genetics .

**CO5**- Understand the basic Cytogenetics .

**UNIT I (10 Hours)**

History of Classical and Modern Genetics, Concept and organization of Genetic material in Bacteria, Plant and Animal; Structure, types, forms and functions of DNA and RNA. Genetic model organisms and their significance (*E.coli*, *Arabidopsis thaliana*, *Caenorhabditis elegans*).

**UNIT II (7 Hours)**

Mendelian laws of inheritance; Non-Mendelian inheritance; Chromosomal theory of inheritance. Back cross and Test cross.

**UNIT III (10 Hours)**

Structural and numerical alterations of chromosome- Deletion, Inversion, Duplication, Translocation. Ploidy and their genetic implications. Mutation- (Spontaneous and Induced) mutagen. Biochemical basis of mutation.

**UNIT IV (10 Hours)**

Microbial Genetics: Methods of Gene transfer – Transformation, Transduction, Sexduction, Mapping genes by interrupted Matting, fine structure analysis of genes.

**UNIT (8 Hours)**

Cytogenetics- Human karyotype, Banding techniques, Human genetic diseases. Pedigree analysis.



**Text Books:**

1. Ajoy Paul (2007). Text Book of Cell and Molecular Biology. First edition, Books Allied (P) Ltd., Kolkata.
2. Peter Snustad D and Michael J Simmons (2003). Principles of Genetics. Third edition, John Wiley and Sons, Inc. publication, New Delhi.

**References Books:**

3. Robertis et al., 1995 Eighth Edition. Cell and Molecular Biology -Waverly publication.
4. E.J.Gardener, M.J.Simmons and D.P.Snustad, Principles of Genetics - John Wiley & Sons Publications.
5. Strickberger, M.W., 1997. Fourth Edition.Genetics -Printice Hall, , 60
6. Alberts., 2002. Molecular Biology of the Cell -. Garland publication, Fourth Edition.
7. Ajoy Paul., 2011. Text Book of Genetics- from Genes to Genomes- Books and Allied (P) Ltd, Kolkata.Third Edition.

**Web References:**

1. [https://www.bioexplorer.net/history\\_of\\_biology/genetics/](https://www.bioexplorer.net/history_of_biology/genetics/)
2. <https://courses.lumenlearning.com/boundless-biology/chapter/laws-of-inheritance/>
3. <https://www.osmosis.org/answers/chromosomal-aberrations#:~:text=Chromosomal%20aberrations%20are%20changes%20in,for%20a%20total%20of%201.>



A20BTE302

GENERAL BIOLOGY

L	T	P	C	Hrs
3	0	0	3	45

**Course Objectives**

- To understand the classification of Plants and Animals.
- To study the Structure and function of plant tissues .
- To understand the micro- and macro-nutrients .
- To understand the plant-water relations.
- To study Digestion of food, etc .

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand the classification of Plants and Animals.

**CO2** - Know the Structure and function of plant tissues.

**CO3** - Understand the micro- and macro-nutrients .

**CO4** - Understand the plant-water relations,

**CO5**- Understand the Digestion of food, etc.

**UNIT- I**

**(8 Hours)**

General classification of Plants and Animals, Concept of Species, Overview of Kingdoms - Animalia and Plantae, General characteristics of each group up to class level with an example.

**UNIT- II**

**(10 Hours)**

Structure and function of plant tissues: parenchyma, collenchyma, sclerenchyma. Different types of xylem and phloem. Structure and functions of animal tissues: simple epithelial tissue, connective tissues, muscle tissues and nervous tissue (Neurons).

**UNIT- III**

**(7 Hours)**

Autotrophic nutrition, Photosynthesis, micro- and macro-nutrients, overview of mineral element deficiencies in plants. Different types of heterotrophic nutrition.

**UNIT - IV**

**(10 Hours)**

Brief account of plant-water relations, types of transpiration and stomatal mechanisms, ascent of water in xylem and translocation of organic solutes in phloem, Anaerobic and aerobic respirations, Nitrogen fixation, Vegetative and asexual propagation of plants, sexual reproduction in plants (algae to angiosperm), pollination, fertilization.

**UNIT - V**

**(10 Hours)**

Digestion of food in various regions of the alimentary canal; General characteristics of blood vascular system, composition of blood, structure and functions of heart, blood clotting; Nervous system; General view of endocrine system.



**Text Books:**

1. D.J. Taylor, N.P.O. Green, G.W. Stout. Biological Science (3<sup>rd</sup> Edition) –Cambridge University Press. 2008.
2. Taiz, L & Zeiger, E. Plant physiology (5<sup>th</sup> edition), Sinauer Associates, Inc. Sunderland. 2010.
3. Knut Schmidt-Nielsen. Animal physiology (5<sup>th</sup> edition). Cambridge University Press. 1997.

**Reference Books:**

4. Raven, P.H., Evert, R.F & Eichhorn, S.E. Biology of plants (7<sup>th</sup> edition). W.H. Freeman Company publishers, USA. 2005.
6. Campbell, N.A & Reece, J.B. Biology (8<sup>th</sup> edition). Pearson Benjamin Cummings, San Francisco. 2008.

**Web References:**

1. <https://www.pmfias.com/five-kingdom-classification-plants-animals/#:~:text=Biological%20>





**A20BTE303 PARASITOLOGY AND ENTOMOLOGY**

L	T	P	C	Hrs
3	0	0	3	45

**Course Objectives**

- To understand the General Consideration of parasitology.
- To study about Protozoa:
- To study about Cestode and Trematodes
- To study about Nematodes
- To study about Entomology and disease transmission

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand the the General Consideration of parasitology

**CO2** - Know the about Protozoa:

**CO3** - Understand about Cestode and Trematodes

**CO4** - Understand about Nematodes

**CO5**- Understand the basic Entomology and disease transmission

**UNIT I (7 hours)**

General Consideration: Taxonomy, Transmission of parasites, Pathogenesis and pathology, Host immunity in parasitic infections, Clinical manifestations of parasitic infections, Laboratory diagnosis of parasitic infections, Prevention and control of parasitic infections.

**UNIT II (10 hours)**

Protozoa: Entamoeba, Plasmodium, Leishmania, Giardia, Trichomonas, Balantidium, Toxoplasma and Cryptosporium - Habitat, Morphology, Pathogenesis and pathology, Host immunity in parasitic infections, Clinical manifestation and laboratory diagnosis and prevention and control.

**UNIT III (10 hours)**

Cestode and Trematodes: Taenia, Echinococcus, Schistosoma, Fasciola, Paragonimus and Platyhelminthes - Habitat, Morphology, Pathogenesis and pathology, Host immunity in parasitic infections, Clinical manifestation and laboratory diagnosis and prevention and control.

**UNIT IV (10 hours)**

Nematodes: Strongyloides, Trichinella, Hookworms, Ascaris, Entrobilus, Trichris, Wuchereria, Brugia, Dracunculus - Habitat, Morphology, Pathogenesis and pathology, Host immunity in parasitic infections, Clinical manifestation and laboratory diagnosis and prevention and control.

**UNIT V (8 hours)**

Entomology and disease transmission: Modern concepts of Entomology, knowledge and Life cycles of arthropod vectors - ticks, mites, fleas, mosquitoes and flies, that are Capable of disease transmit in human and animals, Vector transmitted diseases in India and control measures.



**Text Books:**

1. Parija SC, Text Book of Medical Parasitology, Protozoology & Helminthology (3<sup>rd</sup> edition), All India Publishers & Distributors (2008).
2. Arora. D.R. and Arora, B, Medical Parasitology, (1st edition), CBS Publishers & Distributors, New Delhi (2002).
3. Easwari Nayar, Hand Book on Medical Entomology, Kalpana Printing House, Delhi (1994).

**Reference Books:**

4. Garcia LS, Bruckner DA. Diagnostic Medical Parasitology. American Society for Parasitology, Washington DC, (2004). 64
5. Colle Jc, Duguid JP, Fraser AC and Marimon BP, Mackie and McCartney's Practical Medical Microbiology, 14<sup>th</sup> edition, Churchill Livingstone (2004).

**Web references:**

1. <https://onlinelibrary.wiley.com/doi/abs/10.1128/9781555817381.ch132>
2. <https://byjus.com/neet/protozoa/>
3. <https://www.ncbi.nlm.nih.gov/books/NBK8282/>
4. <https://nematode.unl.edu/wormgen.htm>
5. [https://entnemdept.ufl.edu/fasulo/vector/chapter\\_02.htm](https://entnemdept.ufl.edu/fasulo/vector/chapter_02.htm)



<b>A20BTS303</b>	<b>SOFT SKILLS LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>30</b>

**Course Objectives**

- To train students in soft skills in order to enable them to be professionally competent
- To facilitate the students for oral communication with confidence
- To enrich the sense of social responsibility and accountability of the students
- To help the students to train them for writing different types of resumes in keeping with the demands of the corporate world
- To train the students to work with team environment

**Course Outcomes**

**After completion of the course, the students will be able to**

- CO1**-Enhance the soft skills and compete professionally
- CO2**-Speak and present the ideas with confidence
- CO3**-Establish Interpersonal and leadership qualities
- CO4**-Draft different types of effective and impressive resume that highlight their potential and expectation
- CO5**-Demonstrate the quality of a team player to execute and manage things in professional and personal life

**UNIT I SOFT SKILLS AND PERSONALITY DEVELOPMENT (6 Hrs)**

1. Soft Skills: Meaning and Importance
2. Hard Skills versus Soft Skills
3. Power of Positive Attitude – Etiquette and Manners

**UNIT II COMMUNICATION SKILLS (6 Hrs)**

1. Oral Communication: Forms, Types of Speeches and Public Speaking
2. Presentation: Elements of Effective Presentation and Use of Visual Aids in Presentation
3. Non-verbal Communication: Body Language and Proxemics

**UNIT III INTERPERSONAL SKILLS (6 Hrs)**

1. Interpersonal Skills - Relationship Development and Maintenance and Transactional Analysis
2. Negotiation- Types, Stages and Skills
3. Counseling Skills

**UNIT IV EMPLOYABILITY SKILLS (6 Hrs)**

1. Goal Setting
2. Career Planning
3. Corporate Skills
4. Group Discussion
5. Interview Skills - Types of Interview
6. Job Application - Cover Letter
7. Resume Preparation

**UNIT V PROFESSIONAL SKILLS (6 Hrs)**

1. Decision Making Skills
2. Problem Solving
3. Team Building Skills
4. Team Spirit - Time Management



**Text Books:**

1. Sharma Prashant, "Soft Skills Personality Development for Life Success", BPB Publications, 1<sup>st</sup> Edition, 2018.
2. Robbins & Hunsaker, "Training in Interpersonal Skills", Pearson Publication, 6<sup>th</sup> Edition, 2015.
3. Vishnu P. Singh & C. Subhas & Kapil Dev, "Employability Skills", Asian Publication, 2<sup>nd</sup> Edition, 2014.

**Reference Books:**

1. Ghosh, B.N, "Managing Soft Skills for Personality Development", Tata McGraw Education Publication, 1<sup>st</sup> Edition, 2012.
1. Neera Jain & Shoma Mukherji., "Effective Business Communication" New Delhi: Tata McGraw Hill Education Publication, 1<sup>st</sup> Edition, 2012.
2. Ashraf Rizwi.M, "Effective Technical Communication", Tata McGraw Hill Education Publication, 1<sup>st</sup> Edition, 2010.

**Web references:**

1. [https://www.mindtools.com/pages/main/newMN\\_LDR.htm](https://www.mindtools.com/pages/main/newMN_LDR.htm)
2. <https://www.skillsyouneed.com/ips/negotiation.html>
3. <https://www.investopedia.com/terms/i/interpersonal-skills.asp>
4. <https://www.smemaxx.com/becorporateready>
5. <https://www.skillsyouneed.com/ips/interviewing-skills.html>



	<b>GENETIC ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
<b>A20BTT410</b>	<b>(Common for B.Sc.Biotechnology, B.Sc.Microbiology, B.Sc.Biochemistry)</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

### Course Objectives

- To understand the Fundamental history of Genetic Engineering
- To study about cloning vectors .
- To understand the Gene transfer techniques
- To understand about the techniques to screen the positive clones.
- To study the Applications of Genetic engineering

### Course Outcomes

**After completion of the course, the students will be able to**

**CO1** - Understand the history of Genetic Engineering

**CO2** - Know the basic cloning vectors

**CO3** - Understand the Gene transfer techniques

**CO4** - Understand the about the techniques to screen the positive clones.

**CO5**- Understand the Applications of Genetic engineering

#### UNIT-I

**(10 hours)**

History and basic steps involved in genetic engineering, Enzymes involved in genetic engineering (Nucleases, Restriction enzymes and their types, DNA ligases and ligation, Kinases, Phosphatases, Reverse transcriptase, Transferases, DNA polymerase), Restriction mapping.

#### UNIT -II

**(10 hours)**

Basic design of cloning vectors - plasmid (pBR322 and pUC 18/19), cosmids, phage vectors (lambda and M13), phagemid, yeast vectors (YE<sub>p</sub>, YR<sub>p</sub>, YI<sub>p</sub>), shuttle vectors, BAC and YAC Expression of cloned genes - general features of an expression vector, expression of eukaryotic gene in prokaryotes - advantages and limitations.

#### UNIT - III

**(15 hours)**

Gene transfer techniques - physical (microinjection and biolistic transformation), chemical (CaCl<sub>2</sub> mediated transformation and Lipofection), electroporation and transduction. Selection of recombinants - blue and white screening and plus and minus screening.

#### UNIT -IV

**(15hours)**

Construction of genomic and cDNA library, PCR- steps involved, Guidelines for PCR primer designing, variants of PCR (multiplex, nested, quantitative real time, RT- PCR), applications and limitations. Blotting - southern, northern and western blotting ; Nucleic acid and immuno probes.

#### UNIT -V

**(10 hours)**

Manipulation of gene sequences by random mutations and site directed mutagenesis, Applications of Genetic engineering in industry, medicine and agriculture. Bioethics and Biosafety.



**Text books:**

1. Dubey R.C, Advanced Biotechnology (1st edition), Chand and Company, 2014.
2. Watson D James; et al Recombinant DNA: genes and genomes, (3<sup>rd</sup> edition), Basingstoke: Palgrave pacmillan, 2007.
3. Sathyanarayanan U, Biotechnology (2013) Books and allied (P) ltd.

**Reference books:**

4. Primrose Sandy B. and Richard Twyman, Principles of Gene Manipulation and Genomics (7<sup>th</sup> Edition), Wiley-Blackwell 2006.
5. Brown T. A, Gene Cloning and DNA Analysis: An Introduction, (6<sup>th</sup> Edition) Wiley- Blackwell, 2010.
6. Winnacker L Ernst, From genes to clones -Introduction to gene technology (4<sup>th</sup> edition), Panima Publishing Corporation, 2003.

**Web references:**

1. [https://www.iatp.org/sites/default/files/Brief\\_History\\_of\\_Genetic\\_Engineering\\_](https://www.iatp.org/sites/default/files/Brief_History_of_Genetic_Engineering_)
2. <http://www.igntu.ac.in/eContent/MSc-Biotech-02Sem- ProfBhuminath>
3. [https://www.deshbandhucollege.ac.in/pdf/resources/1589512616\\_Z\(H\)-VI-Bio](https://www.deshbandhucollege.ac.in/pdf/resources/1589512616_Z(H)-VI-Bio)
4. <https://www.synbio-tech.com/gene-library-synthesis/>
5. [https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A\\_Microbiology](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology)



IMMUNOLOGY		L	T	P	C	Hrs
A20BTT411	(Common for B.Sc.Biotechnology, B.Sc.Microbiology, B.Sc.Biochemistry)	4	0	0	4	60

### Course Objectives

- To understand the Fundamentals of Immunology
- To study the Antigens & Immunogenicity
- To understand the Antigen and antibody reactions
- To understand the Structure and organization of nucleus
- To study about Immunity and tumors

### Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the Fundamentals of Immunology

CO2 - Know the Antigens & Immunogenicity

CO3 - Understand the Antigen and antibody reactions

CO4 - Understand the structure and functions of nucleus

CO5- Understand the basic of Immunity and tumors

#### UNIT - I

(15 hours)

Immunology - History & Milestones, Microbial infections and host resistance. Immune response: Innate & Adaptive responses, Humoral and cell mediated Immune Responses. Structures, composition and functions of cells and organs of immune system.

#### UNIT- II:

(10 hours)

Antigens & Immunogenicity. Antigens - Types, properties, Haptens, Adjuvants, Toxoids, Immunoglobulins- structure, types and properties, Theories of antibody formation, Structural and genetic basis of antibody formation.

#### UNIT - III

(10 hours)

Antigen and antibody reactions, Immunodiagnostic methods - Agglutination, precipitations, complement fixation, RIA, ELISA and its types, Immunofluorescence, Production of Monoclonal Antibodies and Hybridoma technique.

#### UNIT - IV

(10 hours)

Cytokines & Chemokines - Classification, types and its functions, Complement system: - structure, properties, functions of complement components and its pathways. Hypersensitivity reactions: Type I, II, III and IV.

#### UNIT - V

(15 hours)

Immunity and tumors: Types of tumors, tumor antigens, immune response to tumors. Immunodeficiency and Auto immune diseases, MHC - Structure and function of class I and class II MHC molecules, Transplantation immunology - types and mechanisms involved.



**Text Books:**

1. Roit, I.M., Delves P.J., Essential Immunology (10<sup>th</sup> edition), Blackwell Science, Oxford 2001
2. Immunology by Kuby, J. (7<sup>th</sup> edition) W.H. Freeman and Company, New York, 2013
3. Kumar. M.S, Leela K Sai, Microbiology and Immunology (2<sup>nd</sup> edition) Jaypeebooks 2014

**Reference books:**

4. Male. D and Roth. D, Immunology (8 edition), Reed Elsevier India Pvt Limited 2013.
5. Khan. F.H. The Elements of Immunology, Pearson Education India, 2009
6. Hay. F.C, Olwyn. M.R West wood, Practical Immunology (4<sup>th</sup> edition), Blackwell science 2002

**Web references:**

1. <https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/history-immunology>
2. <https://www.britannica.com/science/antigen>
3. <https://www.britannica.com/science/antibody>
4. <https://www.sigmaaldrich.com/IN/en/technical-documents/technical-article/protein-biology/elisa/antibody-antigen-interaction>
5. <https://teachmephysiology.com/immune-system/innate-immune-system/cytokines/>
6. <https://www.creative-diagnostics.com/Tumor-Immunity.htm>





		L	T	P	C	Hrs
A20MAD409	<b>BIostatistics</b>					
	(Common for B.Sc.Biotechnology, B.Sc.Micro biology, B.Sc.Biochemistry)	4	0	0	4	60

**Course Objectives**

- To understand the Introduction to Biostatistics .
- To study the Classification and tabulation.
- To understand the Measures of central tendency.
- To understand the Correlation .
- To study about Statistical inference .

**Course Outcomes**

After completion of the course, the students will be able to

CO1 - Understand the Introduction to Biostatistics.

CO2 - Know the Classification and tabulation .

CO3 - Understand the Measures of central tendency .

CO4 - Understand the Correlation .

CO5- Understand the Statistical inference .

**UNIT I**

**(15 hours)**

Introduction to Biostatistics-Definition of Biostatistics-Basic objectives,applications in various branches of science, collectons of data: Internal and External data, primary and secondary data, population and sampling.

**UNIT II**

**(10 hours)**

Classification and tabulation of univariant data, graphical representation- Bar diagram-pie diagram-Histogram,frequency curves.

**UNIT III**

**(15 hours)**

Measures of central tendency - mean, median and mode. Harmonic mean, Measures of dispersion: range and co-efficient of range, standard deviation.

**UNIT IV**

**(10 hours)**

Correlation, coefficient of correlation, regression, simple regression equation, fitting of regression line.

**UNIT V**

**(10 hours)**

Statistical inference-simple sampling-student 't'-test, Chi-square test and 'F' test.



**Text Books:**

1. A.Goun .N.Gupta and B.Dasgupta, "Fundamentals of Statistics" vol I &II world press.
2. an introduction to Biostatistics, 3<sup>rd</sup> edition, sundarrao, P.S.S and Richards, J.Christian medical college, vellore.

**Reference Books:**

3. Biostatistics, Danniell, W.W., 1987. New york, John wiley sons.
4. Statistics for biology, Boston, Bishop, O.N. Houghton, Mifflin.
5. statistics for Biologist, campbell, R.C., 1998. Cambridge university press.
6. Statistical Analysis of epidemiological data, selvin, S., 1991. New york University press.

**Web references:**

1. <https://www.sciencedirect.com/book/9780122622700/introduction-to-biostatistics>
2. [https://www.uobabylon.edu.iq/eprints/publication\\_3\\_12756\\_638.pdf](https://www.uobabylon.edu.iq/eprints/publication_3_12756_638.pdf)
3. <https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php>
4. <https://www.investopedia.com/terms/c/correlationcoefficient.asp>
5. <https://byjus.com/maths/statistical-inference/>



<b>A20BTL412</b>	<b>GENETIC ENGINEERING PRACTICALS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### Course Objectives

- To learn the Genetic Engineering Practicals.

### Course Outcomes

**After the completion of this course, the students will be able to**

- To perform the the Genetic Engineering Practicals.

1. Restriction digestion of pBR322
2. Ligation of digested DNA fragments
3. Competent cell preparation
4. Transformation of bacteria - CaCl<sub>2</sub> method
5. Selection & screening of rDNA antibiotic resistance, blue - white colony
6. Southern hybridization
7. Isolation of total mRNA from Bacteria
8. Northern hybridization
9. Polymerase chain reaction

### Text Books:

1. Laboratory Manual for Genetic Engineering (Vennison John), Publisher: PHI Learning, Genre: Science, ISBN: 9788120338142, 9788120338142.

2. A Practical Textbook of Genetic Engineering in Bacteria (English, Paperback, Sarma P V G K) Publisher: Mjp Publisher, Genre: Science, ISBN: 9789388694414  
Edition: 2021.

### Reference Books:

1. Genetic Engineering: Techniques and Applications by Enrique preston, Publisher: Callisto Reference ,Genre: Science, ISBN: 9781632398703, 9781632398703.

2. Genetic Engineering: Concepts, Tools and Techniques by Rosanna manna, Publisher: Syrawood Publishing House, Genre: Science, ISBN: 9781682861233, 9781682861233.

### Web references:

1. <https://www.addgene.org/protocols/subcloning/>
2. <https://www.addgene.org/protocols/bacterial-transformation/>
3. <https://www.sigmaaldrich.com/US/en/technical-documents/protocol/protein-biology/gel-electrophoresis/southern-and-northern-blotting>
4. <https://www.genscript.com/pcr-protocol-pcr-steps.html>



A20BTL412	IMMUNOLOGY PRACTICALS	L	T	P	C	Hrs
		0	0	2	1	30

**Course objective**

- To learn the Immunology practicals  
**After the completion of this course, the students will be able to**
- To perform the the Immunology practicals
  1. Single Immunodiffusion
  2. Double Immunodiffusion
  3. Rocket Immuno-electrophoresis
  4. WIDAL test
  5. Slide Agglutination Reaction - ABO Blood Grouping
  6. Separation of Blood, plasma and serum
  7. Extraction of antigens from microbes
  8. Western Blotting
  9. Enzyme-Linked Immunosorbent Assay

**Text Books:**

1. A HANDBOOK OF PRACTICAL AND CLINICAL IMMUNOLOGY VOL 2 2ED (PB 2017): Volume II Paperback – 1 January 2017 by **TALWAR and Gupta (Author)**

**Reference Books:**

1. Immunology: Overview and Laboratory Manual by by Tobil Sam-Yellowe, Publisher : Springer; 1st ed. 2020 edition (20 January 2021)
2. Practical Immunology A Laboratory by by Karthik Kaliaperumal und Senbagam, LAP LAMBERT Academic Publish 1st edition (1 January 2017)

**Web references:**

1. [https://www.gbiosciences.com/image/pdfs/protocol/BE-501\\_protocol.pdf](https://www.gbiosciences.com/image/pdfs/protocol/BE-501_protocol.pdf)
2. <https://microbiologynote.com/blood-grouping-principle-and-procedure/>
3. <https://cinj.org/sites/cinj/files/documents/C4ProcedureForSerumAndPlasmaSeparation.pdf>
4. <https://www.healthline.com/health/elisa#procedure>



**BIostatISTICS PRACTICALS**

**A20MAL404**

L	T	P	C	Hrs
0	0	2	2	30

**Course objective**

- To learn the Practical applications of Biostatistics.

**Course Outcomes**

**After the completion of this course, the students will be able to**

- apply the statistical application in Biology
  - Measurements of central tendency-mean, median and mode
  - Measurement of central tendency- Harmonic mean, geometric mean
  - Measurement of dispersion-standard deviation
  - Measurement of dispersion-range
  - Calculation of correlation coefficient values
  - Fitting of regression equation
  - Test of hypothesis-chi square test
  - Hypothesis- student 't' test
  - Hypothesis- 'F' test

**Text Books:**

- A.Goun .N.Gupta and B.Dasgupta, "Fundamentals of Statistics" vol I & II world press.
- An introduction to Biostatistics, 3<sup>rd</sup> edition, Sundar Rao, P.S.S and Richards, J.Christian medical college, Vellore.

**Reference Books:**

- Biostatistics, Daniel, W.W., 1987. New York, John Wiley Sons.
- Statistics for biology, Boston, Bishop, O.N. Houghton, Mifflin.
- Statistics for Biologists, Campbell, R.C., 1998. Cambridge University Press.
- Statistical Analysis of epidemiological data, Selvin, S., 1991. New York University Press.

**Web references:**

- <https://www.sciencedirect.com/book/9780122622700/introduction-to-biostatistics>
- [https://www.uobabylon.edu.iq/eprints/publication\\_3\\_12756\\_638.pdf](https://www.uobabylon.edu.iq/eprints/publication_3_12756_638.pdf)
- <https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php>
- <https://www.investopedia.com/terms/c/correlationcoefficient.asp>
- <https://byjus.com/maths/statistical-inference/>



A20BTE404	DEVELOPMENTAL BIOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

### Course Objectives

- To understand the Spermatogenesis
- To study the of sperm and egg
- To understand the structure of Cell cleavage
- To understand the the Development of Microsporangium
- To study about shoot and root apical meristem

### Course Outcomes

**After completion of the course, the students will be able to**

**CO1** - Understand the Spermatogenesis

**CO2** - Know the basic of sperm and egg

**CO3** - Understand the structure of Cell cleavage

**CO4** - Understand the Development of Microsporangium

**CO5**- Understand the basic of shoot and root apical meristem

### UNIT I (8 hours)

Spermatogenesis and Oogenesis in mammals, Menstrual cycle, Monitoring of estrus cycle, Sperm Banking. Hormones involved in reproduction.

### UNIT II (10 hours)

Activation of sperm and egg- interaction of sperm and egg - Sequence of events in sperm entry - Egg surface changes. Post-fertilization changes. Embryo development.

### UNIT III (10 hours)

Cell cleavage - pattern of cleavage - Chemical changes- Distribution of cytoplasmic substances in the egg -Metamorphosis (Insects and amphibians) -Hormone control of metamorphosis.

### UNIT IV (10 hours)

Development of Microsporangium and Megasporangium, Pollination, Embryo -Embryo sac development and double fertilization in plants, seed formation and germination. Out line of experimental embryology.

### UNIT V (7 hours)

Organization of shoot and root apical meristem, and development. Leaf development and Phyllotaxy.

### Text Books:

1. Gilbert, Scott's. 10th edition (2014). Developmental biology. Sinauer Association, Inc., Publishers.
2. Chattopadhyay.S. 2016. An Introduction to Developmental Biology, Books and Allied (P) Ltd,Kolkata. First Edition.
2. Bruce M Carlson, Patten's Foundation of Embryology,. Tata McGraw Hill Co.
3. Balinsky, B.I., 1981. 5th edition. An Introduction to Embryology, W. B. Saunders Co., Philadelphia
4. Verma , P.S., Agarwal, V.K., and Tyagi., 1995. Chordate embryology, S. Chand & Co., New Delhi.

### Reference Books:

- 5.Jonathan Slack. Essential Developmental Biology. (1<sup>st</sup> ed.) Blackwell Science (2001). 6.A.J.Lack and D.E. Evans, Instant notes in Plant Biology, (1<sup>st</sup> ed.) Bios Scientific Publishers Limited (2001)
- 6.Scott. F. Gilbert, Developmental Biology;( 6<sup>th</sup> ed.) Sinauer Associates, INC., Publishers, Sunderland, Massachusetts. (2000).

### Web references:

1. <https://www.google.com/search?q=Spermatogenesis+and+Oogenesis+notes&ei=RAoYra7Nbnq>
2. <https://byjus.com/biology/embryo-development/>
3. <https://www.google.com/search?q=Development+of+Microsporangium>
4. <https://www.google.com/search?q=Organization+of+shoot+and+root+&source>

		L	T	P	C	Hrs
A20BTE405	BIOLOGY OF CLONING VECTORS	3	0	0	3	45

### Course Objectives

- To understand the Salient features of cloning vectors
- To study the types of plasmids
- To understand the Plasmid Biology
- To understand the of lambda phage vector
- To study about Animal viruses and Agrobacterial plasmids

### Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the Salient features of cloning vectors

CO2 - Know the basic Comparative genomics

CO3 - Understand Plasmid Biology

CO4 - Understand about lambda phage vector

CO5- Understand the about Animal viruses and Agrobacterial plasmids

#### UNIT I

(10 hours)

Salient features of cloning vectors- Restriction enzyme and their mode of action- Types of restriction enzymes – Recombinant DNA – Types of cloning vectors: plasmids, cosmids, single stranded M 13, SV 40 vectors, Phagemids, Shuttle vectors, Broad Host range Vectors.

#### UNIT II

(8 hours)

DNA phages, animal viruses, Ti plasmids, cauliflower mosaic virus. Specialized Vectors. Expression vectors, Off vectors, gene fusion vectors, Vectors for yeast, Streptomyces, Bacillus.

#### UNIT III

(10 hours)

Plasmid Biology: Structural and functional organization of plasmids, plasmid replication, stringent and relaxed plasmids, incompatibility of plasmid maintenance – plasmid rescue technique.- plasmids of gram positive bacteria, ColE1, R1, pT181, psc 101- plasmids of gram negative bacteria P1J101, SLP and SCP. plasmid pBR 322 construction and derivatives.

#### UNIT IV

(10 hours)

Biology of lambda phage- Lambda phage invitro construction of a lambda vector, classes of lambda vectors, cosmid vectors and other use. M 13 vectors and their use in DNA sequencing.

#### UNIT V

(7 hours)

Animal viruses and gene cloning – Agrobacterial plasmids and their use in plant genetic engineering.

### Text Books:

1. Terence A. Brown, Genomes 2, (2nd edition) - Garland Science publishing, 2002.
2. R.W & Primrose S. B, Principles of gene manipulation - An introduction to genetic Engineering, Black well publishers, (5th Edition), 2000.
3. Helen Kreuzer and Adrienne Massey, Recombinant DNA and Biotechnology (2nd edition), ASM Press, 2001

### Reference Books:

1. Gene Cloning – Glover 1984, oxford University press.
2. From genes to clones – Ernst Winnacker panima , publishing corporation , India 2003.
3. Recombinant DNA – Watson, gilman, Zolter, Jan witkowski, 2<sup>nd</sup> Ed, 1992, W.H. Freeman
4. Principles of gene manipulation- Old and Primrose, 4<sup>th</sup> Ed, Black well scientific publications, London, 1989..

### Web references:

1. <https://www.google.com/search?q=salient+features+of+cloning+vectors>
2. <https://www.cuemath.com/geometry/vectors/>
3. [https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A\\_Microbiology/7.04%3A\\_Plasmids/](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology/7.04%3A_Plasmids/)



<b>A20BTE406</b>	<b>MOLECULAR DIAGNOSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>45</b>

### Course Objectives

- To understand the Fundamentals of Genetics and diagnostics
- To study the Molecular methods
- To understand the Nuclear hybridization methods
- To understand the Allele susceptibility
- To study about Cell sorting

### Course Outcomes

**After completion of the course, the students will be able to**

**CO1** - Understand the Fundamentals of Genetics and diagnostics

**CO2** - Know the Molecular methods

**CO3** - Understand the Nuclear hybridization methods

**CO4** - Understand the Allele susceptibility

**CO5**- Understand the Cell sorting

### UNIT-I (10 hours)

Genetics and diagnostics: General features of Chromosomes, chromosome banding patterns, banding techniques and their correlates, karyotyping, DNA profiling hybridization arrays. Early detection of diseases.

### UNIT-II (10hours)

Molecular methods: Nucleic acid extraction: principles and methods. Assessing purity and concentration of nucleic acids, PCR- basic and applied - Alu-PCR, Hot start PCR, PCR-ELISA, Arbitrarily primed PCR, *in situ* PCR.

### UNIT-III (8 hours)

Nuclear hybridization methods, Single nucleotide polymorphisms and plasmid finger printing in infections, PFGE, DGGE. Detection of mutation using ARMS-PCR and microsatellite markers.

### UNIT-IV (10 hours)

Allele susceptibility test for multifactorial disorders (Neural tube defect, cleft-lip and palate, cardiovascular disorder, male infertility)

### UNIT-V (7 hours)

Cell sorting- Flow cytometry and FACS. Neonatal and prenatal diagnosis. Sex identification in forensics.





**Text Books:**

1. Wilson, K. and Walker, J. Practical Biochemistry – Principles and techniques 7<sup>th</sup> edition, 2010, Cambridge University Press,
2. Primrose Sandy B. and Richard Twyman, Principles of Gene Manipulation and Genomics (7<sup>th</sup> Edition), Wiley-Blackwell 2006.
3. Brown T. A, Gene Cloning and DNA Analysis: An Introduction, (6<sup>th</sup> Edition) Wiley-Blackwell, 2010.

**Reference Books:**

4. Terence A. Brown, Genomes 2, (2nd edition) – Garland Science publishing, 2002. 81
5. Old R.W, Primrose S.B, Twyman R. M, Principles of Gene manipulation (6<sup>th</sup>ed.), Wiley-Blackwell, 2002.

**Web reference:**

1. <https://www.google.com/search?q=molecular+genetics+and+diagnostics+notes>
2. <https://academic.oup.com/femspd/article/49/2/184/493227>
3. <https://www.google.com/search?q=nuclear+hybridization+method+notes>



<b>A20BTS404</b>	<b>RESEARCH METHODOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>30</b>

**Course Objectives**

- To understand the research formulation and design
- To study the data collection and analysis
- To understand the soft computing
- To understand the research ethics, IPR and scholarly publishing
- To study about interpretation and report writing

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand the research formulation and design

**CO2** - Know the data collection and analysis

**CO3** - Understand soft computing

**CO4** - Understand the research ethics, IPR and scholarly publishing

**CO5** - Understand the interpretation and report writing

**UNIT I –RESEARCH FORMULATION AND DESIGN****(6 hours)**

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

**UNIT II – DATA COLLECTION AND ANALYSIS****(6 hours)**

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

**UNIT III – SOFT COMPUTING****(6 hours)**

Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

**UNIT IV –RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING****(6 hours)**

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

**UNIT V –INTERPRETATION AND REPORT WRITING**

**(6 hours)**

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

**Text Books:**

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

**Reference Books:**

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992. How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
7. Satarkar, S.V., 2000. Intellectual property rights and Copy right. Ess Ess Publications

**Web reference:**

1. <https://theintactone.com/2018/02/26/br-u1-topic-2-formulation-of-the-research-p>
2. <https://leverageedu.com/blog/research-design/>
3. <https://www.questionpro.com/blog/data-collection/>
4. [https://en.wikipedia.org/wiki/Soft\\_computing](https://en.wikipedia.org/wiki/Soft_computing)
5. <http://www.aau.in/sites/default/files/Unit%203%20RESEARCH%20AND%20>



	<b>BIOTECHNOLOGY FOR HUMAN WELFARE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
<b>A20BTO301</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>30</b>

### Course Objectives

- To understand the about Agricultural Biotechnology
- To study the about Food & Dairy Biotechnology
- To understand about Biotechnology for disease diagnosis
- To understand about Biotechnology for treatment & prevention of diseases
- To study about Environmental Biotechnology

### Course Outcomes

**After completion of the course, the students will be able to**

**CO1** - Understand the Agricultural Biotechnology

**CO2** - Know the Food & Dairy Biotechnology

**CO3** - Understand the Biotechnology for disease diagnosis

**CO4** - Understand the Biotechnology for treatment & prevention of diseases

**CO5**- Understand the Environmental Biotechnology

#### **UNIT I (6 hours)**

Agricultural Biotechnology - Organic farming. Integrated farming, Vermicompost, Crop Improvement.

#### **UNIT II (6 hours)**

Food & Dairy Biotechnology- Microbes as food, feed. Prebiotics. Probiotics. Algae - SCP, Beta carotene, Fungi as food – Mushroom. Fermented food products.

#### **UNIT III (6 hours)**

Biotechnology for disease diagnosis- Clinical diagnosis. Lab diagnosis – Microscopy, Macroscopy, Biochemical, serological & Molecular diagnosis of diseases – PCR, RT –PCR, ELISA, Karyotyping

#### **UNIT IV (6 hours)**

Biotechnology for treatment & prevention of diseases-Treatment – Symptomatic therapy, specific therapy, antimicrobials Prevention – Active immunization, passive immunization, combined immunization, herd immunity.

#### **UNIT V (6 hours)**

Environmental Biotechnology- Waste management–Solid, liquid, sewage, municipal waste Bioremediation. Bioleaching. Biodegradation.

**Text Books:**

1. D. Balasubramanian, C. F. A. Bryce, K. Dharmalingham, J. Green and K. Jayaraman. 1996. Concepts in Biotechnology. Universities Press.
2. Ashok K. Chauhan. 2009. A Textbook of Molecular Biotechnology. I.K. International Publishing house Pvt. Ltd.
3. Chandrakant Kokate, SS Jalalpure, Pramod H.J. 2011. Textbook of Pharmaceutical 85
4. Biotechnology. A division of Reed Elsevier India Pvt. Ltd.

**Reference Books:**

1. B.C. Bhattacharyya and Rintu Banerjee. 2007. Environmental Biotechnology. Oxford Higher Education Publication.
2. Krishna B Ghimire. 2000. Social change and conservation. London Earthscan Publ.
3. P.J. Delves, IS.J. Artin, ID.R. Burton and I.I.M. Roitt. 2006. Essential Immunotechnology. 12<sup>th</sup> Edition. Wiley & Blackwell.

**Web references:**

1. <https://www.google.com/search?q=Agricultural+Biotechnology+notes&rlz=1C1YTUH>
2. <https://www.google.com/search?q=Food+%26+Dairy+Biotechnology+notes>
3. [https://www.researchgate.net/publication/301712223\\_Biotechnology\\_in\\_the\\_Diagnosis](https://www.researchgate.net/publication/301712223_Biotechnology_in_the_Diagnosis)
4. <https://www.google.com/search?q=Biotechnology+for+treatment+%26+prevention+of+diseases>
5. <https://www.google.com/search?q=Environmental+Biotechnology>



	L	T	P	C	Hrs
<b>FOOD PROCESSING</b>					
<b>A20BTO302</b>	2	0	0	2	30

### Course Objectives

- To understand the about Food processing
- To study the about Thermal processing
- To understand about Ionizing radiations
- To understand about Refrigeration
- To study Freezing

### Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the Food processing

CO2 - Know the Thermal processing

CO3 - Understand the Ionizing radiations

CO4 - Understand the Refrigeration

CO5- Understand the Freezing

#### UNIT I

(6 hours)

**Introduction to Food processing**-Scope and importance; basic concepts about properties of foods: liquid, solid and gases; Equipment for raw material processing: Elementary concept of material handling in food industry, equipment and functioning of belt conveyor, screw conveyor, bucket elevator and pneumatic conveyor, size reduction, mixing and forming, separation and concentration of food components.

#### UNIT II

(6 hours)

**Thermal processing**-Degree of processing, selecting heat treatment, heat resistance of microorganisms, nature of heat transfer, protective effects of food constituents, types of thermal treatments.

#### UNIT III

(6 hours)

**Ionizing radiations**-Forms of radiant's energy; ionizing radiations, sources and properties; radiation units; radiation effects; limiting indirect effects; dose fixing factors; objectives in food irradiation; safety and quality of irradiated food.

#### UNIT IV

(6 hours)

**Refrigeration**-Refrigeration, cool storage and shelf life extension; cool storages with air circulation, humidity control and gas modifications (i.e. CA, MA & SA).

#### UNIT V

(6 hours)

**Freezing**-Changes during freezing, rate of freezing, choice for final temperature for frozen foods, freezing methods, freezing effects. Dehydration – Dehydration, water activity and food safety / quality; methods of dehydration. Packaging: Properties of packaging material, factors determining the packaging requirements of various foods and brief description of packaging of frozen products, dried products, fats and oils and thermally processed foods.



**Text Books:**

1. Sivasankar, B. 2002. Food Processing and Preservation. PHI, India
2. Hosahalli S. Ramaswamy & Michele Marcotte. 2005. Food Processing: Principles and Applications Hardcover, CRC Press.

**References:**

1. P.J.Fellows. 2009. Food Processing Technology: Principles and Practice. 3<sup>rd</sup> Edition Woodhead Publishing.
2. G. Subbulakshmi & Shobha A. Udipi, 2006. Food Processing and Preservation. New Age International Publishers, India.

**Web references:**

1. <https://www.google.com/search?q=Introduction+to+Food+processing>
2. <https://www.google.com/search?q=thermal+processing+of+food>
3. <https://www.google.com/search?q=ionizing+radiation+in+food+processing>
4. <https://www.coolingindia.in/refrigeration-in-food-processing-cold-chain>
5. <https://www.google.com/search?q=freezing+in+food+processing>



	L	T	P	C	Hrs
<b>FOOD TECHNOLOGY</b>					
<b>A20BTO303</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>30</b>

**Course Objectives**

- To understand the about Food chemistry
- To study the about Food Microbiology
- To understand about Food Processing
- To understand about Food Preservation
- To study about Manufacture of food products

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand the about Food chemistry

**CO2** - Know about Food Microbiology

**CO3** - Understand the Food Processing

**CO4** - Understand the Food Preservation

**CO5**- Understand the Manufacture of food products

**UNIT I**

**(6 hours)**

**Food chemistry**-Constituent of food - contribution to texture, flavour and organoleptic properties of food; food additives - intentional and nonintentional and their functions; enzymes in food processing.

**UNIT II**

**(6 hours)**

**Food Microbiology**-Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases - infections and intoxications, food spoilage - causes.

**UNIT III**

**(6 hours)**

**Food Processing**-Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations - mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing.

**UNIT IV**

**(6 hours)**

**Food Preservation**-Use of high temperatures - sterilization, pasteurization, blanching, canning - concept, procedure & application; Low temperature storage - freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods.

**UNIT V**

**(6 hours)**

**Manufacture of food products**-Bread and baked goods, dairy products - milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages.





**Text Books:**

1. Crosby, N.T. 1981. Food packaging. Materials Applied Science Publishers, London.
2. David, S. Robinson. 1997. Food Chemistry and nutritive value. Longman group, UK.
3. Frazier, W.C. and Westhoff, D.C. 1988. Food Microbiology. 4<sup>th</sup> Edition. McGram-Hill, New York.
4. Pyke, M. 1981. Food Science and Technology. 4<sup>th</sup> Edition. John Murray, London.
5. Sivasankar, B. 2002. Food processing and preservation. Prentice Hall, New Delhi.

**Reference Books:**

1. Brenner, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E.V. 1979. Food engineering Operations. 2<sup>nd</sup> Edition. Applied Sciences Pub. Ltd., London.
2. Desrosier, N.W. 1996. The Technology of Food Preservation. CBS Publishers and Distributors, New Delhi.
3. Fennema, O.R. 1976. Principles of food science: Part I, Food chemistry, Marcel Dekker, New York.
4. Lindsay, W. 1988. Biotechnology, Challenges for the flavor and food Industries. Elsevier Applied Science.

**Web reference:**

1. <https://www.google.com/search?q=food+chemistry>
2. <https://www.google.com/search?q=Food+Microbiology>
3. <https://www.google.com/search?q=food+processing>
4. <https://www.google.com/search?q=food+preservation>
5. <https://www.google.com/search?q=Manufacture+of+food+products>



L	T	P	C	Hrs
2	0	0	2	30

**HERBAL TECHNOLOGY****A20BTO401****Course Objectives**

- To understand the about Food chemistry
- To study the about Food Microbiology
- To understand about Food Processing
- To understand about Food Preservation
- To study about Manufacture of food products

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand the about Food chemistry

**CO2** - Know about Food Microbiology

**CO3** - Understand the Food Processing

**CO4** - Understand the Food Preservation

**CO5**- Understand the Manufacture of food products

**UNIT-I****(6 hours)**

Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

**UNIT-II****(6 hours)**

Pharmacognosy - systematic position - chemical constitution and medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.

**UNIT-III****(6 hours)**

Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; Catharanthus roseus (cardiotonic), Withania Somnifera (drugs acting on nervous system), Clerodendron Phlomoides (anti- rheumatic) and Centella asiatica (memory booster).

**UNIT-IV****(6 hours)**

Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds, fatty acids, tannins, glycosides and volatile oils).

**UNIT-V****(6 hours)**

Medicinal Plant Biotechnology: Genetics as applied to medicinal herbs - mutation - polyploidy. Plant tissue culture as source of biomedicinals - Historical developments - types of cultures - phytopharmaceuticals in tissue cultures.



**Text books:**

1. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
2. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994.

**References books:**

3. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
4. The indigenous drugs of India, Kanny,Lall, Dey and Raj Bahadur,1984. International Book Distributors.
5. yurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
7. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

**Web reference:**

1. <https://www.google.com/search?q=Herbal+medicines>
2. <https://www.news-medical.net/health/What-is-Pharmacognosy.aspx>
3. <https://www.google.com/search?q=Phytochemistry>
4. <https://www.google.com/search?q=Analytical+pharmacognosy&source>
5. <https://www.google.com/search?q=Medicinal+Plant+Biotechnology>



<b>A20BTO402</b>	<b>VERMICULTURE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>30</b>

**Course Objectives**

- To understand the about Vermicomposting
- To study the about Physical, chemical and biological changes brought by earth worm in soil
- To understand about Optimal conditions for Vermiculture
- To understand about Basic components for vermiculture
- To study about Composting

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand the about Vermicomposting

**CO2** - Know about Physical, chemical and biological changes brought by earth worm in soil

**CO3** - Understand the Optimal conditions for Vermiculture

**CO4** - Understand the Basic components for vermiculture

**CO5**- Understand about Composting

**UNIT-I**

**(6 hours)**

Vermicomposting- Definition, introduction and scope: Ecological classification: Humus feeders, Humus formers, leaf mold, top soil and sub soil types.

**UNIT-II**

**(6 hours)**

Physical, chemical and biological changes brought by earth worm in soil - burrows - drilosphere - earthworm casts.

**UNIT-III**

**(6 hours)**

Optimal conditions for Vermiculture - temperature, moisture, pH, soil type, organic matter, protection from sunlight, rain, predators - food preference.

**UNIT-IV**

**(6 hours)**

Basic components for vermiculture - Culture practices - Home - School - Industries - Vermi wash.

**UNIT-V**

**(6 hours)**

Composting - Vermicomposting - Required conditions - Methods - Advantages - Cost-Benefit analysis of Vermicomposting.



**Text Books:**

1. Edwards, C.A. and Bohlen, P.J. 1996, Ecology of earthworms-3<sup>rd</sup> Edition, Chapman and hall.

**Reference Books:**

2. Edwards, C.A. and Bohlen, P.J. 1996, Ecology of earthworms-3<sup>rd</sup> Edition, Chapman and hall.
3. Jsmail, S.A., 1970, Vermicology. The biology of earthworms. Orient Longman, London.
4. Lee, K.E., 1985. Earthworms - Their ecology and relationship with soil and land use, Academic Press, Sydney.

**Web reference:**

1. <https://www.google.com/search?q=Vermicomposting&source>
2. <https://www.google.com/search?q=Physical%2C+chemical+and+biological+changes>
3. <https://www.google.com/search?q=Optimal+conditions+for+Vermiculture>
4. <https://www.google.com/search?q=Basic+components+for+vermiculture>
5. <https://www.google.com/search?q=Composting+-+Vermicomposting+>



	L	T	P	C	Hrs
<b>A20BTO403</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>30</b>

**BIOTECHNOLOGY FOR SOCIETY**

**Course Objectives**

- To understand the about Sericulture, Aquaculture ect.
- To study the about Pest control and management
- To understand about Biodegradation
- To understand about r DNA product Production
- To study about Transgenics

**Course Outcomes**

**After completion of the course, the students will be able to**

**CO1** - Understand the about Sericulture. Aquaculture etc.

**CO2** - Know about Pest control and management

**CO3** - Understand about Biodegradation

**CO4** - Understand about r DNA product Production

**CO5**- Understand about Transgenics

**UNIT I**

**(6 hours)**

Sericulture, Aquaculture, Apiculture. Vermiculture. Mushroom technology.

**UNIT II**

**(6 hours)**

Biofertilizers, Biopesticides, Biorepellants, Pest control and management, Biomass (SCP), Bioplastics and Bioweapons.

**UNIT III**

**(6 hours)**

Bio dyes, Bio fuels – Biodiesel & Biogas. Bioindicators. Biodegradation- Role of GMO's.

**UNIT IV**

**(6 hours)**

Production of Penicillin, Recombinant Vaccines (HBV). Recombinant Insulin. Plantibodies. Vaccines in animal cells, Gene therapy.

**UNIT V**

**(6 hours)**

Transgenic animals and their applications- Mice, Sheep and Fish. Transgenic plants and their applications- BT Cotton, Flavr-Savr tomato and Golden rice.



**Text Books:**

1. Animal Biotechnology ,M .M. Ranga, (2000) , Agrobios (India),
2. Industrial Microbiology – A.H. Patel, MacMillan Publishers, 2005
3. A text book of Biotechnology, R. C. Dubey, (2001), Rajendra Printer.New Delhi.

**References Books:**

4. Introduction to Plant Biotechnology Chawla,(2003) (2nd edn) Oxford and IBH publishers
5. Biotechnology, Satyanarayana. U, (2008), Books and Allied (p) Ltd.

**Web reference:**

1. <https://www.google.com/search?q=Sericulture%2C+Aquaculture%2C+Apiculture>
2. <https://www.google.com/search?q=Biofertilizers%2C+Biopesticides%2C+Biorepellants%2>
3. <https://www.google.com/search?q=Bio+dyes%2C+Bio+fuels+%E2%80%93+Biodegradation>
4. <https://www.google.com/search?q=Production+of+Penicillin%2C+Recombinant+Vaccines>
5. <https://www.google.com/search?q=Transgenic+animals+and+their+applications>



## Annexure – II

		L	T	P	C	Hrs
<b>A20BTE509</b>	<b>BIOPROCESS TECHNOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

**Course objective**

- To understand the basics of Principles of Bioprocess technology.
- To ensures the students to understand about the Introduction to fermentation.
- To understand the Microbial growth and death in fermentation
- To impart practical skills of Industrial wastewater treatment and disposal.
- To ensures the students to understand about Industrial wastewater treatment and disposal

**Course Outcomes**

**After the completion of this course, the students will be able to**

- CO1** – Define the Principles of Bioprocess technology.  
**CO2** – know the Introduction to fermentation.  
**CO3** – Describe the Microbial growth and death in fermentation.  
**CO4** – know about Downstream processing  
**CO5** – Demonstrate the Industrial wastewater treatment and disposal

**UNIT -I****(10 hours)**

Principles of Bioprocess technology – Introduction and history of traditional and modern bioprocess technology. General concepts of fermentation technology – Outline of an integrated bioprocess and various unit operations. Industrially important microbes: Isolation, Screening & Preservation techniques, Strain improvement methods.

**UNIT-II****(15 hours)**

Introduction to fermentation - Types of fermentation processes (Submerged & solid static) - Media formulation - Synthetic and complete media, Sterilization (batch & continuous) – Air, Filter and Media sterilization – Operation: Inoculum preparation and sampling. Fermenters: Design of a fermenter – Types: Stirred tank, Fluidized bed, Immobilized bed bioreactors, Photo bioreactors, Air lift bioreactors and its other types.

**UNIT – III****(10 hours)**

Microbial growth and death kinetics - Bioprocess control & monitoring of various factors, temperature, agitation, pressure, pH, dissolved oxygen and foam sensing, online measurements. Control systems – Manual control, Automatic control - on/off control & PID control, Computer applications in fermentation technology - Scale up & Scale down of microbial reactions.

**UNIT – IV****(10 hours)**

Downstream processing: Removal of microbial cells and solid matter – Precipitation, Filtration, Centrifugation, Liquid – Liquid extraction, Chromatography and membraneprocesses, BOD and COD measurements.

**UNIT -V****(15 hours)**

Industrial wastewater treatment and disposal: Physical treatment, chemical treatment and biological treatments. Aerobic processes - trickling filter, towers, biologically aerated filters, rotating drums, fluidized bed systems, activated sludge process. Anaerobic treatment - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blankets. Disposal - seas and rivers, lagoons, spray irrigation, well-disposal, landfilling, incineration, disposal of effluents to sewers.



**Text Books:**

1. Stanbury P.F., Whitaker. A & Hall. S. J. Principles of fermentation technology(2<sup>nd</sup> edition), Aditya Books Private Ltd., 2000.
2. Crueger, W. and Crueger, A, Biotechnology: A Textbook of Industrial Microbiology. (2nd Ed.), Panima Publishing Corporation, New Delhi. 2000.
3. Waites M.J., Morgan N.L., Rockey J.S., Industrial Microbiology. 2<sup>nd</sup> edition, Blackwell Science, 2002.

**Reference books:**

4. Demain L. & Davies E. Manual of Industrial Microbiology and Biotechnology(2<sup>nd</sup> edition), ASM Press, Washington, 2004.
5. Emt El Mansi, Bryce, CFA, Demain, AL (Eds). Fermentation Microbiology and Biotechnology (2nd Edition), CRC Press. 2006.

**Web references:**

1. [https://link.springer.com/chapter/10.1007/978-1-4613-8748-0\\_2](https://link.springer.com/chapter/10.1007/978-1-4613-8748-0_2)
2. <https://www.google.com/search?q=Introduction+to+fermentation+&ei=NG45Y5TOGqbn4>
3. <https://www.google.com/search?q=Microbial+growth+and+death+kinetics+&ei=b245Y7fhFpGt4-E>
4. <https://www.google.com/search?q=downstream+processing+&ei=6m45Y8zoMcGt4-EP>
5. <https://www.google.com/search?q=Industrial+waste+water+treatment+and+disposal+&ei=Lm85Y56>

	L	T	P	C	Hrs
<b>A20BTT514</b>					
<b>BIOINFORMATICS</b>					
	4	0	0	4	60

**Course objective**

- To understand the basics of Bioinformatics: an overview
- To ensure the students to understand about the Sequence Analysis.
- To understand the Phylogenetic analysis
- To impart practical skills of Structure prediction: protein.
- To understand the Applications of bioinformatics in Drug discovery.

**Course Outcomes**

**After the completion of this course, the students will be able to**

**CO1** – Define the Bioinformatics: an overview.

**CO2** – Describe about the Sequence Analysis.

**CO3** – Describe some of the Phylogenetic analysis

**CO4** – Recognize the Structure prediction: protein.

**CO5** – Demonstrate the Applications of bioinformatics in Drug discovery

**UNIT -I****(10 hours)**

**Bioinformatics: an overview** - Introduction to Computational Biology and Bioinformatics; some of the biological problems that require computational methods for their solutions; Role of internet and www in bioinformatics. Biological Databases Acquisition – Primary and Secondary databases, Nucleotide sequence databases. Types of DNA sequences – genomic DNA, cDNA, recombinant DNA, Expressed sequence tags (ESTs).

**UNIT -II****(15 hours)**

**Sequence Analysis** – Methods of sequence alignment: Dot plots; Scoring matrix – identify matrix, genetic code matrix (GCM); Substitution matrix, Percentage accepted Mutation (PAM). Block Substitution Matrix (BLOSUM), dynamic programming algorithms; Needleman-Wunch and Smith Waterman; alignment scores and gap penalties; Database searching (BLAST and FASTA). Multiple Sequence alignment (MSA) – significance. Softwares : ClustalW and Meme.

**UNIT – III****(15 hours)**

**Phylogenetic analysis** – Phylogenetics, cladistics and ontology; Phylogenetic representations – graphs, trees and cladograms; Classification and ontologies; Steps in phylogenetic analysis; Methods of phylogenetic analysis – similarity and distance tables, distance matrix method; Method of calculation of distance matrix (UPGMA, WPGMA); The Neighbor Joining Method; The Fitch/Margoliash method; Steps in constructing alignments and phylogenies; Phylogenetic softwares – PHYLIP

**UNIT – IV****(10 hours)**

**Structure prediction: protein-** Methods for prediction of secondary and tertiary structures of proteins – knowledge-based structure prediction; fold recognition; Comparative protein modeling. Identification of motifs and domains, protein family database. RNA structure prediction.

**UNIT -V****(10 hours)**

**Applications of bioinformatics in Drug discovery:** Finding new drug targets to treat diseases – Pharmacophore identification - Structure based drug design. Mining of sequence data: Mining data from Yeasts. Microarray and genome wide expression analysis: transcriptomes, proteome: Genomics in medicine, disease monitoring, profile for therapeutic molecular targeting.

**Text Books:**

1. Mount, D. Bioinformatics: Sequence and Genome Analysis; Cold Spring Harbor Laboratory Press, New York. 2004
2. Baxevanis, A.D. and Ouellette. B.F. Bioinformatics – a practical guide to the analysis of Genes and Proteins; John Wiley and Sons, New Jersey, USA. 1998.
3. Lesk, A.M. Introduction to Bioinformatics, First edition, Oxford University Press, UK. 2002
4. Rastogi, S.C, Mendiratta. N and Rastogi. R. Bioinformatics: Concepts, Skills and Applications, CBS Publishers, New Delhi, India. 2006

**Reference books:**

1. Pevzner, P.A. Computational Molecular Biology; Prentice Hall of India Ltd, New Delhi. 2004
2. Sensen, C.W. Essentials of Genomics and Bioinformatics. Wiley-VCH Publishers, USA. 2002
3. Andrew R. Leach Molecular Modeling – Principles and Applications Second Edition, Prentice Hall, USA. 2001
4. Creighton, T.E. Proteins: structure and molecular properties Second edition, W.H. Freeman and Company, New York, USA. 1993
5. Bioinformatics, 4th Edition Andreas D. Baxevanis (Editor), Gary D. Bader (Editor), David S. Wishart (Editor), ISBN: 978-1-119-33558-0 May 2020.

**Web references:**

1. <https://www.sciencedirect.com/topics/computer-science/bioinformatics>
2. <https://www.ncbi.nlm.nih.gov/guide/sequence-analysis/>
3. <https://www.news-medical.net/health/What-is-Phylogenetic-Analysis.aspx>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6407873/>
5. <https://www.google.com/search?q=Applications+of+bioinformatics+in+Drug+discovery>

	L	T	P	C	Hrs
<b>A20BTT515</b>					
<b>PLANT BIOTECHNOLOGY</b>					
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

**Course objective**

- To understand the basics of Conventional breeding for crop improvement
- To ensures the students to understand about the Basics of Plant tissue culture
- To understand the Principles of Somatic Hybridization
- To impart practical skills of Genetic engineering of plants
- To ensures the students to understand about Applications of transgenic plants

**Course Outcomes**

**After the completion of this course, the students will be able to**

**CO1** – Define the Conventional breeding for crop improvement

**CO2** – Describe the concept Basics of Plant tissue culture

**CO3** – Describe the Principles of Somatic Hybridization

**CO4** – Describe the Genetic engineering of plants

**CO5** – Demonstrate the Applications of transgenic plants

**UNIT - I****(10 hours)**

Conventional breeding for crop improvement- Introduction, Domestication, Methods of Plant Breeding- Hybridization, Clonally Propagated Species, Breeding Enhancements- Marker-Assisted Selection, Mutation Breeding. Plant genome organization, organization of chloroplast genome, cytoplasmic male sterility, genetic male sterility.

**UNIT -II****(15 hours)**

Basics of Plant tissue culture, Sterilization, plant tissue culture media Components (inorganic, organic and plant hormones) and types of nutrient media, Callus and Suspension cultures, Micropropagation, Somatic embryogenesis and Germplasm conservation. Embryo culture, Rapid clonal propagation, somaclonal variations and synthetic or artificial seeds, embryo rescue, production of haploid plants (microspores and ovules). Applications and limitations of haploid plants. Secondary metabolites from plants.

**UNIT – III****(15 hours)**

Introduction and Principles of Somatic Hybridization – Protoplast Isolation, Protoplast fusion, Selection of hybrid cell, Regeneration of hybrid plants, Somatic hybrids and cybrids – cytoplasm transfer, Genetic transformation, Advantages and Limitations, Molecular markers – RFLP, RAPD, DNA fingerprinting.

**UNIT – IV****(10 hours)**

Genetic engineering of plants - Gene constructs, Vectors- Plasmid vectors and plant viral vectors (CaMV, Gemini virus, Tobacco Mosaic virus), cloning vectors for higher plants - Genetic manipulation using *Agrobacterium tumefaciens*. Gene transfer in plants - Electroporation, Particle Gun Method, Microinjection, Polyethylene glycol mediated transformation, Chloroplast transformation, terminator seed technology.

**UNIT -V****(10 hours)**

Applications of transgenic plants- Pest resistance, Herbicide resistance, virus resistance, Fungal and bacterial resistance, Delay of fruit ripening, Salt & drought tolerance, improvement of crop yield and Quality, Improved nutrition.

**Text Books:**

1. Plant Biotechnology, 2015 by Singh B.D. (Author)
2. M. S. Clark. 1997. *Plant Molecular Biology: A Laboratory Manual*. Springer-Verlag.
3. Slater A., Scott N.W. and Fowler, M.R. 2008. *Plant Biotechnology - the genetic manipulation of plants*. 2<sup>nd</sup> Edition. Oxford University press, USA.
4. H.S. Chawla, 2002. *Introduction to Plant Biotechnology*. Oxford and IBHP Publishing Co. Pvt. Ltd. New Delhi.

**Reference books:**

1. Monica. A. Hughes. 1999. *Plant Molecular Genetics*. Pearson Education limited, England.
2. Harrison, M.S. and Bal, I.R. 1997. *General techniques of all culture* Cambridge University press.
3. Prasash M. and Arora. C.K.. 1998. *Plant tissue culture*, Ammol publication Pvt. Ltd.
4. Darling D.C. and Morgan S.J. 1994. *Animal cells, culture Media*. Wiley, New York.
5. *Plant Biotechnology* by Ricroch, Agnes, Chopra, Surinder, Fleischer, Shelby, Springer Nature (Sie)

**Web references:**

1. <https://www.google.com/search?q=Conventional+breeding+for+crop+improvement>
2. <https://passel2.unl.edu/view/lesson/a2f44b5b9a27/1#:~:text=Plant%20tissue%20culture%20>
3. <https://www.google.com/search?q=Principles+of+Somatic+Hybridization>
4. <https://www.google.com/search?q=Genetic+engineering+of+plants>
5. <https://www.google.com/search?q=Applications+of+transgenic+plants&ei=01k5Y-yUHLyu4-EPi>

		L	T	P	C	Hrs
<b>A20BTE507</b>	<b>ANIMAL BIOTECHNOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>45</b>

### Course objective

- To understand the Introduction, history, basic concept of animal cell culture.
- To understand about the Basic techniques of mammalian cell culture.
- To understand the applications and limitations of animal Biotechnology
- To role of Animal models in Experimentation.
- To ensures the students to understand about Animal diseases.

### Course Outcomes

**After the completion of this course, the students will be able to**

**CO1** – Describe the Introduction, history, basic concepts of animal cell culture.

**CO2** – Describe historical concept of spontaneous generation and the experiments performed .

**CO3** – Describe the applications and limitations of Animal Biotechnology.

**CO4** – Describe the role of Animal models in Experimentation

**CO5** – Describe about Animal diseases

### UNIT -I

**(10 hours)**

Introduction, history, basic concept of animal cell culture, primary cell culture and established cell lines, maintenance of cultures, requirements of animal cell culture, media - natural (clots, biological fluids and tissue extracts) and synthetic (serum containing media, serum free media, chemically defined media, protein free media).

### UNIT-II

**(10 hours)**

Basic techniques of mammalian cell culture, disaggregation of animal tissues - mechanical, enzymatic and EDTA, evolution of cell line, monolayer culture, suspension culture, immobilized culture, organ culture - plasma clot, raft method, agar gel, grid method, embryo culture, maintenance of cell culture.

### UNIT – III

**(10 hours)**

Artificial insemination, Super ovulation, In vitro fertilization and embryo transfer, applications and limitation, Transgenic animals (avian, rodent & ruminants), Transgenic methods, Embryonic Stem cell transfer, Targeted Gene Transfer, Detection of transgenic animals, Production of useful proteins in transgenic animals, Sericulture basics and production of useful proteins through sericulture.

### UNIT – IV

**(7 hours)**

Role of Animal models in Experimentation. Molecular markers - RFLP, RAPD, VNTR, AFLP. Somatic and Reproductive cloning - Definition, history and types. Somatic cell nuclear transfer, story of dolly, Therapeutic cloning and its significance.

### UNIT -V

**(8 hours)**

Animal diseases (cattle) -Mad cow, Anthrax, Foot and Mouth, Lumpy skin, Bluetongue; (Poultry)- Newcastle; Bird flu, Avian Influenza, Marek's disease – Vaccines; Bioethics and biosafety in animal handling.

**Text Books:**

1. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten, Molecular Biotechnology: Principles and Applications of Recombinant DNA (4<sup>th</sup> edition), ASM publisher (2009).
2. Michael Wink, An Introduction to Molecular Biotechnology: Fundamentals, methods and applications, (2<sup>nd</sup> edition), John Wiley and sons 2013.
3. Ganga. G & Slochanachetty, An Introduction to Sericulture, (2<sup>nd</sup> edition), Oxford and IBH publishers Pvt.Ltd.Delhi (2012).
4. Old R.W, Primrose S.B, Twyman R. M, Principles of Gene manipulation (6<sup>th</sup> edition), Blackwell Sciences, (2001)
5. Textbook of Animal Biotechnology Paperback – 2013, by B. Singh (Author), S.K. Gautam (Author)
6. ANIMAL BIOTECHNOLOGY (PB 2018) Paperback – 2018, by SRIVASTAVA A K (Author)

**Reference books:**

1. Tom Strachan & Andrew P. Read, Human Molecular Genetics, 2nd edition. Garland Science, (2004).
2. Maule J.P, The Semen of Animals and Artificial Insemination, Commonwealth Agricultural Bureaux, 1962
3. John R.W. Masters, Animal Cell Culture, 3<sup>rd</sup> edition, OUP Oxford, (2000).

**Web references:**

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7325846/#:~:text=Cell>
2. <https://www.abcam.com/protocols/mammalian-cell-tissue-culture-techniques-protocol>
3. <https://www.google.com/search?q=applications+and+limitations+of+animal+Biotechnology>
4. <https://www.google.com/search?q=Molecular+markers+of+animal+Biotechnology>
5. <https://vikaspedia.in/agriculture/livestock/general-management-practices-of-livestock>

	L	T	P	C	Hrs
<b>A20BTE508</b>					
<b>NANOBIOTECHNOLOGY</b>					
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>45</b>

### Course objective

- To understand the Introduction of rDNA Technology.
- To ensures the students to understand about the Different types of Vectors.
- To understand the Cloning Strategies.
- To impart Selection & Screening of rDNA products and Gene Sequencing
- To ensures the students to understand about the Applications of rDNA Technology.

### Course Outcomes

After the completion of this course, the students will be able to

**CO1** – Define the Introduction of rDNA Technology.

**CO2** – Describe the Different types of Vectors.

**CO3** – Describe about the Cloning Strategies.

**CO4** – Describe the Selection & Screening of rDNA products and Gene Sequencing

**CO5** – Demonstrate the Applications of rDNA Technology

#### UNIT -I

**(10 hours)**

Introduction to nanomaterials- Various types of nanomaterials, Three-dimensional, twodimensional, one-dimensional and zero-dimensional• nanomaterials. Carbon nanotubes, Graphene, Carbon dots, metal nanoparticles,• metal oxide-based nanomaterials, semiconductor nanomaterials, quantum dots, hybrid nanoparticles, Bio-nanomaterials, polymer nanoparticles, lipid nanoparticles• etc. Synthesis methodologies, Top down and bottom up approaches• for nanomaterial synthesis.

#### UNIT-II

**(7 hours)**

Properties of nanomaterials- Structural properties, chemical properties, surface• functionalization, physical properties.

#### UNIT-III

**(8 hours)**

Characterization of nanomaterials by various analytical• methods, optical characterization and spectroscopy such as FTIR, UV-Vis, DLS, Zetapotential, structural characterization by X-Ray Diffraction, XPS and advanced microscopy (TEM, SEM, AFM) etc.

#### UNIT – IV

**(10 hours)**

Nanobiotechnology in healthcare; Role of nanobiotechnology in the area of infectious• & noninfectious diseases Nanopharmaceuticals• Diagnosis, sensors and biosensors• Delivery vehicles, biomedical applications of nanomaterials. • Multimodal nanoparticles, targeted drug delivery, theranostics

#### UNIT – V

**(10 hours)**

Nanobiotechnology for Agriculture: Nanotechnology based tools to enhance agricultural productivity Nanobased Agri and Food Products, food preservation and• toxicity Nanopesticides and Nanofertilizers• Nano-biostimulants and soil enhancers• Nano-enabled technologies and abiotic stress management• Nanobiotechnology for Crop improvement• Precision Delivery Systems• Diagnostics and sensing• Nanotechnology for environment: contamination detection and• remediation.



**Text Books:**

1. Nanobiotechnology: Concepts, Applications and Perspectives (2004), Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
2. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
3. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.

**Reference books:**

5. A. K. Mishra, Ed., Application of nanotechnology in water research (Wiley, Scrivener Publishing, Hoboken, New Jersey, 2014).
6. K. R. Nill, Glossary of biotechnology and nanobiotechnology terms (Taylor & Francis, Boca Raton, 4th ed., 2006).
7. J. Kim, Ed., Advances in nanotechnology and the environment (Pan Stanford, Singapore, 2012).
8. P. N. Prasad. Nanophotonics (Wiley, New York, 2003).
9. A. L. Rogach, Semiconductor nanocrystal quantum dots synthesis, assembly, spectroscopy and applications (Springer, Wien; London, 2008).
10. E. Gazit, Plenty of room for biology at the bottom: an introduction to bionanotechnology (Imperial College Press ; Distributed by World Scientific Pub. in the USA, London : Hackensack, NJ, 2007).
11. G. E. J. Poinern, A laboratory course in nanoscience and nanotechnology (CRC Press, Taylor & Francis Group, Boca Raton, 2015).
12. C. A. Mirkin, C. M. Niemeyer, Eds., More concepts and applications (Wiley-VCH, Weinheim, 2007), Nanobiotechnology.

**Web references:**

1. <https://www.azonano.com/article.aspx?ArticleID=4932>
2. <https://www.phi4tech.com/nanomaterials/>
3. <https://nanocomposix.com/pages/nanoparticle-characterization-techniques>
4. <https://www.netscribes.com/nanotechnology-in-healthcare/>
5. <https://www.mdpi.com/2071-1050/13/4/1781>

		L	T	P	C	Hrs
<b>A20BTE509</b>	<b>MICROBIAL BIOTECHNOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>45</b>

### Course objective

- To understand the General concepts of microbial biotechnology
- To understand about the Biofertilisers and their importance in crop productivity
- To understand the Concepts & basic modes of fermentation
- To impart practical skills of Fermentation in preparing and preserving foods
- To ensures the students to understand about Microbial applications.

### Course Outcomes

**After the completion of this course, the students will be able to**

- CO1** – Define the General concepts of microbial biotechnology  
**CO2** – Describe about Biofertilisers and their importance in crop productivity  
**CO3** – Describe the Concepts & basic modes of fermentation  
**CO4** – Recognize about Fermentation in preparing and preserving foods  
**CO5** – Demonstrate the Microbial applications

#### **UNIT-I (8 hours)**

General concepts of microbial biotechnology - Genetic engineering of microbes for the production of antibiotics, enzymes, insulin, growth hormone and monoclonal antibodies. Synthetic bacteria, Microorganisms as factories for the production of novel compounds.

#### **UNIT-II (7 hours)**

Biofertilisers and their importance in crop productivity - Bacterial, algal and fungal biofertilisers - their significance and practice. Biopesticides - Bacterial, fungal and viral. Production of biofertilisers and biopesticides for large scale applications.

#### **UNIT – III (10 hours)**

Concepts & basic modes of fermentation - Batch, fed batch and continuous fermentation. Types of fermentation - Solid substrate, surface and submerged fermentation. Fermenter design - mechanically agitated, pneumatic and hydrodynamic fermenters.

#### **UNIT – IV (10 hours)**

Fermentation in preparing and preserving foods - pickling, producing colours and flavours, Process wastes - whey, molasses, starch substrates and other food wastes for bioconversion to useful products. Bacteriocins from lactic acid bacteria, meat fermentation, soy fermentation, sauerkraut production, Microbial fermentation of tea, coffee and cacao.

#### **UNIT-V (10 hours)**

Microbial leaching of ores, Bioweapons and Bioshields, Microbial biocatalyst and microbial fuel cells. Microbial fuels (biohydrogen, bioethanol and biomethane), Nutraceuticals from algae, Algal Pigments.

**Text Books:**

1. Microbial Biotechnology: Fundamentals of Applied Microbiology by Alexander N. Glazer (Author), Hiroshi Nikaido (Author), 2<sup>nd</sup> edition, October 2007.
2. Microbial Biotechnology, Author : N. Arumugam, A. Thangamani, L.M. Narayanan, V. Kumaresan, Saras publication.
3. Jackson AT. 1991. Bioprocess Engineering in Biotechnology. Prentice Hall, Engelwood Cliffs.
4. Shuler ML and Kargi F. 2002. Bioprocess Engineering: Basic concepts, 2<sup>nd</sup> Edition. Prentice Hall, Engelwood Cliffs.

**Reference books:**

1. Microbial biotechnology (1995) Alexander N.Glazer Hiroshi Nikaido W.H.Freeman& Company
2. Fungal ecology and biotechnology (1993) Rastogi Publications, Meerut
3. Young M.M., Reed. 2004. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine. Vol 1, 2, 3 and 4. Elsevier India Private Ltd, India.
4. Mansi EMTEL, Bryle CFA. 2007. Fermentation Microbiology and Biotechnology. 2<sup>nd</sup> Edition. Taylor & Francis Ltd, UK.

**Web references:**

1. <https://actascientific.com/ASMI/pdf/ASMI-03-0500.pdf>
2. <https://biologyreader.com/biofertilizer-production.html>
3. <https://microbenotes.com/bioreactor/>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6723656/>
5. [https://www.google.com/search?q=Microbial+leaching+of+ores%](https://www.google.com/search?q=Microbial+leaching+of+ores%20)

	L	T	P	C	Hrs
<b>A20BTL516</b>					
<b>BIOPROCESS TECHNOLOGY PRACTICAL</b>					
	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### Course objective

- To learn the Bioprocess Technology practicals

### Course Outcomes

After the completion of this course, the students will be able to

- Perform the Bioprocess Technology practicals

### Practicals:

- Design of Batch Fermenter
- Sterilization in Fermentation
- Immobilization of yeast cells
- Microbial production of Amylase Enzymes in a Fermenter
- Microbial production of Wine in a Fermenter
- Estimation of Alcohol content in Wine
- Solid substrate fermentation
- Surface fermentation
- Downstream Process

### Text Books:

- Stanbury P.F., Whitaker. A & Hall. S. J. Principles of fermentation technology(2<sup>nd</sup> edition), Aditya Books Private Ltd., 2000.
- Crueger, W. and Crueger, A, Biotechnology: A Textbook of Industrial Microbiology. (2<sup>nd</sup> Ed.), Panima Publishing Corporation, New Delhi. 2000.
- Waites M.J., Morgan N.L., Rockey J.S., Industrial Microbiology. 2<sup>nd</sup> edition, Blackwell Science, 2002.

### Reference books:

- Demain L. & Davies E. Manual of Industrial Microbiology and Biotechnology(2<sup>nd</sup> edition), ASM Press, Washington, 2004.
- Emt El Mansi, Bryce, CFA, Demain, AL (Eds). Fermentation Microbiology and Biotechnology (2<sup>nd</sup> Edition), CRC Press. 2006.

### Web references:

- [http://biotechjournal.in/images/paper\\_pdffiles/Bio-61bd9545d78b6.pdf](http://biotechjournal.in/images/paper_pdffiles/Bio-61bd9545d78b6.pdf)
- <https://www.sciencedirect.com/science/article/pii/S1877705816311997>
- [file:///D:/c%20backup/Downloads/3404%20\(1\).pdf](file:///D:/c%20backup/Downloads/3404%20(1).pdf)
- <https://link.springer.com/content/pdf/bfm:978-81-322-2095-4/1.pdf>
- <https://www.generalmicroscience.com/industrial-microbiology/types-of-fermentation>

	L	T	P	C	Hrs
<b>A20BTL516</b>					
<b>BIOINFORMATICS PRACTICALS</b>					
	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### Course objective

- To learn the Bioinformatics practical to applications in Biology

### Course Outcomes

#### After the completion of this course, the students will be able to

- Perform the Bioinformatics practical on Biology related applications

### Practicals:

- Open access bibliographic resources and literature databases: PubMed, BioMedCentral
- Nucleic acid sequence databases: GenBank, EMBL, DDBJ;
- Protein sequence databases: Uniprot-KB: SWISS-PROT, TrEMBL
- Genome Databases at NCBI, EBI, TIGR, SANGER
- Sequence file formats: GenBank, FASTA, GCG, MSF.
- Pairwise sequence alignment: BLAST
- Multiple sequence alignment: ClustalW, MEGA
- Protein structure database: PDB, Rasmol.
- Sequence editing and manipulation: Bioedit and Sequence manipulation suite.
- Phylogenetic Analysis

### Text Books:

- Bioinformatics Practical Manual Paperback – Large Print, 28 September 2015 by Mohammed Iftekhar (Author), Mohammed Rukunuddin Ghalib (Author)
- Bioinformatics: A Practical Manual Paperback – 1 January 2010 by Kasturi K (Author), K. Sri Lakshmi (Author)
- Bioinformatics Practical Manual : An Easy Guide to In-Silico Analysis ISBN NO:9789391012601, Author(s) / Editor(s):Jaspreet Kaur and Jasvinder Kaur

### Reference books:

- Mount, D. Bioinformatics: Sequence and Genome Analysis; Cold Spring Harbor Laboratory Press, New York. 2004
- Baxevanis, A.D. and Ouellette. B.F. Bioinformatics – a practical guide to the analysis of Genes and Proteins; John Wiley and Sons, New Jersey, USA. 1998.
- Lesk, A.M. Introduction to Bioinformatics, First edition, Oxford University Press, UK.2002
- Rastogi, S.C, Mendiratta. N and Rastogi. R. Bioinformatics: Concepts, Skills and Applications, CBS Publishers, New Delhi, India. 2006

### Web references:

- <https://www.psgrkcw.ac.in/wp-content/uploads/2020/06/lab-manual>
- [https://www.academia.edu/26542989/LAB\\_MANUAL\\_BIOINFORMATICS\\_LABORATORY](https://www.academia.edu/26542989/LAB_MANUAL_BIOINFORMATICS_LABORATORY)
- [https://webstor.srmist.edu.in/web\\_assets/srm\\_mainsite/files/files/BI0505%20LAB%20MANUAL](https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BI0505%20LAB%20MANUAL)

		L	T	P	C	Hrs
<b>A20BTL517</b>	<b>PLANT BIOTECHNOLOGY PRACTICAL</b>					
		<b>0</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>0</b>

### Course objective

- To learn the techniques in Plant Biotechnology

### Course Outcomes

After the completion of this course, the students will be able to

- Do the plant Biotechnology practicals

### Practicals:

1. Safety Practices and Aseptic culture for plant cell culture laboratory
2. Preparation of plant tissue culture medium
3. Micro propagation using (Node, internode, leaf and shoot tip)
4. Callus induction
5. Cell suspension culture
6. Isolation, fusion and Culture of Protoplast
7. Production of Synthetic seeds
8. Transformation of leaf discs with *Agrobacterium tumefaciens*
9. Mapping of plants genome by RAPD marker
10. Genetic variability of Plants by RFLP

### Text Books:

1. Satyanarayanan, U. 2005. Biotechnology, Books and allied (p) Ltd.,
2. Bhojwani and Razdan, M.K, 2004. Plant Tissue culture theory & practical.
3. Hurse P.I. and Patterson., M.K. Tissue culture, methods and application,
4. Marchan, D.J. Handbook of cell and Organ culture (2nd ed). Burgess Pub. Co., Minneapolis, USA, (1964).
5. Plant Tissue Culture : Theory and Practice By S.S. Bhojwani and A. Razdan

### Reference books:

1. Fu, T-J., Singh, G. and Curtis, W.R. (Eds). 1999. Plant Cell and Tissue Culture for the Production of Food ingredients. Kluwer Academic/Plenum Press.
2. Henry, R.J. 1997. Practical Application of plant Molecular biology. Chapman and hall.

### Web references:

1. <https://jru.edu.in/studentcorner/labmanual/agriculture/Lab%20Manual%20PPB.pdf>
2. [https://webstor.srmist.edu.in/web\\_assets/downloads/2021/18BTC108J-lab-manual.pdf](https://webstor.srmist.edu.in/web_assets/downloads/2021/18BTC108J-lab-manual.pdf)
3. [https://rarsvni.kau.in/sites/default/files/documents/a\\_plant\\_biotechnology\\_laboratory\\_manual.pdf](https://rarsvni.kau.in/sites/default/files/documents/a_plant_biotechnology_laboratory_manual.pdf)

		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Hrs</b>
<b>A20BTS505</b>	<b>IN-PLANT TRAINING / INTERNSHIP</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>30</b>

**Course objective:**

In-Plant training / Internship provides practical knowledge to the students and explain how the industry works. It is expose the students to actual working environment and enhance their knowledge and skill from what they have learned in the college.

**Evaluation:**

**IN-PLANT TRAINING / INTERNSHIP REPORT-** A report to be submitted in partial fulfillment of the requirements for the Evaluation and Award of marks.

		L	T	P	C	Hrs
<b>A20BTT618</b>	<b>MARINE BIOTECHNOLOGY</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

**Course objective**

- To understand the basics of marine ecosystem and its functioning.
- To understand about the Bioactive compounds from marine organisms
- To understand the Aquaculture
- To know Chromosome manipulation in aquaculture
- To ensure the students to understand about Microbial applications in marine ecosystem

**Course Outcomes**

**After the completion of this course, the students will be able to**

- CO1** – Define the marine ecosystem and its functioning.  
**CO2** – Describe about Bioactive compounds from marine organisms.  
**CO3** – Describe about Aquaculture.  
**CO4** – Describe the Chromosome manipulation in aquaculture  
**CO5** – know the Microbial applications in marine ecosystem

**UNIT -I (10 hours)**

The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystems. Hydrothermal vents - biodiversity of organisms. Marine microbes - unculturable bacteria, occurrence, characteristics and exploitation, Barophilic organisms and their potential gene application for Marine Biotechnology Industry

**UNIT –II (15 hours)**

Bioactive compounds from marine organisms, GFP, RFP characteristics and their applications, Green mussel adhesive protein, Marine hydrocolloids - Agar, Agarose, Chitosan, Chitin, Alginate, Carrageen and its applications, Marine enzymes and their applications in food processing, Marine Pharmaceuticals – Zinconotide, Dolostain, Bryostain.

**UNIT – III (15 hours)**

Aquaculture - Culturing of shrimp, edible mollusks, oysters, pearl oysters, sea cucumbers. Culture of live feed organisms - brine shrimp, rotifers, marine algae. Techniques for identification of bacterial & viral pathogens in aquaculture Methods of diagnosis of SEMBV, MBV and Vibrio diagnosis, Probiotic bacteria and their importance in aquaculture; Vaccines in aquaculture: Fish, shrimps & prawns

**UNIT – IV (10 hours)**

Chromosome manipulation in aquaculture – hybridization; Ploidy induction; Gynogenesis, Androgenesis and sex reversal in commercially important fishes; Cryopreservation of fish gametes and embryo; Transgenic fishes - Antifreeze and metallothionein gene.

**UNIT – V (10 hours)**

Biofouling, biofilms, corrosion and antifouling treatment. Ballast water: consequences & management. Red tides: causative organisms and control. Control of oil spills and bioremediation.



**Text Books:**

1. Milton Fingerman, Nagabhushanam. R, Recent Advances in Marine Biotechnology, Vol. 8: January 1, Science Publisher, (2003).
2. Kim, Se-Kwon, Springer Handbook of Marine Biotechnology, Springer Handbooks,(2014) Pillay
3. T V R; Kutty M N, Aquaculture: Principles and practices, 2nd edition,Blackwell Pub., (2005).
4. Essentials of Marine Biotechnology 1st ed. 2019 Edition, Kindle Edition by Se-Kwon Kim (Author) Format: Kindle Edition

**Reference books:**

1. Ronald M. Atlas , Richard Bartha, Microbial Ecology: Fundamentals and Applications (4th edition), Benjamin Cummings, (1997).
2. Marco Saroglia, Zhanjiang Liu, Functional Genomics in Aquaculture, Wiley-Blackwell, (2012).
3. Laboratory manual on methodologies for assessing Biodiversity in estuaries,mangroves and coastal waters – Annamalai University

**Web references:**

1. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6163760/>
3. <https://www.sciencedirect.com/journal/aquaculture>
4. <https://www.google.com/search?q=Chromosome+manipulation+in+aquaculture>
5. <https://www.google.com/search?q=Biofouling%2C+biofilms%2C+corrosion+and+antifouling>

	L	T	P	C	Hrs
<b>A20BTT619</b>					
<b>PHARMACEUTICAL BIOTECHNOLOGY</b>					
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

**Course objective**

- To understand the Definition and scope of Pharmaceutical Biotechnology.
- To understand the General classes and properties of phytopharmaceuticals.
- To understand the Antimicrobial agents
- To understand the Process of drug discovery and development.
- To ensures the students to understand about Vaccines: concept, production and types

**Course Outcomes**

**After the completion of this course, the students will be able to**

**CO1** – Define the Definition and scope of Pharmaceutical Biotechnology.

**CO2** – Describe the General classes and properties of phytopharmaceuticals.

**CO3** – Describe the Antimicrobial agents.

**CO4** – know the Process of drug discovery and development

**CO5** – know the Vaccines: concept, production

**UNIT-I****(10 hours)**

Definition and scope of Pharmaceutical Biotechnology, sources of drugs, classification of pharmacological agents (based on chemistry, mode of action, dosage forms), route of administration, absorption and bioavailability of drugs, distribution and liver detoxification metabolism and drug excretion.

**UNIT-II****(15 hours)**

General classes and properties of phytopharmaceuticals, Extraction of phytochemicals, Phytochemical screening of medicinal plants. Bioassay guided fractionation methods- TLC, HPTLC, GC, and HPLC, Role of NMR and Mass spectrometry in drug discovery.

**UNIT – III****(15 hours)**

Antimicrobial agents- Antibiotics - source, classification, mode of action, Antimicrobial resistance, and Antimicrobial activity studies (antibacterial, antiviral, antifungal and antiparasitic activity).  
Pharmacological Assays - In-vitro assays - anti-oxidant, anti- cancerous and assay system based on enzymes and cells, immunological (RIA and ELISA) - In vivo assays - Anti-inflammatory, Anti-analgesic.

**UNIT – IV****(10 hours)**

Process of drug discovery and development- Target identification and validation, Assay development, lead optimization, pre-clinical testing, clinical trials involved in drug discovery and development, regulatory approvals and phase IV trials, High throughput screening, CPCSEA guidelines, ICMR guidelines for drug testing.

**UNIT-V****(10 hours)**

Vaccines: concept, production and types - Inactivated, Attenuated, toxoid, Recombinant vaccines, Peptide and DNA vaccines, Edible vaccines, Nanodrugs, Recombinant proteins, approved rDNA drugs in market, Probiotics, Nutraceuticals.

**Text Books:**

1. Satoskar R.S, Nirmala N. Rege, and Bhandarkar S. D, Pharmacology and Pharmacotherapeutics (Revised 23rd Edition), Popular Prakashan, Mumbai.
2. Tripathy K. D, *Essentials of Medical Pharmacology (6<sup>th</sup> edition)*, Jaypee publishers
3. Shoba rani R Hiremath, Text book of industrial pharmacy, orient longman Pvt ltd2008.
4. Crommelin Daan J. A., Sindelar D. Robert (3<sup>rd</sup> edition) Pharmaceutical Biotechnology: Fundamentals and Applications, CRC Press, 2007.

**Reference books:**

1. Trease, G.E.and Evans, W.C., 2011, Pharmacognosy (12<sup>th</sup> edition), Bailliere Tindall Eastbourne, U.K
2. Mukherje P.K.,Quality Control Herbal Drugs–An approach to evaluation of botanicals. Business Horizons Pharmaceutical Publishers, 2005
3. Sambamurthy K., Pharmaceutical Biotechnology (1st edition) New Age International

**Web references:**

1. <https://www.google.com/search?q=Definition+and+scope+of+Pharmaceutical>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4840792/>
3. <https://www.britannica.com/science/antimicrobial-agent>
4. <https://www.nebiolab.com/drug-discovery-and-development-process/>
5. <https://vk.ovg.ox.ac.uk/vk/types-of-vaccine>

		L	T	P	C	Hrs
<b>A20BTT620</b>	<b>BIOSAFETY, BIO-ETHICS AND IPRS</b>					
		4	0	0	4	60

### Course objective

- To understand the basics of Biosafety
- To ensures the students to understand about the Food safety issues
- To understand the Bioethics
- To understand about IPR
- To ensures the students to understand about Patent.

### Course Outcomes

**After the completion of this course, the students will be able to**

**CO1** – Define the Biosafety.

**CO2** – Describe about Food safety issues.

**CO3** – Describe about Bioethics.

**CO4** – knowabout IPR

**CO5** – know about Patent

### UNIT-I

**(10 hours)**

**Biosafety:** Ethical issues concerning biotechnology, Primary containment for biohazards, Recommended biosafety levels for specific microorganisms, Biosafety guidelines for industrial operations with GMOs, Field trial of GM crops.

### UNIT-II

**(15 hours)**

**Food safety issues:** Environmental risk assessment and food and feed safety assessment, Balance of genetically altered and natural population in an ecosystem, Safety of modified crops, Livestock as food and their nutritional values, Social and economic effects.

### UNIT – III

**(15 hours)**

**Bioethics:** Ethical conflicts in biological sciences - bioethics in health care, Artificial reproductive technologies, Ethics in transplantation and stem cell research. Animal rights/welfare, Agricultural biotechnology - Genetically engineered food, environmental risk. Protection of environment and biodiversity – biopiracy.

### UNIT – IV

**(10 hours)**

**IPR:** Different forms of IPR; General concept of patenting; Indian Patent Act 1970; Current Indian patent law, rules and regulation. Basics of patents: types of patents; recent amendments; WIPO Treaties; Budapest Treaty; Patent Cooperation Treaty (PCT) and implications; procedure for filing a PCT application.

### UNIT-V

**(10 hours)**

Role of a Country Patent Office; filing of a patent application. Examples for any plant, microbe, animal patents, Patenting of drugs, Food products, new inventions.

**Text Books:**

1. Satheesh. M. K. Biosafety and Bioethics, (1<sup>st</sup> edition), I.K. International publishinghouse pvt. ltd., 2008
2. IPR, Biosafety and Bioethics Deepa Goel, Shomini Parashar, Pearson Education India, 2013
3. Intellectual Property Rights, Bioethics, Biosafety and Entrepreneurship in Biotechnology by Sibi G. 2020

**Reference books:**

1. Ignacimuthu.S, Bioethics, (1<sup>st</sup>edition), Alpha Science International, 2009
2. Rajmohan Joshi, Biosafety And Bioethics 01 Edition, 2006. Isha Books.
3. M.K. Sateesh, Bioethics and Biosafety 2008 . I K International Publishing House.
4. Goel And Parashar, IPR, Biosafety and Bioethics, 1e Paperback – 2013, Pearson.

**Web references:**

1. <https://www.iberdrola.com/innovation/what-is-biosafety>
2. <https://environhealthprevmed.biomedcentral.com/articles/10.1186/s12199-019-0825-5>
3. <https://bioethics.msu.edu/what-is-bioethics>
4. <https://www.wipo.int/about-ip/en/>
5. <https://ipindia.gov.in/patents.htm>

	L	T	P	C	Hrs
<b>A20BTT621</b>					
<b>MEDICAL BIOTECHNOLOGY</b>					
	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>60</b>

### Course objective

- To understand the basics of Medical Biotechnology.
- To ensure the students to understand about the Genetic & Metabolic Disorders
- To understand the Revolution in treatment
- To understand the Cancer - Molecular, cellular and genetic basis.
- To ensure the students to understand about Gene therapy

### Course Outcomes

After the completion of this course, the students will be able to

**CO1** – Define the importance of Medical Biotechnology

**CO2** – Describe the Genetic & Metabolic Disorders.

**CO3** – Describe about the Revolution in treatment.

**CO4** – Recognize the Cancer - Molecular, cellular and genetic basis

**CO5** – know about the Gene therapy

#### UNIT-I

**(10 hours)**

Introduction – Origin, significance & worldwide market of Medical Biotechnology. Revolution in clinical diagnosis, Antibody and Nucleic Acid Hybridization techniques, Imaging techniques (Nanodiagnosis).

#### UNIT -II

**(15 hours)**

Genetic & Metabolic Disorders – Introduction, Classification, Impact of genetic diseases on human health - Chromosome errors - Down syndrome, Klinefelter's and Turner's syndrome. Metabolic disorders – Phenylketonuria, Homocystinuria, Mucopolysaccharidosis, Gangliosidosis, Gaucher's disease, Diabetes, Hemophilia and sickle cell anemia. Treatment of Genetic diseases - prenatal diagnosis, Genetic Counseling - Ethical, Legal and Social Issues.

#### UNIT – III

**(15 hours)**

Revolution in treatment – Recombinant DNA technology for human insulin, Hepatitis B vaccine. Therapeutic proteins and peptides – Erythropoietin, Tissue plasminogen activator, clotting factor VIII, Antibody Engineering and Therapeutic Antibodies, Phage therapy.

#### UNIT – IV

**(10 hours)**

Cancer - Molecular, cellular and genetic basis of cancer, tumor virus and oncogenes, tumor suppressor genes and mechanism of action of p53 proteins. Stem Cells - Sources and types of stem cells, Stem cell transplant and its types, Potential targets for stem cell treatment, Therapeutic applications of stem cells, Regenerative medicine and Stem cell ethics.

#### UNIT-V

**(10 hours)**

Gene therapy- basic approaches and types of gene therapy, vectors used in gene therapy, application of gene therapy in medicine. Nanobiotechnology - Introduction, types and structures of nanoparticles, biosynthesis of nanoparticles, application of nanoparticles in treatment.

**Text Books:**

1. Glick B.R. and Pasurank .Molecular biotechnology – Principle and Applications of Recombinant DNA- J.I.(4<sup>th</sup> edition), ASM Press. 2010.
2. Anthony D. Ho, Hoffman. R, and Esmail D. Zanjani, Stem Cell Transplantation (4<sup>th</sup> edition), Wiley – liss publishers, 2006.
3. Hornyak. G.L , Moore. J.J. Tibbals H.F., Dutta. J. Fundamentals of Nanotechnology (1<sup>st</sup> edition), CRC press, 2008.
4. Medical Biotechnology Book by Dr. V. V. Rao and Pratibha Nallar
5. Medical Biotechnology Book by Bernard R. Glick, Cheryl L. Patten, and T. L. Delovitch
6. Medical Biotechnology Book by S. N. Jogdand

**Reference books:**

1. Jogdand. S. N. Medical Biotechnology –, (4<sup>th</sup> edition), Himalayan publishing house, 2004.
2. Freshney. I, Stacey. G. N, Auerbach. J.M, Culture of Human Stem Cells (1<sup>st</sup> edition) ,Wiley – Liss publishers, 2007.

**Web references:**

1. <https://india.oup.com/productPage/5591038/7421214/9780195699609>
2. <https://www.webmd.com/a-to-z-guides/inherited-metabolic-disorder-types-and-treatments>
3. <https://www.readcube.com/articles/10.1155/2016/2405954>
4. [https://wiki.cancer.org.au/oncologyformedicalstudents/Cancer\\_biology:\\_Molecular\\_and\\_genetic\\_basis](https://wiki.cancer.org.au/oncologyformedicalstudents/Cancer_biology:_Molecular_and_genetic_basis)
5. <https://www.google.com/search?q=gene+therapy&ei=jMI5Y6D5MsWY4-EP3aizmAw&ved=0ah>

		L	T	P	C	Hrs
<b>A20BTE610</b>	<b>ENVIROMENTAL BIOTECHNOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>45</b>

### Course objective

- To understand about the Introduction of Environmental biotechnology.
- To ensures the students to understand about Methanogenic bacteria and biogas.
- To understand the Principles of waste management
- To know the Basics and types of bioremediation .
- To ensures the students to understand about know about Biomonitoring

### Course Outcomes

After the completion of this course, the students will be able to

**CO1** – know the Introduction to Environmental biotechnology.

**CO2** – Describe the Methanogenic bacteria and biogas.

**CO3** – Describe the Principles of waste management.

**CO4** – know the Basics and types of bioremediation.

**CO5** – know about Biomonitoring

### UNIT-I

**(10 hours)**

Introduction to Environmental biotechnology, Non Renewable resources - coal, petroleum, and natural gas. Renewable resources - solar, wind, tidal, biomass, nuclear, geothermal and hydroelectric resources. Current status and environmental impact of renewable and non-renewable resources

### UNIT-II

**(7 hours)**

Methanogenic bacteria and biogas, microbial hydrogen production, conversion of sugars to alcohols, plant-based petroleum industry, cellulose as the source of energy, Environmental impact of modern fuels.

### UNIT – III

**(8 hours)**

Principles of waste management, types, sources and effects of solid waste, Physical and biological treatment methods, Concept of composting and vermicomposting, Waste to energy conversion, Disposal of wastes.

### UNIT – IV

**(10 hours)**

Basics and types of bioremediation, Bioremediation of oil, heavy metals, pesticides contaminated soil and water, Phytoremediation and its types, Biochemical and genetic basis of biodegradation, Xenobiotic compounds and recalcitrance, Biodegradation of pesticides and petroleum products, Biotransformation of heavy metals, Biopolymers and Biodegradable plastics.

### UNIT -V

**(10 hours)**

Biomonitoring - Bioassays, Biosensors, Biochips, Biological indicators and Biomarkers, Biorestitution of waste land, Bioleaching – microbes involved, Role of Biotechnology in pollution abatement.



**Text Books:**

1. Scragg A. H, Environmental Biotechnology, (2<sup>nd</sup> revised edition), Oxford University Press 2005
2. Jogdand S. N, Environmental Biotechnology (3<sup>rd</sup> edition), Himalaya publishing house Pvt. Ltd 2012.
3. Thakur. I. S, Environmental Biotechnology: Basic Concepts and Applications, (2<sup>nd</sup> revised edition), I K International Publishing House Pvt. Ltd, 2011.

**Reference books:**

1. Varnam A. H - Environmental Microbiology (1st Edition), ASM Press 2001
2. Wang, L.K., Ivanov, V., Tay, J.H., Hung, Y.T, Environmental Biotechnology (Volume 10), Humana Press 2010

**Web references:**

1. <https://www.biologydiscussion.com/biotechnology/environmental-biotech>
2. <https://www.intechopen.com/chapters/52663>
3. <https://www.earthreminder.com/waste-management-principles-methods-benefits/>
4. <https://microbenotes.com/bioremediation/>
5. [https://www.epa.gov/sites/default/files/2015-06/documents/biomonitoring\\_intro.pdf](https://www.epa.gov/sites/default/files/2015-06/documents/biomonitoring_intro.pdf)

		L	T	P	C	Hrs
<b>A20BTE611</b>	<b>GENOMICS AND PROTEOMICS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>45</b>

### Course objective

- To understand the basics Definition of of Genomics and proteomics
- To ensures the students to understand about the Comparative genomics.
- To understand the Functional genomics
- To know about protein detection and Analysis
- To ensures the students to understand about Protein characterization

### Course Outcomes

**After the completion of this course, the students will be able to**

**CO1** – Define the basic of Genomics and proteomics

**CO2** – Describe the Comparative genomics.

**CO3** – Describe about Functional genomics

**CO4** – know about the detection and Analysis of protein

**CO5** – understand about Protein characterization

#### UNIT-I

**(10 hours)**

Definition: Genome organizations, Principles of gene expression, C-value paradox, Genome mapping – Physical mapping and Genetic mapping, Chromosome walking, Linkage analysis

#### UNIT-II

**(15 hours)**

Comparative genomics - genome annotation and analysis, Genome-based search for mutations.

#### UNIT – III

**(15 hours)**

Functional genomics: protein-nucleic acid interactions, RNA interference, Microarrays, Sequencing – Maxam Gilbert and Sanger's methods, Next Generation Sequencing technologies, whole genome sequencing.

#### UNIT – IV

**(10 hours)**

Proteomics – Introduction, Protein detection & Methods of Analysis of Proteins, Protein purification and Separation techniques, Two dimensional PAGE for proteome analysis; Image analysis of 2D gels

#### UNIT-V

**(10 hours)**

Protein characterization – MALDI-TOF and Peptide mass finger printing, Protein sequencing, Protein-protein interactions (Two hybrid interaction screening), Protein arrays, Applications of proteome analysis to drug development

**Text Books:**

1. Terence A. Brown, Genomes 2, (2nd edition) – Garland Science publishing, 2002.
2. Old R.W & Primrose S. B, Principles of gene manipulation – An introduction to genetic Engineering, Black well publishers, (5th Edition), 2000.
3. Helen Kreuzer and Adrienne Massey, Recombinant DNA and Biotechnology (2nd edition), ASM Press, 2001
4. Concepts and Techniques in Genomics and Proteomics 1st Edition, 2011, N Saraswathy, P Ramalingam.
5. Genomic and Proteomic Techniques: In Post Genomics Era by R.S. Dassanayake
6. Discovering Genomics, Proteomics and Bioinformatics (Paperback) | Released: 2007  
By: A. Malcolm Campbell (Author) | Publisher: Pearson Education

**Reference books:**

1. Primrose S.B. & Twyman R.M. Principles of Genome Analysis and Genomics (3rd edition) Blackwell publishing. 2003.
2. Mike Bailey and Keith Hirst, Advanced Molecular Biology, Harper Collins Publisher Limited, (2<sup>nd</sup> edition) 2000.
3. Genomics and Proteomics: Principles, Technologies, and Applications Hardcover – 24 June 2015, by Devarajan Thangadurai (Editor), Jeyabalan Sangeetha (Editor)

**Web references:**

1. <https://journals.asm.org/doi/10.1128/MMBR.00006-15>
2. <https://www.nature.com/scitable/knowledge/library/comparative-genomics>
3. <https://www.ebi.ac.uk/training/online/courses/functional-genomics-i-introduction>
4. <https://www.technologynetworks.com/proteomics/articles/proteomics>
5. <https://www.biosyn.com/tew/protein-characterization-and-purification-methods>

	L	T	P	C	Hrs
<b>A20BTE612</b>					
<b>ENZYME TECHNOLOGY</b>					
	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>45</b>

**Course objective**

- To understand the Introduction of Enzymes
- To ensure the students to understand about the Enzyme Catalysis.
- To understand the Enzyme Kinetics and Inhibition
- To understand about Enzyme Regulation
- To understand about Industrial and Clinical uses of Enzymes

**Course Outcomes**

**After the completion of this course, the students will be able to**

**CO1** – know about the Introduction of Enzymes

**CO2** – understand about the Enzyme Catalysis

**CO3** – understand the Enzyme Kinetics and Inhibition

**CO4** – understand about Enzyme Regulation

**CO5** – understand about Industrial and Clinical uses of Enzymes

**UNIT-I****(10 hours)**

Introduction to Enzymes: General introduction and historic background- General Terminology, Nomenclature and Classification of Enzymes. Criteria of purity of enzymes- Specific activity. Enzyme units-Katal and IU. Enzyme activity- chemical nature of enzymes. Protein nature of enzymes and Non protein enzymes- Ribozymes and DNAzymes. Metalloenzymes and metal activated enzymes. Coenzymes and Cofactors- Prosthetic group.

**UNIT-II****(8 hours)**

Enzyme Catalysis: Lock and key, Induced fit and Transition state Hypotheses. Mechanism of enzyme catalysis- Acid-base catalysis, covalent catalysis, Metal ion catalysis, Proximity and orientation effects etc. Mechanism of Serine proteases- Chymotrypsin, Lysozyme, Carboxypeptidase A and Ribonuclease., Proenzymes (Zymogens).

**UNIT – III****(10 hours)**

Enzyme Kinetics and Inhibition: Kinetics of a single-substrate enzyme catalysed reaction, Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number, Kcat. Kinetics of Enzyme Inhibition. Kinetics Allosteric enzymes. Factors affecting the enzyme activity- Concentration, pH and temperature. Reversible Inhibition- Competitive, Non Competitive, Uncompetitive, Mixed, Substrate, Allosteric and Product Inhibition. Irreversible Inhibition.

**UNIT – IV****(7 hours)**

Enzyme Regulation: Feedback Regulation, Allosteric Regulation, Reversible Covalent Modification and Proteolytic Activation. Enzymes in the cell, localization, compartmentation of metabolic pathways, enzymes in membranes, concentrations. Mechanisms of enzyme degradation, lysosomal and nonlysosomal pathways, examples.

**UNIT-V****(10 hours)**

Industrial and Clinical uses of Enzymes (Applied Enzymology): Industrial Enzymes- Thermophilic enzymes, amylases, lipases, enzymes in industry, enzymes used in various fermentation processes, cellulose degrading enzymes, Metal degrading enzymes. Clinical enzymes- Enzymes as thrombolytic agents, Anti-inflammatory agents, streptokinase, asparaginase, Isoenzymes like CK and LDH, Transaminases (AST, ALT), Cholinesterases, Phosphatases. Immobilization of enzymes.

**Text Books:**

1. Nelson.D.L, Cox. M. M. Lehninger's Principle of Biochemistry. 4th ed. Freeman,2004
2. Berg.J.M, Tymoczko.J.L, Stryer, L. Biochemistry. 6th ed. Freeman, 2006.
3. Understanding Enzymes: An Introductory Text (Muticolour) Paperback – 1 January 2018 by Dr. Aditya Arya (Author, Illustrator), Dr. Amit Kumar (Author), Jayanti Jha (Author)

**Reference books:**

1. Dixon & Webb. Enzymes. 3rd ed. Longmans, 1979.
2. Murray. R.K, Granner.D.K, Mayes. P.A, Rodwell. V.W.Harper's Biochemistry. 27<sup>th</sup>ed. McGraw Hill, 2006.
3. Fundamentals Of Enzymology, 3rd Edition, Released: 2009, Publisher: Oxford University Press Publisher Imprint: Oxford University Press

**Web references:**

1. <https://www.shivajicollege.ac.in/sPanel/uploads/econtent/ed8ad70c5da6e71fs>
2. <https://byjus.com/jee/enzyme-catalyst/>
3. [https://chem.libretexts.org/Bookshelves/General\\_Chemistry/Book%3A\\_](https://chem.libretexts.org/Bookshelves/General_Chemistry/Book%3A_)
4. <https://study.com/learn/lesson/enzyme-regulation-mechanisms.html>
5. <https://www.slideshare.net/mallikaswathi/industrial-and-clinical-medical-applications>

	L	T	P	C	Hrs
<b>A20BTL622</b>					
<b>MARINE BIOTECHNOLOGY PRACTIACL</b>					
	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### Course objective

- To learn the Marine Biotechnology Practicals

### Course Outcomes

After the completion of this course, the students will be able to

- Perform the Marine Biotechnology Practicals

### Practicals:

1. Study of any 5 marine bacteria and algae (Macro and micro)
2. Isolation, characterization and antagonistic effects of probiotic bacteria against fish pathogens.
3. DPPH assay for antioxidant extracted from marine algae
4. Extraction of carotenoids from marine algae/Bacteria/Fungi
5. Extraction and estimation of Gelatin / Collagen.
6. Extraction of alkaloids from marine organisms and their separation by TLC.
7. Monodon baculovirus (**MBV**) detection by PCR
8. Estimation of BOD in marine water
9. Estimation of COD in marine waters

### Text Books:

1. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015.
2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press\_Taylor& Francis (2017)
3. Introduction to Marine Biology, Laboratory Manual Paperback – Import, 29 January 2010 by George Karleskint, James Small, Richard Turner, Peter Baass

### Reference books:

1. R. S. K. Barnes, R. N. Hughes(auth.)-An Introduction to Marine Ecology, Third Edition- Wiley-Blackwell (1999)
2. Blanca Hernández-Ledesma, Miguel Herrero-Bioactive Compounds from Marine Foods- Plant and Animal Sources-Wiley-Blackwell (2013)
3. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds\_ Sources, Characterization and Applications-Springer US (2012)
4. W. Evans-Trease and Evans Pharmacognosy 15 th ed.-Saunders (2010)

### Web references:

1. <https://www.christianbook.com/marine-biology-manual-introductions>
2. <https://www.google.com/search?q=marine+biotechnology+lab+manual&source=hp&eis>
3. <https://downloads.hindawi.com/journals/specialissues/429647.pdf>

	L	T	P	C	Hrs
<b>A20BTL622 PHARMACEUTICAL BIOTECHNOLOGY PRACTICAL</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>30</b>

### Course objective

- To learn the Pharmaceutical Biotechnology Practicals

### Course Outcomes

After the completion of this course, the students will be able to

- Do the Pharmaceutical Biotechnology Practicals

### Practicals:

1. Preparation of different methods of medicinal plant extracts.
2. Antibacterial activity of medicinal plant extracts.
3. Antifungal activity of medicinal plant extracts.
4. Phytochemical screening of Primary metabolites.
5. Phytochemical screening of Secondary metabolites.
6. Total antioxidant activity.
7. Separation of medicinal plant extracts by chromatography.
8. Estimation of ascorbic acid in multivitamin formulations.
9. Sterility testing of injectables.

### Text Books:

1. Satoskar R.S, Nirmala N. Rege, and Bhandarkar S. D, Pharmacology and Pharmacotherapeutics (Revised 23rd Edition), Popular Prakashan, Mumbai.
2. Tripathy K. D, Essentials of Medical Pharmacology (6<sup>th</sup> edition), Jaypee publishers
3. Shoba rani R Hiremath, Text book of industrial pharmacy, orient longman Pvt ltd 2008.
4. Crommelin Daan J. A., Sindelar D. Robert (3<sup>rd</sup> edition) Pharmaceutical Biotechnology: Fundamentals and Applications, CRC Press, 2007.

### Reference books:

1. Pharmaceutical Microbiology - Hugo, W.B, Russell, A.D 6th edition Oxford Black Scientific Publishers
2. Trease, G.E.and Evans, W.C., 2011, Pharmacognosy (12<sup>th</sup> edition), Bailliere Tindall Eastbourne, U.K
3. Mukherje P.K., Quality Control Herbal Drugs—An approach to evaluation of botanicals. Business Horizons Pharmaceutical Publishers, 2005
4. Sambamurthy K., Pharmaceutical Biotechnology (1st edition) New Age International

### Web references:

1. [https://www.academia.edu/40480618/DEPARTMENT\\_OF\\_PHARMACEUTICAL](https://www.academia.edu/40480618/DEPARTMENT_OF_PHARMACEUTICAL)
2. [https://www.researchgate.net/publication/257028879\\_Lab\\_Manual\\_in\\_Pharmaceutical\\_Microbiology\\_Biotechnology-I](https://www.researchgate.net/publication/257028879_Lab_Manual_in_Pharmaceutical_Microbiology_Biotechnology-I)
3. [https://web.xidian.edu.cn/yqxia/files/20140227\\_103205.pdf](https://web.xidian.edu.cn/yqxia/files/20140227_103205.pdf)

		L	T	P	C	Hrs
<b>A20BTS606</b>	<b>R&amp;D and BIO-ENTREPRENEURSHIP</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>30</b>

### Course objective

- To understand the R & D key concepts and Definitions
- To understand the Innovation and entrepreneurship in bio-business
- To understand about the Bio markets - business strategy and marketing
- To understand the Finance and accounting
- To understand technology management

### Course Outcomes

**After the completion of this course, the students will be able to**

**CO1** – know about R & D key concepts and Definitions

**CO2** – Define the Innovation and entrepreneurship in bio-business

**CO3** – Understand about the Bio markets - business strategy and marketing..

**CO4** – Understand the Finance and accounting

**CO5** – Understand technology management

### UNIT -I

**(6 hours)**

R & D key concepts and Definitions-Technological innovation, Characteristics of Technological Innovation and Innovative Activities within the firms, Models of the technological innovation process, role of R&D within the process of innovation, implications of R&D strategy and organisation.

### UNIT-II

**(6 hours)**

Innovation and entrepreneurship in bio-business: Introduction and scope in Bio-entrepreneurship, Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities for innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

### UNIT – III

**(6 hours)**

**Bio markets - business strategy and marketing:** Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.

### UNIT – IV

**(6 hours)**

**Finance and accounting:** Business plan preparation including statutory and legal requirements, Business feasibility study, financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

### UNIT-V

**(6 hours)**

**Technology management:** Technology – assessment, development & upgradation, Managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).



**Text Books:**

1. R&D Strategy and Organisation - World Scientific by V Chiesa
2. Adams, D. J., & Sparrow, J. C. (2008). *Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences*. Bloxham: Scion.
3. Shimasaki, C. D. (2014). *Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies*. Amsterdam: Elsevier. Academic Press is an imprint of Elsevier.

**Reference books:**

1. Onetti, A., & Zucchella, A. *Business Modeling for Life Science and Biotech Companies: Creating Value and Competitive Advantage with the Milestone Bridge*. Routledge.
2. Jordan, J. F. (2014). *Innovation, Commercialization, and Start-Ups in Life Sciences*. London: CRC Press.
3. Desai, V. (2009). *The Dynamics of Entrepreneurial Development and Management*. New Delhi: Himalaya Pub. House.

**Web references:**

1. <https://www.oecd-ilibrary.org/docserver/9789264239012-4-en>
2. <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.463.4354&rep=rep1&type=pdf>
3. [https://www.researchgate.net/publication/262153345\\_Marketing\\_of\\_Biological\\_Products](https://www.researchgate.net/publication/262153345_Marketing_of_Biological_Products)
4. [bplans.com/accounting-and-bookkeeping-business-plan/](http://bplans.com/accounting-and-bookkeeping-business-plan/)
5. [emerald.com/insight/content/doi/10.1108/jtmc.2007.30202aaa.001/full/html](http://emerald.com/insight/content/doi/10.1108/jtmc.2007.30202aaa.001/full/html)

		L	T	P	C	Hrs
<b>A20BTS607</b>	<b>SEMINAR PRESENTATION</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>30</b>

**Course objective:**

The objective of the course is to enhance the communication skill of student and to introduce students to the latest upcoming updates of the field.

**Evaluation:**

Identifying suitable topic in Biotechnology and Literature survey. Preparation of report for the seminar presentation and Presentation of the seminar in PPT format. Discussion on the topic and evaluation.