

# **Dr. N.G.P.ARTS AND SCIENCE COLLEGE (Autonomous)**

## **REGULATIONS 2019-20 for Post Graduate Programme (Outcome Based Education model with Choice Based Credit System)**

### **Master of Science (Biotechnology)**

(For the students admitted during the academic year 2019-20 and onwards)

#### **Programme: Biotechnology**

#### **Eligibility:**

A candidate who has passed in Higher Secondary Examination with any Academic Stream or Vocational Stream as one of the subjects under Higher Secondary Board of Examination and as per the norms set by the Government of Tamil Nadu or an Examination accepted as equivalent thereto by the Academic Council, subject to such conditions as may be prescribed thereto are permitted to appear and qualify for the **M.Sc. Biotechnology Examination** of this College after a programme of study of three academic years.

#### **Programme Educational Objectives:**

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

1. This programme will enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology. It helps them to understand emerging and advanced concept in modern biology and guide them to take up their carrier in this field.
2. This programme will facilitate the students to acquire knowledge in fields such as Genetic Engineering, Protein Engineering and Molecular Therapeutics.
3. The programme will aid the students to learn the recent developments in the field of Genomics, Proteomics, Stem cell biology and Tissue Engineering approach.



**PROGRAMME OUTCOMES:**

On the successful completion of the program, the following are the expected outcomes.

<b>PO Number</b>	<b>PO Statement</b>
<b>PO1</b>	Impart quality biotechnology education to students and to develop young minds as outstanding scholars/teachers/entrepreneurs and responsible citizens.
<b>PO2</b>	Apply their understanding of the commercialization processes to biotechnology products or services in future.
<b>PO3</b>	Graduates of the course will have strong background in the interface of biotechnology and be able to use the tools in industry and/or institutes wherever necessary.
<b>PO4</b>	Ability to design and carry out experiments (safely) and to interpret experimental data and apply the scientific method by developing valid hypotheses, designing experiments, gathering relevant data using current technology, and interpreting quantitative and qualitative data.
<b>PO5</b>	Develop an awareness of ethical issues in biochemical research and careers options along with understanding of the area of biotechnology chosen.



### TOTAL CREDIT DISTRIBUTION

Courses	Credits	Total Marks		Credits	Cumulative Total credits
Core Theory	4	13 X 100 =	1300	52	78
Core Lab	3	4 X 100 =	400	12	
Core Lab	2	3 x100 =	300	06	
Project and Viva Voce	8	1 X 100=	100	08	
Elective	3	4X 100 =	400	12	12
<b>Total</b>			<b>2500</b>	<b>90</b>	<b>90</b>



**CURRICULUM**  
**M.Sc. BIOTECHNOLOGY**

Course Code	Course Category	Course Name	L	T	P	Exam (hours )	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
193BT2A1CA	Core -I	Molecular Biology & Genetics	4	-	-	3	25	75	100	4
193BT2A1CB	Core -II	Biochemistry	4	-	-	3	25	75	100	4
193BT2A1CC	Core – III	Microbiology	4	-	-	3	25	75	100	4
193BT2A1CD	Core - IV	Bioanalytical Techniques	4	-	-	3	25	75	100	4
193BT2A1CP	Core Practical-I	Molecular biology & Genetics and Biochemistry	-	-	5	6	40	60	100	2
193BT2A1CQ	Core Practical-II	Microbiology & Bioanalytical Techniques	-	-	5	6	40	60	100	2
193BT2A1DA	DSE - 1	Protein Engineering	3	1	-	3	25	75	100	3
193MB2A1DA		Microbial Nanotechnology								
193BC2A1DA		Cancer Biology, Diagnosis and Therapy								
Total			19	1	10	-	-	-	700	23

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M.Sc. Biotechnology (Students admitted during the AY 2019-20)

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
193BT2A2CA	Core V	Immunotechnology	4	-	-	3	25	75	100	4
193BT2A2CB	Core VI	Genetic Engineering	4	-	-	3	25	75	100	4
193BT2A2CC	Core VII	Bioprocess Technology	4	-	-	3	25	75	100	4
193BT2A2CD	Core VIII	Biodiversity & Bioprospecting	4	-	-	3	25	75	100	4
193BT2A2CP	Core Practical-III	Immunotechnology and Bioprocess Technology	-	-	5	6	40	60	100	2
193BT2A2CQ	Core Practical - IV	Genetic Engineering, Biodiversity & Bioprospecting	-	-	5	6	40	60	100	3
193BT2A2DA	DSC -II	Forensic Biotechnology	3	1	-	3	25	75	100	3
193MB2A2DA		Medical Laboratory Techniques								
193BC2A2DA		Biochemistry of Toxicology								
Total			19	1	10	-	-	-	700	24



Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
193BT2A3CA	Core - IX	Plant & animal Biotechnology	4	-	-	3	25	75	100	4
193BT2A3CB	Core X	Environmental Biotechnology	4	-	-	3	25	75	100	4
193BT2A3CC	Core XI	Genomics & Proteomics	4	-	-	3	25	75	100	4
193BT2A3CD	Core XII	Research Methodology & IPR	4	-	-	3	25	75	100	4
193BT2A3CP	Core Practical - V	Plant & Animal Biotechnology & Genomics & Proteomics	-	-	5	6	40	60	100	3
193BT2A3CQ	Core Practical VI	Environmental Biotechnology, Research Methodology & IPR	-	-	5	6	40	60	100	3
193BT2A3DA	DSC III	Molecular Therapeutics	3	1	-	3	25	75	100	3
193MB2A3DA		Molecular Diagnostics in Microbiology								
193BC2A3DA		System Biology								
193BT2A3TA	Internship	A to C								
Total			19	1	10	-	-	-	700	25



Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ES E	Total	
Fourth Semester										
193BT2A4CA	Core XIII	Pharmaceutical Biotechnology	4	-	-	3	25	75	100	4
193BT2A4CP	Core Practical VII	Pharmaceutical Biotechnology	-	-	6	6	40	60	100	3
193BT2A4CV	Project	Project and Viva Voce	-	-	16	-	40	60	100	8
193BT2A4DA	DSE-IV	Stem Cell Technology	3	1	-	3	25	75	100	3
193MB2A4DA		Microbial Technology								
193BC2A4DA		Neurobiology								
Total			7	1	22	-	-	-	400	18
Grand Total									2500	90



## DISCIPLINE SPECIFIC ELECTIVE

Students shall select the desired course of their choice in the listed elective course during Semesters I - IV

### Semester I (Elective I)

#### List of Elective Courses

S. No.	Course Code	Name of the Course
1.	203BT2A1DA	Forensic Biotechnology
2.	193MB2A1DA	Microbial Nanotechnology
3.	193BC2A1DA	Cancer Biology, Diagnosis and Therapy

### Semester II (Elective II)

#### List of Elective Courses

S. No.	Course Code	Name of the Course
1.	203BT2A2DA	Protein Engineering
2.	193MB2A2DA	Pharmaceutical Quality Control
3.	193BC2A2DA	Biochemistry of Toxicology

### Semester III (Elective III)

#### List of Elective Courses

S. No.	Course Code	Name of the Course
1.	193BT2A3DA	Molecular Therapeutics
2.	193MB2A3DA	Molecular Diagnostics in Microbiology
3.	193BC2A3DA	System Biology





## Semester IV (Elective IV)

### List of Elective Courses

S.No.	Course Code	Name of the Course
1.	193BT2A4DA	Stem Cell Technology
2.	193MB2A4DA	Practical-Microbiological Laboratory Techniques
3.	193BC2A4DA	Practical-Neurobiology

### EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S. No.	Course Code	Course Title
1.	193BT2ASSA	Food Biotechnology
2.	193BT2ASSB	Developmental Biology



## **Regulation (2019-2020)**

### **PG Programme**

Effective from the academic year 2019-20 and applicable to the students admitted to the Degree of Master of Arts/Commerce/Management/Science.

#### **1. NOMENCLATURE**

**1.1 Faculty:** Refers to a group of programmes concerned with a major division of knowledge. Eg. Faculty of Computer Science consists of Programmes like Computer Science, Information Technology, Computer Technology, Computer Applications etc.

**1.2 Programme:** Refers to the Master of Arts/Management/Commerce/Science Stream that a student has chosen for study.

**1.3 Batch:** Refers to the starting and completion year of a programme of study. Eg. Batch of 2015-2017 refers to students belonging to a 2-year Degree programme admitted in 2015 and completing in 2017.

**1.4 Course:** Refers to a component (a paper) of a programme. A course may be designed to involve lectures / tutorials / laboratory work / seminar / project work/ practical training / report writing / Viva voce, etc or a combination of these, to effectively meet the teaching and learning needs and the credits may be assigned suitably.

##### **a) Core Courses**

A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

##### **b) Extra Departmental Course (EDC)**

A course chosen generally from a related discipline/subject, with an intention to seek exposure in the discipline relating to the core domain of the student.

**c) Discipline Specific Elective Course (DSE):** DSE courses are the courses offered by the respective disciplinary/ interdisciplinary programme.



#### **d) Project Work:**

It is considered as a special course involving application of knowledge in problem solving/analyzing/exploring a real-life situation. The Project work will be given in lieu of a Core paper.

#### **e) Extra credits**

Extra credits will be awarded to a student for achievements in co-curricular activities carried out outside the regular class hours. The guidelines for the award of extra credits are given in section two, these credits are not mandatory for completing the programme.

#### **e) Advanced Learner Course (ALC):**

ALC is doing work of a higher standard than usual for students at that stage in their education. Research work carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days.

## **2. EXTRA CREDITS**

- Earning extra credit is mandatory. However, it is not essential for programme completion.
- Extra Credits will be awarded to a student for achievement in co-curricular/ extracurricular activities carried other than the regular class-hours.
- A student is permitted to earn a maximum of 10 extra Credits during the programme duration of PG from I to IV Semester.
- Candidate can claim a maximum of 1 credit under each category listed.

The following are the guidelines for the award of Extra credits:

### **2.1 Proficiency in Foreign Language**

<b>Qualification</b>	<b>Credit</b>
A pass in any foreign language in the examination conducted by an authorized agency	1



## 2.2 Proficiency in Hindi

Qualification	Credit
A pass in the Hindi examination conducted by Dakshin Bharat Hindi Prachar Sabha	1

Examination passed during the programme period only will be considered for extra credit

## 2.3 Self-study Course

Qualification	Credit
A pass in the self-study courses offered by the department	1

The candidate should register in the self-study course offered by the department only in the III semester

## 2.4 Typewriting/Short hand

A Pass in shorthand /typewriting examination conducted by Tamil Nadu Department of Technical Education (TNDTE) and the credit will be awarded.

Qualification	Credit
A pass in the type writing /short hand examination offered by TNDTE	1

## 2.5 Diploma / Certificate

Courses offered by any recognized University / NCVRT

Qualification	Credit
A pass in any Certificate /Diploma/PG Diploma Course	1



## 2.6 CA /ICSI/ CMA

Qualification	Credit
Qualifying foundation/Inter level/Final in CA/ICSI/CMA etc.	1

## 2.7 Sports and Games

The Student can earn extra credit based on their achievement in sports as given below:

Qualification	Credits
Achievement in University/State /National/ International	1

## 2.8 Online Courses

Pass in any one of the online courses

Qualification	Credit
SWAYAM/NPTEL/Spoken Tutorial etc.,	1

## 2.9 Publications / Conference Presentations (Oral/ Poster) /Awards

Qualification	Credit
Research Publications in Journals/oral/poster presentation in Conference	1

## 2.10 Innovation / Incubation / Patent / Sponsored Projects / Consultancy

Qualification	Credit
Development of model/ Products/ Prototype/ Process/App/Registration of Patents/ Copyrights/ Trademarks/Sponsored Projects/Consultancy	1



## 2.11 Representation

Qualification	Credit
Participation in State / National level celebrations such as Independence day, Republic day Parade, National Integration camp etc.,	1

## 3. EXAMINATIONS

The following are the distribution of marks for External and Internal i.e., Comprehensive examination and Continuous Internal Assessment and passing minimum marks for theory papers of PG programmes.

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for External alone		
100	75	38	25	50
50	50	25	----	25

The following are the Distribution of marks for the Continuous Internal Assessment in the theory papers of PG programmes.

S. No.	For Theory- PG courses	Distribution of Marks
1	TESTS I (2 hours )	5
2	TESTS II / End semester Model test (3 hours)	10
3	OBE- Rubrics	10
TOTAL MARKS		25



The following are the distribution of marks for the External Assessment in PG Theory courses

S. No.	For Theory- PG courses	Distribution of Marks	
1	Comprehensive (Written) Examination	65	50
2	Online MCQ Examination	10	--
<b>TOTAL MARKS</b>		<b>75</b>	<b>50</b>

The following are the distribution of marks for External examinations (CE) and Continuous Internal Assessment (CIA) and passing minimum marks for the practical courses of PG programmes.

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for External alone		
100	60	30	40	50
200	120	60	80	100

The following are the distribution of marks for the Continuous Internal Assessment (CIA) in PG practical courses

S. No.	For Theory - PG Practical courses	Distribution of Marks	
1	Tests: Two tests out of which one shall be during the mid semester and the other to be conducted as model test at the end of the semester.)	24	48
2	OBE- Rubrics	16	32
<b>TOTAL MARKS</b>		<b>40</b>	<b>80</b>

The following are the distribution of marks for the External Assessment in PG practical courses

S. No.	For Theory - PG Practical courses	Distribution of Marks	
1	Experiment-I	25	50
2	Experiment-II	25	50
3	Record & Viva-Voce	10	20
<b>TOTAL MARKS</b>		<b>60</b>	<b>120</b>



The following are the distribution of marks for Project and Viva voce examinations/Industrial Training and Continuous Internal Assessments and passing minimum marks for the project courses/Industrial Training of PG programmes

TOTAL MARKS	EXTERNAL		Internal Max. marks	Overall Passing Minimum for total marks (Internal + External)
	Max. marks	Passing Minimum for External alone		
100	60	30	40	50
200	120	60	80	100

The following are the distribution of marks for the Continuous Internal Assessment in PG Project/ Industrial Training courses.

S. No.	For- PG Project courses/ Industrial Training	Distribution of Marks	
1	Review-I	8	16
2	Review-II	8	16
3	Review-III	8	16
4	OBE- Rubrics	16	32
TOTAL MARKS		40	80

The following are the distribution of marks for the External Examination (CE) in PG Project / /Industrial Training courses

S. No.	For- PG Project courses/ Industrial Training Courses	Distribution of Marks	
1	Record Work and Presentation	40	80
2	Viva-Voce	20	40
TOTAL MARKS		60	120

- The end semester examinations shall normally be conducted after completing 90 working days for each semester.





- The maximum marks for each theory and practical course (including the project work and Viva-Voce examination in the final Semester) shall be 100 with the following breakup.

**(i) Theory Courses**

Continuous Internal Assessment (CIA) : 25 Marks

End Semester Exams (ESE) : 75 Marks

(Online Exam: 10 Marks & Written Exam: 65 Marks)

**(ii) For Practical Courses**

Continuous Internal Assessment (CIA) : 40 Marks

End Semester Exams (ESE) : 60 Marks

**Continuous Assessment OBE Rubrics Score Sheet**

Degree: \_\_\_\_\_ Branch: \_\_\_\_\_ Semester: \_\_\_\_\_

Course Code: \_\_\_\_\_ Course: \_\_\_\_\_

Max. Marks: \_\_\_\_\_ Internal: \_\_\_\_\_ External: \_\_\_\_\_ Total: \_\_\_\_\_

S. No.	REG. NO.	THEORY / PRACTICAL & LIBRARY CLASS PARTICIPATION ( 15 ) (Compulsory)				RUBRICS ASSESSMENT (SELECT ANY ONE)									Total Marks out of : 30	Total Marks out of : 16 / 10 / 08 / 04
						PAPERS / REPORTS ( 15 )			ASSIGNMENTS ( 15 )			CLASS PRESENTATION ( 15 )				
		Library	Integration of Knowledge	Interaction & Participation	Demonstration of Knowledge	Organization & Knowledge	Format & Spelling	Reference / Experiments	Demonstration of Knowledge	Format & Spelling	Reference	Content & Coherence	Creativity and Speaking Skills	Duration of Presentation		
1		6	3	3	3	5	5	5	5	5	5	5	5	5		



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*M.Sc. Biotechnology (Students admitted during the AY 2019-20)*

### a) Utilization of Library

Marks will be awarded to the student based on the hours spent in the library after the working hours and submission of report by the student.

Hours spent in Library	Marks	Type of Document submitted
2	1	Report/ Assignment/ Class presentation
4	2	
6	3	
8	4	
10	5	
12	6	

- During the Library hour, the student must spend time in reading the articles, books, journals of their subject of interest
- Each student should borrow minimum three books during the semester

### b) Class Participation

Active participation in classroom discussion by the student will be evaluated based on Integration of knowledge, Interaction and Participation and demonstration of knowledge.

### c) Papers / Reports/ Assignments/ Class Presentation

The student will be evaluated based on his ability to do analysis of application of theory to real world problems or creative extension of class room learning and his/her ability to communicate the given topic effectively and clearly. The following are the distribution of marks for the continuous internal assessment in PG practical courses

## 4. FOR PROGRAMME COMPLETION

Programme Completion (for students admitted during the A.Y.2019-20 and Onwards)

Student has to complete the following:



- i) Core, EDC, DSE, Project as mentioned in the scheme
- ii) Internship / Industrial/ Institutional training as mentioned in the scheme

Students must undertake industrial / institutional training for a minimum of 15 days and not exceeding 30 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

Based on the performance Grade will be awarded as follows:

<b>Marks Scored</b>	<b>Grade to be awarded</b>
75 and above	A
60-74	B
50-59	C
< 50	Re-Appearence



COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
193BT2A1CA	MOLECULAR BIOLOGY AND GENETICS	THEORY	4			4

**Total Credits: 4**

**Total Instruction Hours: 48**

**Preamble:**

1. To study the Basic components of Cell
2. To comprehend at length the functions of Cells and its organelles.
3. To learn gene expression and its regulation.

**Course outcomes**

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

CO Number	CO Statement	Knowledge Level
CO1	Imparts knowledge on the mode of DNA replication and repair mechanisms	K3, K4, K5
CO2	Provide in-depth understanding of transcriptional events and its role in gene regulation	K4, K5
CO3	Focus on translational events and its role in gene expression & protein targeting	K4, K5
CO4	To gain knowledge about Human genetics and various genetic disorders	K4,K5
CO5	To analyze the inheritance pattern and population genetics	K4,K5

**Mapping with Programme Outcomes**

COs/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	M	S	M	M
CO3	S	M	S	S	M
CO4	S	S	S	S	M
CO5	S	S	S	S	M

S-Strong; M-Medium; L-Low



193BT2A1CA	MOLECULAR BIOLOGY AND GENETICS	SEMESTER - I
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**Total Credits: 4**

**Total Instruction Hours: 48**

## CONTENTS

### UNIT - I

#### **DNA replication:**

**10 h**

Over view of Central dogma & Experimental proof for Semiconservative method\*. Enzymes & accessory proteins involved in DNA replication. Replication process in prokaryotic & Eukaryotic DNA. Regulations of Eukaryotic replication. Differences between Prokaryotic and eukaryotic replication. Other Replication models - Theta and Rolling circle model. **DNA Repair mechanism-** Nucleotide excision, Base excision, Mismatch repair, Photo-reactivation, SOS and recombination repair. **Recombination:** Homologous and site-specific recombination.

### UNIT - II

**8 h**

#### **Transcription:**

Importance of DNA binding Proteins, RNA polymerase. Mechanism of Transcription in prokaryotes & Eukaryotes. **Transcriptional Regulation-** Regulatory elements and mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing. **Modifications in RNA-** 5' cap formation, transcription, 3'-end processing and polyadenylation, splicing, RNA Editing, Nuclear export of mRNA. r-RNA & t- RNA processing.

### UNIT - III

**12 h**

#### **Translation:**

Overview of Genetic code, codon and anticodon concepts, wobble hypothesis\*. The translation machinery, role of t RNA & ribosome. Mechanism of translation in Prokaryotes & Eukaryotes. **Post translational modifications of proteins-** Phosphorylation, Deformylation, Glycosylation, Acetylation, Amidation, Lipid attachment, S - Nitrosylation and Disulfide bond formation. **Translation Regulation-** Translational inhibitors, Control of gene expression at translational level. **Protein targeting-** Synthesis of Secretory and membrane proteins, import into nucleus, mitochondria and chloroplast.



## UNIT - IV

### Mendelism and Non Mendelism:

10 h

Overview on mendelian and non-mendelian inheritance.\*

**Human Genetics-** Introduction to Human Genetics. Chromosomal changes resulting in abnormal phenotype: Numerical (Aneuploidy) changes resulting in genetic syndromes eg: Turner, Down & Klinefelter Syndromes. Structural changes resulting in genetic diseases: eg: Cri-du-chat syndrome,

**Genetic Diseases and Inheritance Pattern:** Autosomal inheritance – Dominant (Eg: Adult polycystic kidney, Achondroplasia); Autosomal inheritance – Recessive (Eg: Albinism, Sickle Cell Anemia, Phenyl Ketosuria); X-linked: Recessive (Eg: Duchenne muscular dystrophy – DMD); X-linked: Dominant (eg. Xg blood group); Y-linked inheritance (Holandric – eg. Testes determining factor); Mitochondria disorders like LHON, DAD, MERRF and MELAS. Cancer genetics.

## UNIT - V

08 h

### Analysis of inheritance pattern:

Pedigree analysis; Diagnosis of disease: Molecular cytogenetics, DNA markers - VNTR, STR, microsatellite, SNP and their detection techniques - RFLP genotyping, RAPD, AFLP. **Prevention of disease:** Prenatal diagnosis; Genetic counseling. **Population genetics:** Organization and measure of genetic variation: Random mating population, Hardy-Weinberg principle. Sources responsible for changes in gene frequencies: Mutation, selection, migration and isolation; random genetic drift; insights into human migration, natural selection and evolution.

(Note: \* Self Study)

### TEXT BOOKS:

1. Lodish, H. & Baltimore. D. 1994. **Molecular cell Biology**. 2<sup>nd</sup> edition. American Scientific Books.
2. Gardner, E.J. 1991. **Principles of Genetics**. 8<sup>th</sup> edition. John Wiley and Sons Inc, New York.

### REFERENCES:

1. Lewin, B. 2004. **Genes V**. Oxford University press.
2. Gerald Karp. 2002. **Cell and Molecular Biology**. 3<sup>rd</sup> edition. John Wiley Sons.
3. Freifelder, D. and Malacinski, G. M. 1996. **Essential of Molecular Biology**, 2<sup>nd</sup> edition. Panima Publishing Co., New Delhi.
4. Strickberger, M. W. 2013. **Genetics**. 3<sup>rd</sup> edition. Prentice Hall College Division, New Delhi



COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
193BT2A1CB	BIOCHEMISTRY	THEORY	4			4

**Total Credits: 4**

**Total Instruction Hours: 48**

**Preamble:**

1. To understand the Structure of Biomolecules.
2. To analyze function and pathogenesis of the biomolecules.
3. To learn the metabolism and their regulatory pathways.

**Course outcomes**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the physical properties, Classification, metabolism and disorders of Carbohydrates	K3, K4
CO2	Know the concepts of structure and function, metabolism and disorders associated with Lipid and Fatty acid	K3, K4
CO3	Structural understanding, Biosynthesis of Amino acids and to know about disorders related to amino acids.	K3, K4, K5
CO4	Learning about Mechanism, kinetics and inhibition of Enzymes and Coenzymes.	K3, K4
CO5	Concept and regulatory mechanism of different metabolic activities and their disorders of Nucleic acid.	K3, K4, K5

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	S	M	S	M	M
CO3	S	M	S	S	M
CO4	S	M	S	S	M
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low



193BT2A1CB	BIOCHEMISTRY	SEMESTER - I
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Total Credits: 4

Total Instruction Hours: 48

## CONTENTS

## UNIT-I

8 h

**Carbohydrates:**

\*Classification and reactions: occurrence, properties and biological reactions. Structural features of carbohydrates, Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Gluconeogenesis; interconversion of hexoses and pentoses. Carbohydrate metabolic disorders. Glycogen storage diseases. Lectins – characteristics and functions in biological system.

## UNIT-II

10 h

**Lipids:**

\*Classification, Structure, functions and reactions of Lipids, Biosynthesis of fatty acids, Triglycerides, phospholipids and Sterols, Catabolism of **Fatty acids** - Oxidation( $\alpha$ ,  $\beta$  and  $\omega$ ), Catabolism of triglycerides and phospholipids, Essential fattyacids and their physiological functions. Disorders associated with lipid metabolism and its therapeutic intervention - ketone bodies and ketosis; fatty liver, atherosclerosis.

## UNIT-III

10 h

**Amino Acid:**

Classification and Biosynthesis. Peptides, Classification of Protein, Primary structure of proteins, structural comparison at secondary and tertiary levels (Ramachandran Plot), quaternary and domain structure and architecture. Regulation of Protein metabolism. Protein metabolism in prolonged fasting. Disease related to protein folding – Alzheimer's and mad cow disease.

## UNIT-IV

8 h

**Enzymes and coenzymes:**

IUBMB classification of enzymes, active site, \*Lock and key Model and induced fit hypothesis. Factors affecting enzyme activity, Mechanism of enzyme catalysis: Lysozyme, Enzyme kinetics- Michaelis - Menten (MM) equations, Transformations of MM equation and their significance, Enzyme inhibition: Reversible – Competitive, Noncompetitive, Uncompetitive, Irreversible inhibition, Kinetics of Enzyme inhibition. Isoenzymes, allosteric enzymes, ribozymes, abzymes and artificial enzymes. Diseases Caused By Deficiency Of Digestive Enzymes-Obesity, Galactosemia,Maple Syrup Urine Disease





**UNIT-V****12 h****Nucleic Acids:**

Classification, structure, functions and reactions of nucleic acids, Conformation of Nucleic acids: Structural characteristics of A, B and Z-DNA. 3D structure of t-RNA, ribozymes and riboswitches. Biosynthesis of Nucleotides –De nova and Salvage pathway, Regulations of Purines and Pyrimidine, Metabolism of Purine and Pyrimidine. Disorders of nucleic acids metabolism- Gout, Lesch-Nyhan syndrome, oroticaciduria, and xanthinuria.

(Note: \* Self Study)

**TEXT BOOKS :**

1. Albert L. Lehninger, Michael M. Cox. 2008. **Principles of Biochemistry**. 5<sup>th</sup> Edition. W H Freeman & Co.
2. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, Victor W. Rodwell. 2006. **Harper's Illustrated Biochemistry**. 26<sup>th</sup> Edition. McGraw-Hill Medical Publishing Division.

**REFERENCES:**

1. Geoffrey L. Zubay. 1998. **Biochemistry**. 4<sup>th</sup> Edition. Brown (William C.) Co,U.S.
2. Donald Voet; Judith G Voet; Charlotte W Pratt. 1999. **Fundamentals of Biochemistry**. Wiley & sons. Publications.
3. Jeremy M. Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto. 2015. **Biochemistry**. 8<sup>th</sup> edition. Palgrave Macmillan Publications
4. Herbert J. Fromm, Mark Hargrove.2012.**Essentials of biochemistry**, Kindle edition, Springer publisher.
5. S. C. Rastogi, 2003. **Biochemistry**, Tata McGraw Hill Publication.



COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
193BT2A1CC	MICROBIOLOGY	THEORY	4			4

**Total Credits: 4**

**Total Instruction Hours:48**

**Preamble:**

1. To understand the microbial diversity and systematics.
2. To investigate microbial interactions.
3. To analyze the appropriate applications of microbes.

**Course outcomes**

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

CO Number	CO Statement	Knowledge Level
CO1	To gain knowledge about microbial biodiversity and systematics	K3, K4
CO2	To elucidate microbial growth and physiology	K4
CO3	To analyze microbial interactions and infections	K4, K5
CO4	To examine the microorganisms role in diverse environment	K4, K5
CO5	To apply the knowledge of microbes in food processing technology	K4, K5

**Mapping with Programme Outcomes**

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	S	M	S	S	M
CO3	S	M	S	S	M
CO4	S	S	S	S	M
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low



193BT2A1CC	MICROBIOLOGY	SEMESTER - I
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**Total Credits: 4**

**Total Instruction Hours:48**

## CONTENTS

### UNIT-I

#### **Microbial Diversity**

**8 h**

Microbial Diversity: Concepts of species and hierarchical taxa – Bacterial nomenclature – Bergey's system of classification: Family Enterobacteriaceae, Pseudomonadaceae, Bacillaceae, Chlamydiaceae, Flavobacteriaceae – Classification of Viruses and Fungi – Polyphasic taxonomy.

### UNIT-II

#### **Microbial Growth & Physiology**

**10 h**

Ultrastructure of Archaea (Methanococcus); Eubacteria (E.coli); Unicellular Eukaryotes (Yeast) and viruses (Bacterial, Plant, Animal and Tumor viruses); Microbial growth: Batch, fed-batch, continuous, methods of growth estimation, stringent response, death of a bacterial cell. Microbial physiology: Physiological adaptation and life style of Prokaryotes, Unicellular Eukaryotes.

### UNIT-III

#### **Microbial Interactions and Infection**

**10 h**

Host-Pathogen interactions; Microbes infecting humans – Urinary tract infection, Sexually transmissible infection, Oral cavity and respiratory infection, Nosocomial infection. Diseases caused by Viruses: Chicken pox, Rabies virus, hepatitis, Dengue.

Case study: Emerging Diseases (Swine flu, Chikun gunya, Ebola).

### UNIT-IV

#### **Microbes and Environment**

**8 h**

Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles;

### UNIT-V

#### **Microbes in Food Processing**

**12 h**

Fermented foods and beverages - Microbes and their use in pickling, producing colours and flavours, alcoholic beverages and other products; Process wastes-whey, molasses, starch substrates and other food wastes for bioconversion to useful products;



**TEXT BOOKS:**

1. Pelczar MJ Jr., Chan ECS and Kreig NR., 1993. **Microbiology**, 5th Edition, Tata McGraw Hill, New Delhi.
2. Maloy SR, Cronan JE Jr., and Freifelder D, 2006. **Microbial Genetics**, Jones Bartlett Publishers, Sudbury, Massachusetts.

**REFERENCES:**

1. Casida, L.E. 1997. **Industrial Microbiology**. New Age International Publishers.
2. Julian E Davies and Arnold L Demain. 2009. **Manual of Industrial Microbiology and Biotechnology**. ASM Publisher.
3. Vidhyasekaran , P. 2008. **Fungal pathogenesis in plants and crops: molecular biology and host defence mechanisms**, Volume 58 of Books in soils, plants, and the environment, 2nd ed., illustrated, CRC Press.
4. Prescott, L. M. Harley, J. P. and Klein, D. A. 1999. **Microbiology**, International edn. 4th edn. WCB Mc Graw-Hill.
5. Patel A H. 2008. **Industrial Microbiology**. PB Books.



COURSE CODE	COURSE NAME	CATEGORY	L	P	T	CREDIT
193BT2A1CD	BIOANALYTICAL TECHNIQUES	THEORY	4			4

**Total Credits: 4**

**Total Instruction Hours: 48**

#### PREAMBLE:

1. To study the functions of measurement systems in Biotechnology.
2. To learn the technical vocabulary associated with instrumentation
3. To analyze the design and basic signal analysis

#### COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the chromatographic techniques and analyzing its applications	K3, K4
CO2	Acquire knowledge on Principle of electrophoresis and Classifying the types of Centrifugation	K3, K4
CO3	Impart knowledge on the various spectral analysis techniques	K3, K4, K5
CO4	Focus on Microscopic Techniques and it's applications	K4, K5
CO5	In depth understanding of electrochemical Techniques and its applications	K4, K5

#### Mapping with Programme Outcomes

COs/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low



193BT2A1CD	BIOANALYTICAL TECHNIQUES	SEMESTER - I
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**Total Credits: 4**

**Total Instruction Hours: 48**

## **UNIT-I**

**08 h**

### **Microscopic and Optical Instruments**

Microscopic - Fluorescent microscope, stereo microscope, electron microscope (SEM, TEM) and specimen preparation. Confocal microscope, Flow cytometry and FACS. Optical bioinstruments- Optical imaging. Dispersive elements. Pulse oximetry. Fluorescence. Light scattering.

## **UNIT-II**

**08 h**

### **Electrophoretic Techniques**

General principles, Support media, Native gels, SDS-PAGE, IEF, 2D gel electrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis(PFGE), Capillary electrophoresis (CE). Centrifugation Techniques: Introduction, Basic principles of sedimentation, Types of centrifuges and their uses, Preparative centrifugation- differential and density gradient separation, Analytical ultracentrifuges and their applications.

## **UNIT-III**

### **Spectroscopic techniques**

**12 h**

IUV and visible light spectroscopy, IR and Raman spectroscopy, Electron Spin Resonance (ESR), NMR, Spectrofluorimetry, Luminometry, Atomic spectroscopy, X-ray diffraction, ORD, CD. Mass spectrometric techniques: Introduction, mass spectrometer, Ionization techniques Electron impact ionization (EI), Electrospray Ionization, Chemical ionization (CI), Field ionization (FI), MALDI, Ion disruption methods, Ion desorption and evaporation methods, Analyzers- Magnetic sector, time-of-flight, quadropole, ion trap, Detectors- electron multipliers, Tandem mass spectrometry, applications.

## **UNIT-IV**

**10 h**

### **Sensors**

Introduction to Sensors: Sensor response and dynamic range. Single vs. multi-channel sensors. Temperature sensors: Thermocouples. Thermistors. Infrared thermography. Light sensors: Photoresistors. Photodiodes. Photomultiplier



tubes. Chargecoupled devices (CCDs). Flow sensors: Thermal mass flow meters. Ultrasonic flow meters.

Case study : Detection of breast tumors.

## UNIT-V

10 h

### Medical imaging

Electromagnetic spectrum. X-rays for medical imaging. X-ray absorption of the elements. Angiography. Esophagography, Fluoroscopy, Tomography. X-ray computed tomography (CT or CAT scan). Drawbacks of radiographic imaging. Magnetic resonance imaging (MRI). Functional MRI. Positron emission tomography (PET). Doppler ultrasound.

Case study: Diagnosing Down syndrome in utero with ultrasound.

### TEXT BOOKS:

1. Sawhney, S.K. & Randhir Singh. 2006. **Introductory Practical Biochemistry**. 3<sup>rd</sup> edition. Narosa publishing House.
2. Boyer, Rodney F Benjamin and Cummins. 2001. **Modern Experimental Biochemistry**, 2<sup>nd</sup> edition. Pearson Education.

### REFERENCES:

1. Freifelder, D. 1982. **Physical Biochemistry: Application to Biochemistry and Molecular Biology**. 2<sup>nd</sup> edition. W. H. Freeman Publishers.
2. Walker, J. & Wilson, K. 2000. **Principle & Technique - Practical Biochemistry**, 5<sup>th</sup> edition. Cambridge university press.
3. John G. Webster. 2004. **Medical Instrumentation Application and Design**. John Wiley and sons, New York.
4. Gleichen, A. 2019. **The Theory of Modern Optical Instrumnets: A Reference Book for Physicst, Manufacturers of Optical Instruments and for Officers in Army and Navy**, 1<sup>st</sup> edition. Palala Press.
5. Robert, P.A. and Williams, J. 2019. **Farr's Physics for Medical Imaging**, 2<sup>nd</sup> edition, Elsevier Health Sciences, UK.



COURSE CODE	COURSE NAME	CATEGORY	L	P	T	CREDIT
193BT2A1CP	CORE PRACTICAL- I: MOLECULAR BIOLOGY, GENETICS AND BIOCHEMISTRY	PRACTICAL		5		2

**Total Credits: 2**

**Total Instruction hours: 60**

### CONTENTS

1. Isolation of genomic DNA from human blood sample
2. Bacterial conjugation.
3. Bacterial Transformation
4. Molecular analysis using RAPD
5. RFLP analysis
6. Estimation of total Protein and albumin from serum
7. Estimation of glucose from serum.
8. Estimation of Vitamin C from Citrus fruits.
9. Estimation of total amino acids from serum.
10. Estimation of DNA & RNA.
11. Determination of blood cholesterol
12. Separation of amino acids from serum Paper Chromatography.
13. Separation of plant pigments by Thin Layer Chromatography.

### REFERENCES:

1. Joseph Sambrook, Michael R. Green. 2012. **Molecular Cloning: A Laboratory Manual**. 4<sup>th</sup> edition. Cold Spring Harbor.
2. Thomas R. Mertens and Robert L. Hammersmith. 1997. **Genetics Laboratory Investigations**. 11<sup>th</sup> edition. Benjamin Cummings.
3. Sadasivam, S. and Manickam, A. 1996. **Biochemical Methods**. New Age International.





COURSE CODE	COURSE NAME	CATEGORY	L	P	T	CREDIT
193BT2A1CQ	CORE PRACTICAL- II: MICROBIOLOGY, BIOANALYTICAL TECHNIQUES	PRACTICAL		5		2

**Total Credits: 2**

**Total Instruction hours: 60**

### CONTENTS

1. Isolation of enzyme producing Bacteria from soil.
2. Isolation of Fungi from spoiled food.
3. Isolation of Antibiotic producing microorganisms against given pathogen.
4. Observation of Bacterial growth rate.
5. UV mutagenesis.
6. Morphological Analysis of Microbes using stereomicroscope
7. Observation of fungal morphology using Phase contrast microscopy
8. Biochemical observations of Bacteria
9. 16S rRNA sequence amplification
10. SDS PAGE
11. 2-D gel electrophoresis

### REFERENCES :

1. Joseph Sambrook, Michael R. Green. 2012. **Molecular Cloning: A Laboratory Manual**. 4<sup>th</sup> edition. Cold Spring Harbor.
2. Thomas R. Mertens and Robert L. Hammersmith. 1997. **Genetics Laboratory Investigations**. 11<sup>th</sup> edition. Benjamin Cummings.
3. Sadasivam, S. and Manickam, A. 1996. **Biochemical Methods**, New Age International.



COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
193BT2A1DA	PROTEIN ENGINEERING	THEORY	3	1		3

Total Credits: 3

Hours Per Week: 4

**PREAMBLE:**

1. To study the function and application of proteins.
2. To analyze folding of proteins.
3. To learn the protein engineering and designing

**COURSE OUTCOMES**

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the bond and modification of protein	K3, K4
CO2	Acquire knowledge on protein Architecture	K3, K4
CO3	Impart knowledge on the various electromagnetic radiation	K3, K4, K5
CO4	Focus on DNA binding factors	K4, K5
CO5	In depth understanding of designing of protein and its applications Documentation, Inspection and certification Procedure	K4, K5

**Mapping with Programme Outcomes**

COs/Pos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S-Strong; M-Medium; L-Low



193BT2A1DA	ELECTIVE I: PROTEIN ENGINEERING	SEMESTER - I
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**Total Credits: 3**

**Total Instruction Hours: 48**

## CONTENTS

### UNIT - I

#### **Bonds and Energies in Protein Makeup** **10 h**

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Amino acids, their characteristics, molecular properties (size, solubility, charge, pKa). Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups).

### UNIT - II

#### **Protein Architecture** **10 h**

Primary structure, peptide mapping, peptide sequencing - Edman method. Secondary structures, super secondary structure, nucleotide binding folds, prediction of substrate binding sites. Tertiary structure, Domains, folding, denaturation and renaturation. Overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Ramachandran Plot.

### UNIT - III

#### **Elucidation and characterization of Proteins** **8 h**

Interaction with electromagnetic radiation (radio, micro, infrared, visible, ultraviolet, X-ray) and elucidation of protein structure. Characterization of protein using NMR spectroscopy, x ray crystallography, spectroscopic and calorimetric methods.

### UNIT - IV

#### **Structure-function relationship of Proteins** **10 h**

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn - helix motifs in homeodomain, Leucine zippers. Membrane proteins - characteristics, transmembrane segments. Bacteriorhodopsin and photosynthetic reaction center.

### UNIT - V

#### **Protein engineering and Designing** **10 h**

Overview, advantages, principles with specific examples: thermal stability, T4-lysozyme, recombinant insulin. Strategies for design of novel protein, production of de novo protein design. Computer methods in protein modeling.



Understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis and other commercial applications.

#### TEXT BOOKS:

1. Walsh, G. 2014. **Proteins: Biochemistry and biotechnology**. 2<sup>nd</sup> edition. Wiley Blackwell. NJ, USA.
2. Wiliamson, M.P. 2012. **How Proteins Work**. Garland Science, NY, USA

#### REFERENCES:

1. Voet D. and Voet G.2001. **Biochemistry**. 3<sup>rd</sup> Edition. John Wiley and Sons.
2. Branden C. and Tooze J. 1999. **Introduction to Protein Structure**. 2<sup>nd</sup> edition. Garland Publishing, NY, USA.
3. Creighton T.E.1993. **Proteins**. 2<sup>nd</sup> Edition. Freeman WH.
4. Moody P.C.E. and Wilkinson A.J. 1990. **Protein Engineering**. IRL Press, Oxford, UK.
5. Craik, C.S., Cleland, J.L. 1996. Protein Engineering: Principles and Practice. Wiley Blackwell, NJ, USA.



Course Code	Course Name	Category	L	T	P	Credit
193MB2A1DA	ELECTIVE I: MICROBIAL NANOTECHNOLOGY	Theory	3		0	3

## PREAMBLE

This course has been designed for students to learn and understand

- The role of microbes and other eukaryotes in the synthesis of nanoparticles
- Advanced methods of synthesis and designing of nano particles
- Educate the potential applications of nano particles/ materials in a variety of areas.

## COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To apply the basics of Nanosciences, able to differentiate particles at macro, micro and nano level	K2, K3
CO2	To know the synthesise of nanoparticles at the laboratory scale	K3
CO3	Understand the characterization techniques involved in nanotechnology	K3
CO4	To explore the interdisciplinary applications of nanotechnology	K2,K3
CO5	To learn the positive and negative aspects of nanotechnology and its present status in India	K2

## MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	S
CO2	S	M	M	M	M
CO3	M	M	M	M	M



<b>CO4</b>	M	M	M	M	M
<b>CO5</b>	M	M	M	M	M

S Strong

M Medium

L Low



193MB2A1DA	ELECTIVE I: MICROBIAL NANOTECHNOLOGY	SEMESTER I
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Total Credits: 3

Total Instructions Hours: 48

## Syllabus

**Unit I** Introduction to bionanotechnology | 9 h |

History – concept and future prospects – application in Life Sciences. Terminologies – nanotechnology, bionanotechnology, nanobiomaterials, biocompatibility, nanomedicine, nano tube, nanowires, quantum Dots, nanocomposite, nanoparticles, nanosensors. Emergence of Bionanotechnology.

**Unit II** Synthesis of nanoparticles | 10 h |

Molecular nanotechnology – nanomachines – collagen. Applications of nanoparticles – cancer therapy – nanoparticles in manipulation of biomolecules and cells. Cytoskeleton and cell organelles. Types of nanoparticles production – physical, chemical and biological. Microbial synthesis of nanoparticles – bacteria, fungi and yeast – principle and mechanism of synthesis.

**Unit III** Types of nanoparticles and methods of characterization | 10 h |

Types of Nanoparticles – Silver, Gold and Titanium. Physical and chemical properties of nanoparticles. Characterization– UV-Vis spectroscopy, particle size analyzer, Electron Microscopy – HRTEM, SEM, AFM, EDS, XRD. Other tools and techniques required for bionanotechnology: X- Ray crystallography, NMR, rDNA technology, site directed mutagenesis, fusion proteins.

**Unit IV** Applications of bionanotechnology | 10 h |

Drug and gene delivery – protein and nanoparticle mediated. Nanoparticles in drug targeting, MRI, DNA and Protein Microarrays. Nanotechnology in health sectors - Development of green chemistry – commercial viability of nanoparticles. Nanomedicines, Antibacterial activities of nanoparticles. Nanotechnology in agriculture. Toxicology in nanoparticles – Dosimetry. Advantages of nanoparticles – drug targeting, protein detection, MRI,

**Unit V** Merits and demerits of nanoparticles | 9 h |

Health and safety implications from nanoparticles: Health issues – Environmental



issues – Need for regulation – Societal implications - Possible military applications  
 – Potential benefits and risks for developing countries – Intellectual property issues.  
 Bioinformatics: molecular modeling, docking, computer assisted molecular design.

### Text Books

- 1 | Parthasarathy BK. Introduction to Nanotechnology, Isha Publication. 2007. |
- 2 | Elisabeth Papazoglou and Aravind Parthasarathy. Bionanotechnology.  
Morgan and Claypool Publishers. 2007. |

### References

- 1 | Bernd Rehm. Microbial Bionanotechnology: Biological Self-assembly Systems  
and Biopolymer-based Nanostructures. Horizon Scientific Press. 2006. |
- 2 | David E Reisner and Joseph D Bronzino. Bionanotechnology: Global  
Prospects. CRC Press. 2008. |
- 3 | Ehud Gazit. Plenty of Room for Biology at the Bottom: An Introduction to  
Bionanotechnology. Imperial College Press. 2006. |
- 4 | Kamali Kannangara. Nanotechnology: Basic science and emerging  
technologies- Mick Wilson, Overseas Press. 2005. |
- 5 | Pradeep T. Nano Essentials understanding nanoscience and Nanotechnology.  
1st edition. TMH publications. 2007. |





193BC2A1DA	<b>ELECTIVE-I: CANCER BIOLOGY, DIAGNOSIS AND THERAPY</b>	<b>Theory</b>	<b>3</b>		<b>0</b>	<b>3</b>
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## PREAMBLE

This course has been designed for students to learn and understand

- This course offers an overview on cancer, mutations causing cancer, repair mechanism and multiples of diagnostic and treatment methods for cancer.
- Students can gain an in-depth knowledge and understanding on the basic principles of cancer development and available therapeutic approaches.

## COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Compare and contrast benign and malignant tumors. Explain morphological characteristics of cancer cells.	K4 & K5
CO2	Justify molecular basis of the cancer. Distinguish interdisciplinary areas in cancer biology. Elaborate the carcinogenetic process.	K4, K5 & K6
CO3	Discuss about molecular mechanism of oncogenesis and tumor biology. Compare and explain the role of cell cycle in cancer. Value the importance of nutrition given to cancer patients.	K4, K5 & K6
CO4	Judge the role of tumor suppressor genes and apoptosis. Elaborate on epigenetics.	K5 & K6
CO5	Elaborate on the choice of diagnosis and therapy available for cancer patients.	K5 & K6

## MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	S	M	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	S	S	S
S	Strong	M	Medium	L	Low



<b>193BC2A1DA</b>	<b>ELECTIVE-I: CANCER: BIOLOGY, DIAGNOSIS AND THERAPY</b>	<b>SEMESTER I</b>
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**Total Credits: 3**  
**Total Instructions Hours: 36**

### **Syllabus**

#### **Unit I Introduction 7 h**

Introduction: Cancer cell-morphology and growth characteristics. Types of growth-hyperplasia, dysplasia, anaplasia and neoplasia. Types and prevalence of cancer. Nomenclature of neoplasms, classification based on origin/organ. Differences between benign and malignant tumors.

#### **Unit II Carcinogenesis 7 h**

Cancer epidemiology. Cancer endocrinology. Cancer causing agents-radiation, viruses, chemicals. Multistep carcinogenesis: Initiation, Promotion, Progression. Para-neoplastic syndromes. Mutation- definition, significance, rates and frequency. Mutagenic agents. Molecular basis of mutagenesis, induced and spontaneous mutations, crossing over and segregation. Various types of mutations- addition, deletion, inversion, reciprocal, translocation, insertional translocation and frame-shift mutations. Chemical carcinogenesis- genetic and epigenetic carcinogens, pro-carcinogens and co-carcinogens, promoters and initiators, testing for carcinogenicity, Ames test. Cancer biology and biochemistry-aberrant metabolism during cancer development.

#### **Unit III Tumor Markers and Signal Transduction 8 h**

Oncogenes- RNA and DNA tumor viruses, retroviruses and viral oncogenes. Src and Ras gene, mechanism and characteristic of cell transformation. Molecular mechanism of oncogenesis- proto oncogenesis, oncogene, oncoproteins, tumour suppressor genes involved in cancer. Tumormarkers; cellular proto-oncogenes- oncogene activation. Radiation- effect of ionising radiations on DNA, chromosomal aberrations. Genetic basis of cancer, metastasis, use of tumor markers in detection and monitoring of cancer. Signal transduction in cancer: cell- cell interactions, cell adhesion-invasion and metastasis - VEGF signaling and angiogenesis; role of transcription factors. Growth factors-EGF, TNF- $\alpha$  and TGF- $\beta$  and growth factor



receptors. Free radicals and antioxidants in cancer. Diet and cancer

#### **Unit IV** Cell Cycle, Cell Death and Cancer

7 h

Cell Cycle Regulation cancer: control of the cell cycle-cyclins and CDKs, and tumor suppressor genes p53, p21 Rb, BRAC1 and BRAC2. Telomeres, and Immortality; Epigenetics- role of DNA methylation in gene silencing- epigenetic silencing of tumor-suppressor genes. Role of DNA-methylation in gene silencing-epigenetic silencing of tumor-suppressor genes; Death-signaling pathways-mitochondrial and death receptor pathways, apoptosis and cancer (Intrinsic and extrinsic pathways). Mechanism of apoptosis. Impact of apoptosis on oncogenesis. Principles and methods of cancer diagnosis-biochemical, genetic, cytotoxic, cell growth and viability tests.

#### **Unit V** Cancer Diagnosis and Cancer Therapy, Stem Cells and Cancer

7 h

Diagnostics of cancer by histo-pathology, MRI scan, PET-scan, cytogenetic test, karyotype, FISH. Strategies of anticancer drug therapy-chemotherapy-gene therapy. Immuno-therapy and Radiotherapy. Immune therapy, surgical therapy. Principles of cancer biomarkers and their applications. Stem Cells and Cancer.

#### **Text Books**

- 1 McKinnell R. G, Parchment R. E., Perantoni A. O, BarryPierce,Damjanov.I.,2006. The Biological Basis of Cancer, Second Edition, Cambridge University Press, United Kingdom.
- 2 The Biology of Cancer: R. A. Weinberg. Garland Science. 2006.  
Franks,L.M. and Teich,N.M. 1991. An introduction to Cellular and Molecular Biology of cancer, 2nd Edition, Oxford University Press.  
Vincent,T. et al., 2011. Principles and Practice of Oncology: Primer of the Molecular Biology of Cancer, 1st Edition, Lippincott Williams and Wilkins.

#### **References**

- 1 Weinberg,R.A. 2013. The Biology of Cancer, 2nd Edition, Garland Science.
- 2 Hesketh,R. 2013. Introduction to Cancer Biology, Cambridge University Press.
- 3 Pelengaris,S. and Khan,M. 2002. The Molecular Biology of Cancer, 2nd Edition, Wiley Blackwell.



Course Code	Course Name	Category	L	T	P	Credit
193BT2A2CA	CORE : IMMUNOTECHNOLOGY	CORE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- To study the mechanism of immune system.
- To learn various detection methods of antigen-antibody and vaccine technology.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand about basic of immune response.	K3
CO2	Know the antigen - antibody related test.	K3
CO3	Learn about new generation of antibody production techniques.	K3,K4,K5
CO4	Awareness on vaccine immunological types and its role in immune system	K3,K4,K5
CO5	Know about allergic reaction, tumour immunology and its affect on immune system.	K3,K4,K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	M	M	S	S
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

**S Strong**

**M Medium**

**L Low**



193BT2A2CA	CORE : IMMUNOTECHNOLOGY	SEMESTER II
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**Total Credits: 4**

**Total Instruction Hours: 48 h**

### Syllabus

#### **Unit I** Cells and Organs of Immune system 8 h

History and scope of immunology. Types of Immunity: Passive, Active and Acquired immunity. Humoral, Cell Mediated immunity. Cells and organs of immune response and their functions. Antigens - Types, haptens, epitopes and Factors influencing antigenicity. Antibody - Structure, types, properties and functions. Immunoglobulin gene rearrangements.

#### **Unit II** Antigen Antibody Reactions 10 h

Antigen - Antibody interaction, affinity, cross reactivity, specificity, epitope mapping; Agglutination reactions and Precipitation reactions. Immuno assays - Immuno Diffusion and Immunoelectrophoresis, RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, Surface plasmon resonance, Biosensor assays for assessing ligand -receptor interaction.

#### **Unit III** New Generation Antibodies 10 h

Antibody engineering; Hybridoma and monoclonal antibody (MCAb) techniques, Production of murine hybridoma, Production of MCABs in cultures and animal (Ascites), Purification of MCABs. Characterization of MCABs/ and Labelling of antibodies. Phage display libraries; Antibodies as in vitro and in vivo probes.

#### **Unit IV** Vaccine Technology 10 h

Rationale vaccine design based on clinical requirements: Active immunization, live, killed, attenuated, Sub unit vaccines; Recombinant DNA and protein based vaccines, plant-based vaccines and reverse vaccinology; Peptide vaccines, conjugate vaccines; Passive Immunization; Antibody, Transfusion of immuno- competent cells, Stem cell therapy; Cell based vaccines.

#### **Unit V** Hypersensitivity and Transplantation 10 h

Hypersensitivity- Mechanism and Types. Auto immune disorders - Type I diabetes, Rheumatoid arthritis. Tumor immunology: tumor antigens, oncogenes, immune responses, detection of cancers and therapy- chemotherapy and radiation therapy. Transplantation Immunology.



## Text Books

- 1 Roa, C.V (2006). Immunology A Textbook. (2 Edn.) Delhi:Narosa Publishing House Pvt. Ltd.
- 2 Khan, F.H. (2009). The Element of Immunology. (1Edn.) Delhi: Pearson Education.

## References

- 1 KubyJ. (Year). Immunology. (3 Edn.) New York: W.H. Freeman and Company.
- 2 Riot, Ivan (1988). Essentials of Immunology. (6 Edn.) London: Blackwell Scientific Publications, Oxford.
- 3 Hay, F.C. (2002). Practical immunology. (4 Edn.) London: Blackwell Scientific Publications.
- 4 Harlow, Ed. (1988). Antibodies Laboratory Manual. (2 Edn.) USA: Cold Spring Harbor Laboratory Press.



Course Code	Course Name	Category	L	T	P	Credit
193BT2A2CB	CORE : GENETIC ENGINEERING	CORE	4		-	4

### PREAMBLE

This course has been designed for students to learn and understand

- To learn various types of vector host systems and steps in creating rDNA molecule
- To gain knowledge on various recombinant DNA techniques and their applications

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the steps in recombinant DNA preparation and labeling	K3, K4
CO2	Explain the features of various types cloning vectors for bacteria, yeast, animals and plants.	K3, K4
CO3	Understand the methods of gene transfer and hybridization	K3, K4
CO4	Describe various molecular techniques and its applications	K4, K5
CO5	Knowing different types of sequencing and gene therapy	K4, K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	M	M
CO2	S	S	S	M	M
CO3	S	S	S	M	S
CO4	S	S	S	S	M
CO5	S	S	S	S	S

**S Strong**

**M Medium**

**L Low**



193BT2A2CB	CORE : GENETIC ENGINEERING	SEMESTER II
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**Total Credits: 4**

**Total Instruction Hours: 48 h**

### Syllabus

#### **Unit I** Basics concepts 9 h

Genetic engineering – Overview and scope. Steps involved in recombinant DNA constructions, enzymes involved in genetic engineering, role of linkers, adaptors and Homopolymer tailing. Selectable and Screenable markers. Labeling of DNA - Radioactive and non-radioactive probes.

#### **Unit II** Cloning Vectors 10 h

Plasmids –pBR322 and pUC vectors, Bacteriophage vectors - M13 vectors, Lambda vectors (Insertion and Replacement vectors), Phagemids, Cosmids, Yeast vectors, Shuttle vectors, Animal Viral vectors - SV-40, baculo & retroviral vectors, Expression vectors – pMal, GST and pET-based vectors, Plant vectors -Ti and Ri Plasmids

#### **Unit III** Cloning Methodologies 10 h

Introduction of cloned genes into cell – transformation, particle bombardment, liposome mediated transfer, electroporation, microinjection and calcium phosphate mediated transfer. Construction of cDNA and genomic libraries. Hybridization techniques - \*Northern, Southern and Colony hybridization.

#### **Unit IV** PCR and Its Applications 9 h

Primer design; Fidelity of thermostable enzymes, \*DNA polymerases, PCR and Types – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products, PCR in molecular diagnostics, PCR based mutagenesis.

#### **Unit V** Gene silencing and Therapy 10 h

DNA sequencing- Chain termination method and NGS. Gene silencing techniques - Introduction to siRNA technology, Micro RNA Principle and application of gene silencing. Gene knockouts and Gene Therapy - Creation of knockout mice, Disease model, Gene targeting. Gene Editing.





## Text Books

- 1 Brown, T. A. (1998). Introduction to Gene Cloning. (3rd Edn.) UK: Stanley Thornes Publishing Ltd.
- 2 Primrose, S. B. (2003). Principles of Gene Manipulation. (6th Edn.) US: Blackwell Science Ltd.

## References

- 1 Bernard Glick, R and Jack Pasternak, J. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA. (4th Edn.) U.S.: ASM press.
- 2 Singh, B.D. (2008). Text book of Biotechnology. (4th Edn.) New Delhi: Kalyani Publishers.
- 3 Sambrook, J. and Russel, D.W. (2001). Molecular Cloning: A Laboratory Manual. (3rd Edn.) US: CSHL.
- 4 James Watson, D. (2001). Recombinant DNA technology. (2nd Edn.) UK: WH Freeman and company.



Course Code	Course Name	Category	L	T	P	Credit
193BT2A2CC	CORE : BIOPROCESS TECHNOLOGY	CORE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- To recognize the fundamentals of Fermentation Technology and to analyze the bioprocess paradigm
- Development of Fermentation products and their regulations

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the concepts microbial culture collection and preservation	K3,K4
CO2	Acquire information about types of Media and Fermentation	K3,K4
CO3	Concept and mechanism of different types of fermenters	K4, K5
CO4	Learning about the purification of fermentation products	K4, K5
CO5	Recent development in microbial product production	K4, K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	M	S	M	M
CO3	S	S	S	M	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

**S Strong**

**M Medium**

**L Low**



193BT2A2CC	CORE : BIOPROCESS TECHNOLOGY	SEMESTER II
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**Total Credits: 4**

**Total Instruction Hours: 48 h**

### Syllabus

**Unit I** Introduction to various field opted for bioprocess 09 h

Fermentation process - Microbial culture; Screening and selection for fermentation processes; Improvement of industrially important microorganisms; Preservation of cultures after strain improvement programme. Inoculum production for bacterial and fungal processes.

**Unit II** Raw material and media formulation for fermentation process 09 h

Fermentation media - Natural media; synthetic media. Sources of Carbon; Nitrogen and vitamins; antifoams and optimization; Aerobic and anaerobic fermentation, Types of Fermentation: Solid Substrate fermentation and submerged fermentation, Batch, Continuous and Fed -Batch. Process parameters: measurement of temperature; pressure and pH; dissolved Oxygen; foam etc.

**Unit III** Bioreactor configurations and types 10 h

Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, Solid state fermenter, Animal and plant cell bioreactors. Scale up and Scale down studies of bioreactors. Rheological properties of fermentation broths, Factors affecting broth viscosity, Mixing in Fermenters.

**Unit IV** Downstream Processing 10 h

Biomass separation by centrifugation; filtration; flocculation and other methods; Cell disintegration: Physical; chemical and enzymatic methods; Separation of solid and liquid phases; isolation and purification techniques for proteins and other products; Principles of bioprocess control; bioprocess automation and application of computers in bioprocessing.

**Unit V** Fermentation Products 10 h

Pharmaceutical Products - Enzymes (Protease and amylase), Antibiotics (penicillins, tetracycline), vitamins (B2, B12), Aminoacids (lysine, glutamic acid), Organic acids (acetic acid, lactic acid). Food Products - Baker's yeast, cheese, Lab grown meat. Agricultural Products - Biofertilizer (Rhizobium, Pseudomonas) and Biopesticides (Bacillus thuringiensis). Algal biofuel.



## Text Books

- 1 Pelczar, MJ (1993). Microbiology. (5th Edn.) Delhi: Tata McGraw Hill.
- 2 Patel A H, A H. (2008). Industrial Microbiology. (3 Edn.) PB Books: Delhi.

## References

- 1 Casida, L E (1997). Industrial Microbiology. (4 Edn.) New Delhi: New Age International Private Limited.
- 2 Presscott, L. (1999). Microbiology. (4 Edn.) Delhi: WCB Mc Graw-Hill.
- 3 Crueger, A (1990). Biotechnology: A textbook of Industrial Microbiology. (2 Edn.) US: Sinauer Associates Inc.
- 4 Michael L. Shuler, Fikret Kargi. (2002). Bioprocess Engineering: Basic Concepts. (2 Edn.) New York, USA: Pearson.



Course Code	Course Name	Category	L	T	P	Credit
193BT2A2CD	<b>CORE : BIODIVERSITY &amp; BIOPROSPECTING</b>	CORE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- To learn the importance of biodiversity and various methods of conservation
- To identify the Bioprospecting potentials of available natural resources
- To know the regulations related with biodiversity and bioprospecting

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	To understand the types of biodiversity, the threats to the biodiversity and Biodiversity hotspots	K3,K4
CO2	To know the management strategies for biodiversity and biodiversity mapping	K3,K4
CO3	To understand the sustainable utilization of resources and benefit sharing	K3,K4,K5
CO4	To understand the screening process of various bioactive substances	K3
CO5	To know the various regulatory bodies of bioprospecting	K4,K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	S	M	M	M
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

**S Strong**

**M Medium**

**L Low**



193BT2A2CD	CORE : BIODIVERSITY & BIOPROSPECTING	SEMESTER II
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**Total Credits: 4**

**Total Instruction Hours: 48 h**

### Syllabus

#### **Unit I** Biodiversity- Overview and Acts 10 h

Biodiversity- Facts about global & Indian biodiversity- Hot spots of Indian Biodiversity- Types of Biodiversity- Measures of Biodiversity(alpha, beta & gamma)-Threats to Biodiversity, Endemic, threatened, Red List of IUCN- National biodiversity strategy and action plan(Initiatives to conservation (international & national)- Organization involved in Biodiversity conservation and research(NBA,BSI,ZSI etc)- The biological diversity act 2002.

#### **Unit II** Biodiversity Management 8 h

BMC-Biodiversity Management Committee ( Roles & Responsibility,Functions) – Operationalisation of BMC- People's Biodiversity Registers- SBB- State Biodiversity Boards roles and responsibilities- Biodiversity informatics(Global & Indian perspectives)-Biodiversity mapping ( History, techniques & uses)

#### **Unit III** Bioprospecting Overview & Products 10 h

Bioprospecting-Methods- Major areas- sustainable utilization of bio resource practices-types- Challenges- Access and Benefit sharing policies – INBio&Merck agreement- Kani tribes benefit sharing model-Economically valuable Products from plant, animals and other bioresources- Bio piracy issues

#### **Unit IV** Methods of screening for bioprospecting 10 h

Screening for different bioactivity- Antimicrobial activity- Enzymes- Plant growth promoting Activity- Antifouling & biofilm activity- anti cancer activity- Anti diabetic activity. High throughput screening- Drug discovery and development.

#### **Unit V** Bioprospecting Regulations 10 h

Regulations on bio-prospecting, access and benefit-sharing (National Environmental Management: Biodiversity act, 2004)- Bioprospecting case studies – Regulatory innovations for bioprospecting in India- Regulation of Bio-Prospecting and Related Intellectual Property Rights in India



## Text Books

- 1 Alan, T.Bull (2004). Microbial Diversity and Bioprospecting. (1st Edn.) Washington, DC: ASM Press.
- 2 Michael, J. Jeffries. (2006). Biodiversity and Conservation. (2ndEdn.) Newyork: Routledge.

## References

- 1 Michael, I.Jeffry, Jeremy Firestone & Karen Bubna-Litic. (2008). Biodiverisy consevation, Law andlivelihoods:Bridging the north- south divide. (1st Edn.) New York: Cambridge University Press.
- 2 Vanesha, Sunkel. (2010). Marine Bioprospecting and Natural Product Research. (1st Edn.) Germany: LAP Lambert Academic Publishing.
- 3 [www.icimod.org](http://www.icimod.org),
- 4 [www.nbaindia.org](http://www.nbaindia.org),



193BT2A2CP	CORE PRACTICAL III: IMMUNOTECHNOLOGY AND BIOPROCESS TECHNOLOGY	SEMESTER II
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**Total Credits:** 2  
**Total Instructions Hours:** 50 h

S.No	Contents
1	Purification of IgG antibodies using affinity chromatography.
2	Ouchterlony Double diffusion
3	Rocket Immuno-electrophoresis
4	Single Radial Immuno diffusion
5	Latex agglutination test.
6	Blood grouping
7	Immobilization of yeast cells
8	Production & estimation of biomass (SCP)
9	Wine production and estimation of alcohol content.
10	Demonstration of acetic acid oxidation (vinegar production.

Note 8 is Mandatory out of 10

### References

1. Frank C. Hay, Olwyn M. R. Westwood. 2002. Practical Immunology. 4th edition. Blackwell Publication.
2. James G. Cappucino and Natalie Sherman. 2014. A Laboratory Manual on Microbiology. 1st edition. Pearson Publication.
3. Dubey R.C. and Maheswari, D.K. 2002. Practical Microbiology. 2nd edition. Chand Publications.





193BT2A2CQ	CORE PRACTICAL IV: GENETIC ENGINEERING AND BIODIVERSITY & BIOPROSPECTING	SEMESTER II
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**Total Credits:** 3

**Total Instructions Hours:** 50 h

S.No	Contents
1	Separation of pigments by column chromatography.
2	Grouping of pollen grains based on diversity.
3	Determination of leave biodiversity based on types.
4	Application of bioinformatics tools used in bioprocess technology.
5	Estimation and comparison of phytochemicals in healthy and diseased plants.
6	Characterization of oilseeds (Biochemical - acid test, iodine number, saponification), (Morphological features)
7	Production of agar from seaweeds
8	Preparation of medicine using aromatic herbal plants (traditional knowledge)
9	Restriction Digestion
10	Ligation of restricted DNA
11	Sketch Pedigree chart and genetic counseling.
12	Isolation of RNA

Note 10 is Mandatory practical out of 12

### References

1. Joseph Sambrook, Michael R. Green. 2012. Molecular Cloning: A Laboratory Manual. 4th edition. Cold Spring Harbor.
2. Thomas R. Mertens and Robert L. Hammersmith. 1997. Genetics Laboratory Investigations. 11th edition. Benjamin Cummings.
3. Sadasivam, S. and Manickam, A. 1996. Biochemical Methods, New Age International. drngpasc@12345

Dr.NGPASC



COIMBATORE | INDIA

*M.Sc. Biotechnology (Students admitted during the AY 2019-20)*

Course Code	Course Name	Category	L	T	P	Credit
193BT2A2DA	ELECTIVE II : FORENSIC BIOTECHNOLOGY	CORE	3	1	-	3

### PREAMBLE

This course has been designed for students to learn and understand

- Keep abreast with all recent developments and emerging trends in Forensic Medicine, Medical Ethics and the Law.
- Interpret histo-pathological, microbiological, DNA profile and other investigative reports for medico-legal purposes.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Impart the concepts of Forensic Serology and examine Forensic samples	K3, K4
CO2	Know the basics of serogenetic markers and its significance in Forensic Science	K3, K4
CO3	Interpret and examine forensic evidence of DNA typing	K3, K4
CO4	Discuss the different methods if DNA profiling	K4, K5
CO5	Distinguish and inspect the data generated from DNA fingerprints and to store the data.	K4, K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	S	S	M	M
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	M	S	S	S	M

**S Strong**

**M Medium**

**L Low**



193BT2A2DA	ELECTIVE II : FORENSIC BIOTECHNOLOGY	SEMESTER II
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**Total Credits: 3**

**Total Instruction Hours: 48 h**

### Syllabus

#### **Unit I** Forensic Serology 8 h

Nature of Blood, Blood Stain Pattern – Interpretation and Significance, Age of Blood Stains, Collection and Preservation of Blood, Semen, Saliva, Urine, Faeces and Milk Samples, Identification of Biological Stains by Chemical, Biochemical, Crystal-Chromatographic and Spectroscopic Methods.

#### **Unit II** Serogenetic Markers 10 h

Introduction of Blood Groups – Biochemistry and Genetics of ABO, MN and Rh systems, Serum proteins: Hp -Transferrin, LDH, Cellular Proteins: PGM, ADA, G6PD, Haemoglobin Variants: Hbf, Hbs, Hbc, HbA, Determination of Sex and Race from Blood, White Blood Group System – HLA and its Forensic Significance.

#### **Unit III** DNA isolation from specimen 10 h

Collection and Preservation of physical evidence for DNA typing, Forensic DNA Analysis- Isolation of DNA, Determination of quality and quantity of DNA, Slab Gel & Capillary Electrophoresis, DNA detection, Fluorescent dyes and silver staining.

#### **Unit IV** DNA Typing 11 h

RFLP analysis, PCR amplification - Sequence polymorphism (HLA DQA1, Polymarker Amplitype PM6, Mitochondrial DNA), Length polymorphism (STRs, Gender identification, D1S80), Instrumentation for STR typing, STR Genotyping, Automated analysis system, DNA Barcoding, Applications of DNA profiling, Legal standards for admissibility of DNA profiling.

#### **Unit V** Interpretation of DNA Typing Results 9 h

Determination of genetic concordance, Evaluation of results- Bayes theorem, Hardy Weinberg law, Frequency estimate calculations- Population sub structure- Likelihood ratios.



## Text Books

- 1 Richard Saferstein, E (2020). Forensic Science Handbook. (2nd Edn.) Delhi: Prentice Hall.
- 2 Allan Jamieson and Scott BaderAuthor, (2016). A Guide to Forensic DNA Profiling. (10Edn.) UK: John Wiley & Sons.

## References

- 1 John Butler, M. (2005). Forensic DNA Typing - Biology, Technology, and Genetics of STR Markers. (2nd Edn.) United States: Academic Press.
- 2 John Butler, M (2009). . Fundamentals of Forensic DNA Typing. (1st Edn.) United States: Academic Press.
- 3 Stuart James, H and William EckertAuthor, G., (1993). Interpretation of blood stain evidence at Crime scenes. (2nd Edn.) US: CRC Press.
- 4 William Tilstone, J, Kathleen Savage, A and Leigh Clark, A. (2006). Forensic Science: An Encyclopedia of History, Methods and Techniques. (1st Edn.) California: ABC - CLINO Inc. .



Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
193BT2A3CA	Core	Plant & Animal Biotechnology	4	-	-	3	25	75	100	4
193BT2A3CB	Core	Environmental Biotechnology	4	-	-	3	25	75	100	4
193BT2A3CC	Core	Genomics & Proteomics	4	-	-	3	25	75	100	4
193BT2A3CD	Core	Research Methodology & IPR	4	-	-	3	25	75	100	4
193BT2A3CP	Core Practical - V	Plant & Animal Biotechnology & Genomics & Proteomics	-	-	5	6	40	60	100	3
193BT2A3CQ	Core Practical - VI	Environmental Biotechnology, Research Methodology & IPR	-	-	5	6	40	60	100	3
193BT2A3CT	Internship*	Grade A to C								
193BT2A3DA	DSC -III	Molecular Therapeutics	3	1		3	25	75	100	3
193MB2A3DA		Molecular Diagnostics in Microbiology								
193BC2A3DA		Systems Biology								
Total			19	1	10				700	25

\* Student shall undergo Training for period of not less than 15 days during third Semester and report has to be submitted for Viva-voce examination (External Evaluation).

### EXTRA CREDIT COURSES

The following are the courses offered under self study to earn extra credits:

S. No.	Course Code	Course Name
1	93BT2ASSA	Food Biotechnology
2	193BT2ASSB	Developmental Biology



Course Code	Course Name	Category	L	T	P	Credit
193BT2A3CA	PLANT AND ANIMAL BIOTECHNOLOGY	CORE	4	-	-	4

## PREAMBLE

This course has been designed for students to learn and understand

- Various in vitro culture techniques
- Preservation techniques of plant and animal cells
- Gene transferring mechanisms

## COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Explain plant culture media types and the role of different media constituents	K3
CO2	Infer knowledge on Agrobacterium biology and transgenic technology	K3
CO3	Compile various types of resistance and green house technology concepts	K4,K5
CO4	Summarize animal cell culture media types and its functions	K3, K4
CO5	Design tissue and organ culture and the applications of the culture products and cryopreservation	K3,K4,K5

## MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	M
CO5	S	S	M	M	S

**S Strong**

**M Medium**

**L Low**



193BT2A3CA	PLANT AND ANIMAL BIOTECHNOLOGY	SEMESTER III
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**Total Credits: 4**

**Total Instruction Hours: 48 h**

### Syllabus

#### **Unit I** Plant Tissue Culture 9 h

Media, plant growth regulators: Callus and suspension culture, somoclonal variation, somatic embryogenesis: Embryo culture, micropropagation protoplast isolation and somatic hybridization; Haploid plants, Artificial seeds and hardening. Germplasm preservation- cryopreservation.

#### **Unit II** Plasmids, Vectors and Nuclear Transformation 10 h

Features of Ti and Ri plasmids, uses of Ti and Ri as vectors, binary vectors, use of 35S and other promoters, viral vectors, reporter genes, Transgenic biology - methods of nuclear transformation - physical, chemical and biological gene transfer methods. Hairy root induction.

#### **Unit III** Plant Resistance 10 h

Engineering of plants for herbicide resistance, insect resistance, disease resistance, antifungal proteins, nematode resistance, abiotic stress. Long shelf life of fruits and flowers. Green house and green - home technology.

#### **Unit IV** Animal cell culture media and its constituents 10 h

Culture media; Balanced salt solutions and simple growth medium, Physical, chemical and metabolic functions of different constituents of culture medium; Role of carbon dioxide, serum, growth factors, glutamine in cell culture; Serum and protein free defined media and their applications. Risks in a tissue culture laboratory and safety - biohazards. Facilities for animal cell culture- infrastructure, equipment, culture vessels.

#### **Unit V** Cell, Tissue and Organ culture techniques 9 h

Primary cell culture techniques - mechanical disaggregation, enzymatic disaggregation, separation of viable and non-viable cells. Mass culture of cells - manipulation of cell line selection - types of cell lines -maintenance of cell lines - immobilization of cells and its application - synchronization of cell cultures. cryopreservation - germplasm conservation. Medical/pharmaceutical products of animal cell culture.



## Text Books

- 1 Singh, B. D. 2006. Plant Biotechnology. 1st edition. Kalyani Publishers. India .
- 2 Chawla, H. S. 2013. Introduction to Plant Biotechnology. 3rd edition. Oxford & IBH publishing company. India

## References

- 1 Ranga, M. M. 2000. Animal Biotechnology. 3rd edition. Agrobios, India
- 2 Darling, D.C. and Morgan, S.J. 1994. Animal Cells Culture and Media. BIOS , Scientific Publishers Limited. India
- 3 Freshney, R. I. 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 6th edition. Wiley Blackwell . USA
- 4 Mathur, J.P. and Barnes, D. 1998. Methods in Cell Biology. 7th edition, Animal Cell Culture Methods Academic Press. USA





Course Code	Course Name	Category	L	T	P	Credit
193BT2A3CB	ENVIRONMENTAL BIOTECHNOLOGY	CORE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- Basic vocabulary of environmental biology
- Hazards of industrial pollutants on environment
- Effect of pollution on biodiversity

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Review on the organization of ecosystem and its functions	K3
CO2	Appraise the global environment problems and the hazards of pollution	K3,K4
CO3	Support the understanding of waste water treatment and Vermicomposting	K3,K4,K5
CO4	Compile Xenobiotics and bioremediation methods	K4,K5
CO5	Grade the awareness on environmental monitoring and environmental laws	K4, K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	M	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	M	M
CO5	S	S	M	S	S

**S Strong**

**M Medium**

**L Low**



<b>193BT2A3CB</b>	<b>ENVIRONMENTAL BIOTECHNOLOGY</b>	<b>SEMESTER III</b>
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**Total Credits: 4**

**Total Instruction Hours: 48 h**

### **Syllabus**

**Unit I** Ecosystem structure and functions 9 h

Abiotic and biotic components, Energy flow, food chain, food web and trophic levels, Ecological pyramids, N,P,C and S cycles in nature. Threats to environment (Pollutions, waste materials and Xenobiotics). Bioaccumulation and Biomagnification

**Unit II** Hazards of Pollution 10 h

Types of pollution (Water, Land, Air, Noise and Nuclear), Methods for the measurement of pollution, Global environmental problems: ozone depletion, green house effect and acid rain.

**Unit III** Waste water Treatment 10 h

Physical, Chemical, Biological treatment system and Solid waste pollution and its management: composting systems, vermicomposting. Biomedical waste management: Current status of biomedical waste management.

**Unit IV** Xenobiotics and Bioremediation 10 h

Xenobiotics in Environment - Biodegradation of Hydrocarbons, Pesticides, Lignin, Synthetic dyes. Bioremediation & Phytoremediation: Applications of bioremediation. Bioabsorption and Bioleaching of heavy metals (Mercury and Lead), advantages and disadvantages of bioleaching.

**Unit V** Environmental Monitoring and Impact Assessment 9 h

Biological monitoring program, bioindicators and environmental monitoring, environmental management. Environmental Laws: Problems in making and implementing environmental laws, Indian environmental laws, national environmental policy.



## Text Books

- 1 Prohit, S.S. 2003. Ecology and environment and pollution. 1st edition. Agrobios publications. India.
- 2 Varma. P.S. 1998. Concept of ecology. 1st edition. Chand & Co Ltd. India

## References

- 1 Dash, M.C. 1998. Fundamentals of Ecology. 2nd edition. Tata McGraw Hill, India.
- 2 Scragg, A. 2007. Environmental biotechnology. 2nd edition. Oxford university press, India
- 3 Kumar, R. 2017. Advances in Environmental Biotechnology, 3rd edition. Springer. USA
- 4 Singh, R.L. 2016. Principles and Applications of Environmental Biotechnology for a Sustainable Future. 1st edition. Springer. USA



Course Code	Course Name	Category	L	T	P	Credit
193BT2A3CC	GENOMICS AND PROTEOMICS	CORE	4	-	-	4

## PREAMBLE

This course has been designed for students to learn and understand

- The scope of Bioinformatics
- Focus on Protein and Genome analysis using Bioinformatics tools
- Importance of gene sequencing

## COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Summarize about Bioinformatics and Databases	K3, K4
CO2	Design Data interpretation using Alignment Algorithms	K3,K4
CO3	Evaluate Genome Analysis and Principles of Docking	K3, K4,K5
CO4	Formulate Proteome analysis, tools & databases available	K4,K5
CO5	Compos concept of proteomics & with their applications	K3,K4,K5

## MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	M	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	M	M	S

**S Strong**

**M Medium**

**L Low**



193BT2A3CC	GENOMICS AND PROTEOMICS	SEMESTER III
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**Total Credits:** 4

**Total Instruction Hours:** 48 h

### Syllabus

#### **Unit I** Bioinformatics and Databases 9 h

Bioinformatics - Introduction and History. Biological Databases. Primary and secondary databases with examples. Specialized biological Databases. Genome sequencing with regulatory elements- BIOSEQ. Protein sequencing, Nucleic acid sequence databases: Gene bank, Protein sequence databases - Swiss-Prot, PDB, PIR. Rasmol - Molecular modeling. Software used for Molecular Modelling. Applications of Bioinformatics.

#### **Unit II** Functional and Comparative Genomics 10 h

Classification of genomics. Sequencing of genomes and sequencing methods (next-generation sequencing). General/main databases of genomes. Structure, organization and composition of prokaryotic genomes. Microbial genomics. Gene expression analysis by cDNA micro arrays. Comparative genomics - Purpose and Methods. Applications of comparative genomes in Medicine. Agriculture and Research.

#### **Unit III** Genome Analysis and Docking 10 h

Microbes, plants and animals - Accessing and retrieving genome project information from web - Identification and classification using molecular markers- 16S rRNA typing/sequencing, Fragment Assembly- ESTs and genomic fragments, Mapping, Gene predictions. Codon optimization tools and its advantages - Gene Expression Profiling - GENSCAN. Molecular docking principles.

#### **Unit IV** Principles of Protein classification 10 h

Protein classification - Based on Structural features, Phylogenetic relationship, CATH - Classification by Class, Architecture, Topology, Homology, SCOP - Structural Classification Of Protein, FSSP - Fold classification based on structure - structure alignment, Molecular Modeling Database - High Throughput Screening - principle - working.

#### **Unit V** Tools in Proteomics 9 h

Protein analysis (includes measurement of concentration, amino-acid composition, N-terminal sequencing); Proteomics classification. 2D gel electrophoresis - sample preparation - Immobilized pH gradient - analysis - Detection and quantitation - various staining methods - gel matching techniques. Basics of mass spectrometry.

ACQUITY TOF and ESI. - Computer Aided Drug Designing.



Dr. NGPASC

COIMBATORE, INDIA

M.Sc. Biotechnology (Students admitted during the AY 2019-20)

## Text Books

- 1 Campbell, A.M. and L. J. Heyer. 2007. Discovering Genomics, Proteomics and Bioinformatics. 2nd edition. Pearson Education. UK.
- 2 Rao, S. D. 2010. Bioinformactis. 2nd edition. Biotech Pharma Publications. India.

## References

- 1 Pevsner, J. 2015. Bioinformatics and Functional Genomics. 3rd edition. Wiley Blackwell Publications, USA
- 2 Lesk, A.M. 2014. Introduction to Bioinformatics. 4th edition. Oxford Publications. UK.
- 3 Baxevanis, A.D. and Ouellette, B.F.F. 2004. Practical Guide to Analysis of Genes and Proteins. 3rd edition. Wiley Jone and Sons. USA
- 4 Tramontano A. 2005. The Ten Most Wanted Solutions in Protein Bioinformatics. 1st edition. CRC Press, USA



Course Code	Course Name	Category	L	T	P	Credit
193BT2A3CD	RESEARCH METHODOLOGY & IPR	CORE	4	-	-	4

## PREAMBLE

This course has been designed for students to learn and understand

- The importance of research and validate data.
- The value of research in the course
- Patenting and licensing expertise

## COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Comprehend and interpret the concepts of research	K3
CO2	Inculcate the importance of scientific validation	K3, K4
CO3	Strategies of reporting the research findings	K3, K4, K5
CO4	Summarize deliverables of Intellectual Property Rights	K4, K5
CO5	Justify filing and licensing of Patents	K3, K4, K5

## MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	M	M	S

**S Strong**

**M Medium**

**L Low**



193BT2A3CD	RESEARCH METHODOLOGY & IPR	SEMESTER III
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**Total Credits: 4**

**Total Instruction Hours: 48 h**

### Syllabus

**Unit I** Research Concepts and Data Collection 09 h

Definition of Research, Qualities of Researcher, Components of Research Problem, Various Steps in Scientific Research, Types of Research; - Research Design. Sampling - Types of sampling - design - procedure - Data : Meaning - Source

**Unit II** Scientific Communication 10 h

Scientific writing skills - Importance; Plagiarism; Scientific publication writing: Elements of a scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts; Publishing scientific papers - the peer review process and problems

**Unit III** Research Reports 10 h

Structure and Components of Research Report, Types of Reports, Styles of reporting, Steps in drafting reports, editing and evaluation of final draft, evaluating the final draft. Pictures and Graphs; Research proposal/ Grant- definition, structure, budget allocation, specific aims, background and significance. Hierarchy of funding agencies in India and their operations.

**Unit IV** Intellectual Property Rights 10 h

Types of IP; Importance of IPR; Patents, Trademarks, Copyright and Related rights, Industrial Design; Traditional knowledge; Geographical indications; Patent life, Legal protection of biotechnological inventions; World Intellectual Property Rights Organization (WIPO); Protection of GMOs; Relevance of IP in Biotechnology.

**Unit V** Patents 09 h

History of Indian Patent System and Law; Patent file procedures; Types of Patent; Status of the patent applications; Precautions during patenting; Patentable and Non-Patentable items; Patent cooperation treaty (PCT); Patent and compulsory licensing. Indian Patent Act 1970 and Recent Amendments; GATT and TRIPS agreement; WIPO Treaties.





## Text Books

- 1 Kuma, R. 2019. Research Methodology: A Step-by-Step Guide for Beginners. 5th edition. SAGE. USA
- 2 Kothari, C.R. 2010. Research Methodology: Methods and Techniques. 2nd edition. New Age International. India

## References

- 1 Gurumani N. 2006. Research Methodology for Biological Science. 1st edition. MJP Publishers, Chennai
- 2 Debbie Holmes, Peter Moody, Diana Dine, Laurence Trueman. 2017. Research Methods for the Biosciences. 3rd edition. Oxford University Press. UK
- 3 David J. Glass. 2014. Experimental Design for Biologists. 2nd edition. Cold Spring Harbor Laboratory Press. USA
- 4 Sam Daniel, P. and Sam, A.G. 2011. Research Methodology. 1st edition. Gyan Publishing House. India



193BT2A3CP	<b>CORE PRACTICAL : PLANT &amp; ANIMAL BIOTECHNOLOGY AND GENOMICS &amp; PROTEOMICS</b>	<b>SEMESTER III</b>
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**Total Credits:** 3  
**Total Instructions Hours:** 60 h

**S.No****LIST OF EXPERIMENTS**

- 1 In vitro Seed Germination
- 2 Micropropagation
- 3 Meristem culture
- 4 Callus induction
- 5 Artificial Seed production
- 6 Suspension cultures
- 7 Embryo culture
- 8 Protoplast Isolation
- 9 Preparation of primary cell culture & trypsinizing
- 10 Determining cell number and viability with a haemocytometer and trypan blue staining
- 11 Sequence analysis using BLAST and Clustal W
- 12 Construction of phylogenetic tree using Bioinformatic tool

**Note:** Out of 12 given experiments any 10 will be carried out

**References**

- 1 Bhojwani, S.S. and Razdan, M. K. 1996. Plant tissue culture: theory and practice. 1st edition. Elsevier science
- 2 Freshney, R. I. 2010. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 6th edition. Wiley Blackwell, USA



193BT2A3CQ	<b>CORE PRACTICAL : ENVIRONMENTAL BIOTECHNOLOGY, RESEARCH METHODOLOGY &amp; IPR</b>	<b>SEMESTER III</b>
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**Total Credits:** 3  
**Total Instructions Hours:** 60 h

**S.No****LIST OF EXPERIMENTS**

- 1 Water Quality analysis-Colour, b) pH c) Acidity
- 2 Total hardness by EDTA titrimetric method
- 3 Estimation of Total alkalinity, carbonate and bicarbonate
- 4 Determination of Chemical oxygen demand
- 5 Estimation of Chloride
- 6 Estimation of nitrate
- 7 Estimation of phosphate
- 8 Estimation of sulphate
- 9 MPN Test (Most Probable Number)
- 10 Simple Regression and Correlation
- 11 To represent data diagrammatically using bars, rectangles, circles and pie diagrams
- 12 Concept of Test of Hypothesis. Applications of t-test statistics to biological problems/data: Chi-square, statistic applications in Biology

**Note:** Any 10 out of the above 12 experiments will be carried out



## References

- 1 Rajan, S and Christey, R.S. 2011. Experimental Procedures in Life Sciences. 2nd edition. Anjanaa Book house. Chennai
- 2 Saadaun, I., 2018. Environmental Biotechnology Manual. 1st edition. University of Jordan Press. Jordan.
- 3 Darayajiya, D. 2018. Environmental Microbiology & Biotechnology. 1st edition, Agricultural University Press. Sardarkrushinagar. Gujarat.
- 4 Sadasivam, S and Manickam, A. 1996. Biochemical Methods. 2nd edition. Newge Publications. India.



Course Code	Course Name	Category	L	T	P	Credit
193BT2A3DA	MOLECULAR THERAPEUTICS	DSC	3	1	-	3

### PREAMBLE

This course has been designed for students to learn and understand

- The types of PCR and its applications in diagnosis
- The importance about the human genome project
- The interaction of molecules based on given therapy

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Sketch the process of drug targeting and gene therapy	K3
CO2	Estimate the current techniques of gene delivery and other therapeutic products	K3,K4
CO3	Summarize recombinant gene therapy	K3,K4,K5
CO4	Integrate pathogenic diseases and metabolic disorders	K4, K5
CO5	Design concept of immunotherapy and its applications	K3,K4,K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	M	S	S
CO5	S	S	M	M	S

**S Strong**

**M Medium**

**L Low**



193BT2A3DA	MOLECULAR THERAPEUTICS	SEMESTER III
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**Total Credits:** 3

**Total Instruction Hours:** 48 h

### Syllabus

#### **Unit I** Concepts of Gene Therapy and Drug Delivery 09 h

Gene Therapy, Drug targeting and drug delivery system. Intracellular barriers to gene delivery, overview of inherited and acquired diseases for gene therapy, virus mediated gene transfer. Liposome and Nanoparticles mediated gene delivery

#### **Unit II** Stem cells and Tissue Engineering 10 h

Cellular therapy; Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells; Concept of tissue engineering; Role of scaffolds; Role of growth factors; Role of adult and embryonic stem cells; Clinical applications; Ethical issues.

#### **Unit III** Recombinant Gene therapy 10 h

Recombinant therapy, Clinical application of recombinant technology, Erythropoietin, insulin analogs and its role in diabetes, Recombinant human growth hormone, streptokinase and urokinase in thrombosis. Recombinant coagulation factors

#### **Unit IV** Microbial Pathogenicity 10 h

Factors predisposing to microbial pathogenicity, types of infectious diseases. General concept of infectious disease, Progression of Infection and Disease - Entrance (Portal of entry), Colonization (Adherence; Adhesion; Attachment), Prevention of Host Defenses, Antigenic Variation, Penetration into Host Cytoskeleton, Damage to Host Cells, Production of Toxins

#### **Unit V** Immunotherapy 09 h

Phage and their application, Immunotherapy, Monoclonal antibodies and their role in cancer, role of recombinant interferons, Immunostimulant and Immunosuppressors in organ transplants, role of cytokine therapy in cancer. Vaccines: types, recombinant vaccines and clinical applications



## Text Books

- 1 Palsson, B. and Bhatia, S. N. 2004. Tissue Engineering. 2nd Edition. Prentice Hall. USA
- 2 Greenwell, P. and McCulley, M. 2008. Molecular Therapeutics: 21st century medicine. 1st Edition. Wiley-Blackwell. USA

## References

- 1 Coleman, W.B. and Tsongalis, G.J. 2006. Molecular Diagnostics for the Clinical Laboratory. 2nd Edition. Humana Press. USA
- 2 Leonard, DGB. 2016. Molecular Pathology in Clinical Practice. 2nd Edition. Springer International Publishers. USA
- 3 Whitehouse, D. and Rapley, R. 2012. Molecular and Cellular Therapeutics. 1st edition. Wiley – Blackwell Publications. USA
- 4 Quesenberry, P.J. , Stein, G.S. et al. 1998. Stem Cell Biology and Gene Therapy. 1st edition. John Wiley and Sons Publications. USA



Course Code	Course Name	Category	L	T	P	Credit
193MB2A3DA	MOLECULAR DIAGNOSTICS IN MICROBIOLOGY	DSE	3	1	-	3

## PREAMBLE

This course has been designed for students to learn and understand

- Microbes and its involvement in causing life threatening diseases
- The identification of microbes through traditional methods
- The identification and characterization of microbes using different molecular techniques

## COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Recall the concept of molecular diagnostics of microorganism.	K2, K3
CO2	Demonstrate the traditional methods of identification of bacteria, fungi, virus, protozoans, and parasites	K3
CO3	Identify microbes based on nucleic acid sequencing and PCR based identification methods	K2, K3
CO4	Illustrate the microbial identification based on proteins and different blotting techniques.	K4
CO5	Develop the hybridization techniques to identify and confirm the type of microbe	K5

## MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	S	S	S	M
CO3	S	S	S	S	M
CO4	S	S	S	S	M
CO5	S	S	S	S	M

**S Strong**

**M Medium**

**L Low**



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193MB2A3DA	MOLECULAR DIAGNOSTICS IN MICROBIOLOGY	SEMESTER III
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**Total Credits: 3**

**Total Instruction Hours: 48 h**

### Syllabus

#### **Unit I** Introduction 10 h

History and Transcending of diagnostics over time - Traditional and molecular diagnostics - Significance of molecular diagnostics - Scope for Molecular diagnostics - Rise of diagnostic industry in Indian and global scenario. Diseases - Infection - mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases - bacterial, viral, fungal, protozoans and other parasites. Host-Parasite Interactions.

#### **Unit II** Traditional disease diagnosis methods and tools 10 h

Diagnosis of infection caused by Bacteria - Streptococcus, Salmonella, and Mycobacterium. Diagnosis of fungal infections - Dermatophytosis, Candidiasis and Aspergillosis. Diagnosis of viruses - Adenoviruses, Rhabdo Viruses, and Retroviruses. Diagnosis of Protozoans: Malaria, Trypanosomiasis, Leishmaniasis. Study of helminthic diseases - Fasciola hepatica and Ascaris lumbricoides.

#### **Unit III** Molecular Diagnosis using Immunoglobins 10 h

Introduction - antigen-antibody binding interactions and assays - monoclonal, and polyclonal antibodies. Agglutination - RIA, ELISA's, chemiluminescence, immunofluorescence, Western blots - Bioluminescence. Proteins and Amino acids, Qualitative and quantitative techniques: Protein stability, denaturation; amino acid sequence analysis.

#### **Unit IV** Molecular Diagnosis using Nucleotides 9 h

Automated DNA sequencing- Principles, Methods and Instrumentation- Advances in DNA sequencing - New Generation sequencing Methods, Pyrosequencing, BLAST, FASTA, Microarrays, SAGE. Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Ligase Chain Reaction. RACE, RNA fingerprinting.

#### **Unit V** Hybridization and Sequencing 9 h

Southern, Northern, in-situ (including FISH), microarrays - types and applications; Protein extraction and analysis (including PAGE and its variations); Western Blot, Southern, northern, dot/slot blot; electrophoresis, nucleic acid probe preparation



## Text Books

- 1 Thomas J Kindt, Barbara A Goldsby, Richard Osborne 2006, "Kuby's Immunology", W. H. Freeman Publishers, New York.
- 2 William B Coleman, Gregory J Tsongalis, 2005, "Molecular Diagnostics: For the Clinical Laboratorian", 2nd Edition, Hanuma Publishers, New Delhi.

## References

- 1 Upadhya and Nath, 2016, "Biophysical Chemistry: Principles and Techniques", 4th Edition, Himalaya Publishing House Pvt. Ltd. New Delhi.
- 2 Keith Willson and Kenneth H. Goulding. 1991, "A Biologist's Guide to Principles and Techniques of Practical Biochemistry", 3rd Edition, Cambridge University Press, USA.
- 3 Keith Willson and John Walker, 2010, " Principles and Techniques of Biochemistry and Molecular Biology", 7th Edition, Cambridge University Press, US.
- 4 Lele Buckingham and Maribeth L. Flaws, 2019, "Molecular Diagnostics: Fundamentals, Methods & Clinical applications", 3rd Edition, F. A. Davis Company, Philadelphia.



Course Code	Course Name	Category	L	T	P	Credit
193BC2A3DA	SYSTEMS BIOLOGY	DSE	3	1	-	3

## PREAMBLE

This course has been designed for students to learn and understand

- The structure, dynamics and basic design principles of biological systems
- The transformation of biology from a descriptive to a predictive science
- The systems biology of evolution

## COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Distinguish designed and evolved systems	K2 & K3
CO2	Elucidate structures of any networks in the biological systems	K2 & K3
CO3	Elucidate mechanisms of dynamics of any networks in the biological systems	K3 & K4
CO4	Relate systems dynamics with organism evolution	K4 & K5
CO5	Design and create synthetic biological networks for various applications	K5 & K6

## MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	M	M	M
CO3	S	S	S	M	M
CO4	S	S	S	S	S
CO5	S	S	S	S	S

**S Strong**

**M Medium**

**L Low**



193BC2A3DA	SYSTEMS BIOLOGY	SEMESTER III
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**Total Credits:** 3

**Total Instruction Hours:** 48 h

### Syllabus

#### **Unit I** Introduction to Systems Biology 10 h

System biology concept: designed and evolved systems. Biological Networks: elements (Nodes-Gene, Edges-Protein, Receptor, Ligand, Morphogens, Field, Metabolites, Neurotransmitters), interaction, motifs, circuits, modularity, switch, dynamics, regulation, superimposed networks. Examples for biological networks: transcriptional, developmental, signal transduction, metabolic and neuronal networks. Emergent property. Random networks, Scale-free networks, small-world networks. Degree distribution, Clustering coefficient. Self-organizing (SOM) and connectivity maps, and its uses.

#### **Unit II** Systems Structure-I 9 h

Transcription Networks: Recurring Network Motifs-Regulation-Auto-regulation: positive auto-regulation (PAR) and negative auto-regulation (NAR). Feed Back Loop (FBL)- Positive Feed Back Loop, Negative Feed Back Loop. Feed Forward Loop (FFL), coherent-FFL and incoherent-FFL. Interlocked FFL. Lactose (simple), Arabinose (C-FFL), Flagella (C-FFL), Galactose (I-FFL) systems in E. coli and B.subtilis Sporulation Network.

#### **Unit III** Systems Structure-II 9 h

Transcription Networks: Sensory Transcription Networks-Regulation: Single-Input Module (SIM)-Last-In-First-Out (LIFO) and First-In-First-Out (FIFO). Multi-Output Forward Loop: Bi-Fans and Dense Overlapping Regulons (DOR). Arginine (LIFO), Flagella production (FIFO) and CRP (cAMP Response Protein) (DOR) system in E. coli. Double-Positive Feedback Loop and Double-Negative Feedback Loop. Regulating Feed Back and Regulated Feed Back.

#### **Unit IV** Systems Dynamics and Evolution 10 h

Stochasticity, Robustness (cancer-HIF-1 VEGF, uPAR), Fragility (Diabetes mellitus) and Organisms Diversity. Robustness Trade-offs. Robustness and evolvability-environmental and genetic perturbation. e.g.  $\lambda$ -phage life cycle (genetic switch), Bacterial chemotaxis, Developmental plasticity (patterning in fruit fly development) and tumor resistance against therapies (EGFR).

#### **Unit V** Mechanism of Systems Dynamics 10 h

Principle of Robustness: System control-Negative feedback loop-stable system dynamics (Bacterial chemotaxis). Positive feedback loop-bistability ( $\lambda$ -phage life cycle). Redundancy, Modular design (liver-glucose and lung-oxygen physiology) and Decoupling (protein folding-Hsp90). Self-extending symbiosis: horizontal gene transfer, serial endosymbiosis and oocyte-mediated vertical transfer of symbionts.



## Text Books

- 1 Uri Alon, 2020, "An Introduction to Systems Biology: Design Principles of Biological Circuits" 2nd Edition, Chapman & Hall/CRC, Taylor and Francis group, New York, USA
- 2 Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, and Ralf Herwig, 2009, "Systems Biology A Text Book", 1st Edition, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.

## References

- 1 Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley and David A. Stahl, 2015, "Brock Biology of Microorganisms", 4th Edition, Pearson Education Inc, Illinois, USA.
- 2 John E. Hall, 2016, "Guyton and Hall Textbook of Medical Physiology", 13th Edition, ELSEVIER Inc, Philadelphia, USA
- 3 Scott F. Gilbert, 2010, "Developmental Biology", 9th Edition, Sinauer Associates, Inc, Massachusetts USA
- 4 Robert A. Weinberg, 2014, "The Biology of Cancer", 2nd Edition, Garland Science, Taylor & Francis Group, New York, USA



193BT2ASSA	SELF STUDY - FOOD BIOTECHNOLOGY	SEMESTER III
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**Total Credit: 1**

## Syllabus

### Unit I Food Biotechnology

Introduction and Scope; Production of Single cell protein and Baker's yeast; Mushroom cultivation. Food and dairy products: Cheese, bread and yogurt. Fermented vegetables – Saurkraut; Fermented Meat – Sausages.

### Unit II Novel Microorganisms

LAB (Probiotics), Cyanobacteria, methylotrophs enzyme biotransformations. Role of Plant tissue culture for improvement of food additives; color and flavor. Genetic modifications of microorganisms; detection and rapid diagnosis. Genetically modified foods and crop

### Unit III Food Borne Infections And Intoxications

Food borne infections and intoxications; with examples of infective and toxic types – Clostridium, Salmonella, Staphylococcus. Mycotoxins in food with reference to Aspergillus species. Food preservation: canning, dehydration, ultrafiltration, sterilization, irradiation. Chemical and naturally occurring antimicrobials; Biosensors in food industry

### Unit IV Types of beverages and their importance

Synthetic beverages- carbonated, low-calorie and dry beverages; isotonic and sports drinks; soft drinks.

### Unit V Quality assurance

Microbiological quality standards of food, Intellectual property rights and animal welfare. Government regulatory practices and policies. FDA, EPA, HACCP, ISI. Risk analysis; consumer and industry perceptions



## Text Books

- 1 Lee B.H.V., 1996, Fundamentals of Food Biotechnology, 1st Edition, C H Publishers, Inida
- 2 Roger, A., 1989, Food Biotechnology, 1st edition, Elsevier Applied Sci. Pub., USA

## References

- 1 Goldberg I., 1994, Functional Food, . 1st edition. Chapman & Hall Publishers, India
- 2 Anthony P. et al, 2005. Food Biotechnology. 2nd edition. CRC Publication, USA.
- 3 Casida, L.E. 1997. Industrial Microbiology. 6th edition. New Age International Publishers, India
- 4 Presscott, L. M. Harley, J. P. and Klein, D. A. 1999. Microbiology, 4th edition, WCB Mc Graw-Hill, India



<b>193BT2ASSB</b>	<b>SELF STUDY - DEVELOPMENTAL BIOLOGY</b>	<b>SEMESTER III</b>
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**Total Credit: 1**

## **Syllabus**

### **Unit I Concepts of Development**

Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

### **Unit II Gametogenesis**

Fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

### **Unit III Morphogenesis and Organogenesis in Animals**

Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis - vulva formation in Caenorhabditis elegans; eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development - larval formation, metamorphosis; environmental regulation of normal development; sex determination. Programmed cell death and aging

### **Unit IV Morphogenesis and Organogenesis in Plants**

Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems, floral development and senescence in Arabidopsis and Antirrhinum

### **Unit V Techniques for the Study of Development**

Techniques for the study of development: Microscopy - Study of gene expression by biochemical methods - Study of gene expression by in situ methods - Microinjection - Cell-labeling methods - Cell sorting





## Text Books

- 1 Jonathan, MW, 2006, Essential developmental biology, Wiley-Blackwell, USA
- 2 Schatten GP, 2006, Current topics in developmental biology, Academic press, USA

## References

- 1 Wallace A., 2000, The origin of animal body plans: a study in evolutionary developmental biology, Cambridge university press, UK
- 2 Werner A. Muller. 1997. Developmental biology. Springer
- 3 Lodish, H. & Baltimore D, 1994, Molecular Cell Biology, 2nd edition, American Scientific Books, USA
- 4 Alberts, B., 1998, Essential Cell Biology, 1st edition. Garland Publishers, USA



Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
193BT2A4CA	Core XIII	Pharmaceutical Biotechnology	4	-	-	3	25	75	100	4
193BT2A4CP	Core Practical	Pharmaceutical Biotechnology	-	-	6	6	40	60	100	3
193BT2A4CV	Core XV Project	Project and Viva Voce	-	-	16	-	80	120	200	8
193BT2A4DA	DSE-IV	Stem Cell Technology	3	1	-	3	25	75	100	3
193MB2A4DA		Microbial Technology								
193BC2A4DA		Neurobiology								
Total			7	1	22	-	-	-	500	18
Grand Total									2600	90



Course Code	Course Name	Category	L	T	P	Credit
193BT2A4CA	PHARMACEUTICAL BIOTECHNOLOGY	CORE	4	-	-	4

### PREAMBLE

This course has been designed for students to learn and understand

- To evaluate pharmaceutical parameters of current biotechnology products.
- To determine parameters related to stability and formulation.
- The applications of bioprospecting in relation to pharma industry.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Imparts knowledge on importance of enzymes and applications in drugs	K3, K4, K5
CO2	Provide in-depth understanding of active constituents	K4, K5
CO3	Focus on natural sources for synthesis of drugs	K4, K5
CO4	To gain knowledge vaccine types and production	K4, K5
CO5	To analyze the toxicity levels and measurement	K4, K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	M	S	M	M
CO3	S	M	S	S	M
CO4	S	S	S	S	M
CO5	S	S	S	S	M

**S Strong**

**M Medium**

**L Low**



193BT2A4CA	PHARMACEUTICAL BIOTECHNOLOGY	SEMESTER IV
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**Total Credits:** 4

**Total Instruction Hours:** 48 h

### Syllabus

#### **Unit I** Enzymes in Pharmaceutical Biotechnology 8 h

Properties – dynamics of enzymatic activity, sources, extraction and purification: Applications pharmaceutical, therapeutic and clinical. Production of amyloglucosidase, glucose isomerase, amylase and trypsin. Immobilization – applications – perspective of enzyme engineering.

#### **Unit II** Active Drug Constituents 10 h

Introduction to active constituents - isolation, classification, properties. Systematic pharmacognostic study of a) Carbohydrates and derived products: agar, guar gum, acacia, Honey, Isabgol, pectin, Starch and sterculia b) Lipids: Bees wax, Castor oil, Cocoa butter, Cod-liver oil, Kokum butter, Lard, Rice, Bran oil, Shark liver oil and Wool fat.

#### **Unit III** Plant and Animal Sources 12 h

Herbal Medicines – Characteristics, Efficacy, importance, allergic reactions. Principles - Ayurveda, Unani, Siddha, Homeopathy. Drugs derived from Animal – Gelatin, Glycerin, Heparin, Lanolin, Premarin, Animal vaccines. Pharmaceuticals from Marine source – Cytarabine, Zicomotide, Omega – 3- acid ethyl ester, Trabectedin, Brentuximab vedotin.

#### **Unit IV** Vaccines and Related Products Production 8 h

DNA Vaccine construction and immunology, DNA vaccine expression, plasmid delivery of DNA vaccines. Bacterial vaccines and preparation. Peptide vaccine. Antitoxins. Serum-immune blood derivatives and immunity related products. Gene Pharming.

#### **Unit V** Immunogenicity 10 h

Estimation of toxicity LD 50 and ED 50. Immunogenicity of biopharmaceuticals: Immunogenicity; Factors contributing to immunogenicity (product-related factors, host-related factors), Measurement of immunogenicity. Consequence of immunogenicity to biopharmaceuticals. Neutraceuticals. Biopharmaceutical. Economics of drug development.



## Text Books

- 1 Crommelin D, Sindelar R and Meibohn B, 2008, "Pharmaceutical Biotechnology – Fundamentals and Applications", 3rd edition, Informa Press, USA.
- 2 Kokate J and Hurakadle, 2011, "Textbook of Pharmaceutical Biotechnology, 1st edition, Elsevier Pres, USA.

## References

- 1 Kayser O and Müller RH, 2005, "Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications", 1st Edition, Wiley Publishers, USA.
- 2 Rho J and Louie, SG, 2003, "Hand book of Pharmaceutical Biotechnology", 1st Edition, CRC Press, USA
- 3 Goodman and Gilman, 2006, " The Pharmacological Basis of Therapeutics", 11th Edition, Mc Graw Hill Medical Publishing Division, India.
- 4 Heinrich Klefenz, 2002, "Industrial Pharmaceutical Biotechnology", 1st Edition, WILEY-VCH Publication, USA.



193BT2A4CP	<b>CORE PRACTICAL VII: PHARMACEUTICAL BIOTECHNOLOGY</b>	<b>SEMESTER IV</b>
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**Total Credits:** 3  
**Total Instructions Hours:** 72 h

<b>S.No</b>	<b>List of Experiments</b>
1	Isolation of Animal Tissues: Intestinal Muscle Preparations.
2	Isolation of Animal Tissues: Skeletal Muscle Preparations, Cardiac Muscle Preparations
3	In-Vitro Evaluation of Hepatoprotective Drugs
4	Evaluation of Antioxidant Activity Using Cell Based Assay Method
5	Sterility Testing of Pharmaceutical Drugs
6	In-Vitro Genotoxicity Assay
7	Mouse Lymphoma Assay (L5178Y TK+/- mouse lymphoma cells)
8	Evaluation the extent of DNA damage by In-Vitro Comet assay
9	In-Vitro Teratogenicity Testing of the drug
10	Pathological Condition Analysis of Animal Tissues by Histopathology

**Note:** Any 8 out of 10 experiments will be carried out



## References

- 1 Patra Jayanta Kumar, Das Swagat Kumar, Das Gitishree, Thatoi Hrudayanath, 2019, "A Practical Guide to Pharmacological Biotechnology", 1st edition, Springer Nature Pvt Ltd., Singapore.
- 2 Prasad GS, Sailam KS, 2019, "Pharmaceutical Microbiology: A Laboratory Manual", 1st edition, PharmaMed Press, India.
- 3 Crommelin Daan JA, Sindelar Robert, Meibohm Bernd, 2019, "Pharmaceutical Biotechnology; Fundamentals and Applications", 5th edition, Springer International Publishing, USA.
- 4 Groves, 2018, "Pharmaceutical Biotechnology", Routledge Taylor and Francis Group, USA



Course Code	Course Name	Category	L	T	P	Credit
193BT2A4DA	STEM CELL TECHNOLOGY	DSE	3	1	-	3

### PREAMBLE

This course has been designed for students to learn and understand

- The types of Stem cells
- Characteristics of different stem cells in animals and plants.
- Applications of stem cells in various dimensions.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Know the process of stem cell and storage	K2,K3
CO2	Understand the stem cell importance in plants	K3, K4
CO3	Imparts knowledge on the stem cells in animals	K3,K4,K5
CO4	In depth understanding of haemopoietic stem cell	K4,K5
CO5	Focus on stem cell therapies and its application	K4,K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	S	M	S	S	S
CO4	S	S	M	M	M
CO5	S	S	S	S	S

**S Strong**

**M Medium**

**L Low**





<b>193BT2A4DA</b>	<b>STEM CELL TECHNOLOGY</b>	<b>SEMESTER IV</b>
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**Total Credits: 3**

**Total Instruction Hours: 48 h**

### **Syllabus**

**Unit I**      Stem Cells and Cellular Pedigrees      11 h

Scope of stem cells – definition of stem cells – concepts of stem cells – differentiation , maturation , proliferation , pluripotency, self – maintenance and self – renewal – problems in measuring stem cells – preservation protocols.

**Unit II**      Stem Cell Concept in Plants      9 h

Stem cell and founder zones in plants – particularly their roots – stem cells of shoot meristems of higher plants.

**Unit III**      Stem Cell Concept in Animals      10 h

Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles – Tumour stem cells, Embryonic stem cell biology - factors influencing proliferation and differentiation of stem cells – hormone role in differentiation.

**Unit IV**      Haemopoietic Stem Cell      9 h

Biology – growth factors and the regulation of haemopoietic stem cells.

**Unit V**      Potential Uses of Stem Cells      9 h

Cellular therapies – vaccines – gene therapy – immunotherapy – tissue engineering – blood and bone marrow – Fc cells.



## Text Books

- 1 Potten CS, 1997, "Stem cells", Elsevier, USA.
- 2 Robert Paul Lanza , 2006, "Essentials of stem cell biology", 2nd edition, Academic Press, USA.

## References

- 1 Song Li, Nicolas L'Heureux, Jennifer Elisseeff, 2011, "Stem Cell and Tissue Engineering", 1st Edition, World Scientific Publishers, Singapore.
- 2 Robert Lanza, John Gearhart, Brigid Hogan, 2006, "Essentials of Stem Cell Biology", 2nd Edition, Macmillan Publishing Solutions, USA.
- 3 Low WC and Verfaillie CM, 2007, "Stem Cell and Regenerative Medicine", 1st Edition, World Scientific Publishers, Singapore.
- 4 Lanza R and Atala A, 2007, "Essential of Stem Cell Biology", 3rd Edition, Academic Press, USA.



Course Code	Course Name	Category	L	T	P	Credit
193MB2A4DA	MICROBIAL TECHNOLOGY	DSE	3	1	-	3

## PREAMBLE

This course has been designed for students to learn and understand

- The production of Sustainable products using Microorganisms.
- The importance of Microorganisms in Pharmaceutical sector.
- How to explore the ideas in commercial level.

## COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Inculcate the knowledge about microbial products.	K3
CO2	Exemplify the ideas about the production and uses of Biofuel and Biofertilizer.	K4
CO3	Demonstrate the commercial production of Biopolymers using Microorganisms.	K3
CO4	Understand the way cells and enzymes were immobilised for industrial uses.	K4
CO5	Explore the production of vaccines and toxoids.	K4

## MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	M	S	S
CO3	S	M	S	S	S
CO4	S	M	S	M	S
CO5	S	S	M	S	S

**S Strong**

**M Medium**

**L Low**



<b>193MB2A4DA</b>	<b>MICROBIAL TECHNOLOGY</b>	<b>SEMESTER IV</b>
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**Total Credits: 3**

**Total Instruction Hours: 60 h**

### **Syllabus**

**Unit I**      Microbial products 12 h

Single Cell Protein and its Economic Aspects: Bacterial, Actinomycetous, Yeast, Fungal and Algal Proteins – Brewer's and Baker's yeast – Food and Fodder yeast – Mushroom (Agaricus, Oyster) and Products from Higher fungi (Ganoderma lucidum).

**Unit II**      Production of Biofuel & Biofertilizer 12 h

Production, Methods and Uses of Bioethanol (*S cerevisiae*) – Biodiesel (*Chlorella*) – Biohydrogen (*Chlamydomonas*) – Biogas (*Methanobacteria*) . Biofertilizer -Types , Mass production and Applications.

**Unit III**      Biopolymer production 12 h

Production and Uses of Polyhydroxybutyrate (PHB) – Xanthan – Alginate – Cellulose – Cyanophycin – Levan – Melanin -Adhesive Protein – Rubber – Polyhydroxyalkanoates – Hyaluronic acid.

**Unit IV**      Immobilization of Cells & Enzymes 12 h

Cells – Surface attachment of cells – Entrapment within porous matrices: Hydrogel Entrapment method, Preformed support materials – Containment behind a barrier: Microencapsulation, Immobilization using membranes – Self aggregation of cells – Enzymes: Methods for Enzyme immobilization – Carrier binding method, Intermolecular cross linking – Applications of Immobilized cells and Enzymes.

**Unit V**      Microbial products with pharmaceutical importance 12 h

Vaccines – Steps of Manufacturing – Growing the microbes and separation – Preparation of Live and killed vaccine – Standardization of vaccine – Preparation of Toxoid and uses – BCG Vaccine – Cholera vaccine – Rabies vaccine – Diphtheria toxoid.



## Text Books

- 1 Patel A H, 2012, "Industrial Microbiology", 2nd Edition, Trinity Press, New Delhi.
- 2 El-Mansi E M T, Bryce C F A, Dahhou B, Sanchez S, Demain A L, Allman A R, 2012, "Fermentation Microbiology and Biotechnology", 3rd Edition, CRC Press, USA.

## References

- 1 Bernard R Glick, Jack J Pasternek, Cheryl L Patten, 2010, " Molecular Biotechnology - Principles and Applications of Recombinant DNA", 4th Edition, ASM Publishers, USA.
- 2 Nidhi Goel, 2013, "Pharmaceutical Microbiology", 1st Edition, Narosa Publishing House, New Delhi.
- 3 Puvanakrishnan R, Sivasubramanian S, Hemalatha T, 2012, "Microbial Technology - Concepts and Applications", 1st Edition, MJP Publishers, New Delhi.
- 4 [https://agritech.tnau.ac.in/org\\_farm/orgfarm\\_biofertilizertechnology.html](https://agritech.tnau.ac.in/org_farm/orgfarm_biofertilizertechnology.html)



Course Code	Course Name	Category	L	T	P	Credit
193BC2A4DA	NEUROBIOLOGY	DSE	3	1	-	3

### PREAMBLE

This course has been designed for students to learn and understand

- Overview of nervous system organisation and function.
- Neuronal transmission in the body.
- Pathways and mechanisms of neuronal disorders.

### COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the morphogenesis of the central nervous system and histology of the nervous system.	K4 & K5
CO2	Examine the functioning of the components of the nervous system	K4 & K5
CO3	Elucidate the role of different neurotransmitters in nerve impulse conduction	K4 & K5
CO4	Understand the process of vision, olfaction and taste sensation in detailed pathways	K4 & K5
CO5	Analyse the neurologic process behind the different neurological diseases	K4 & K5

### MAPPING WITH PROGRAMME OUTCOMES

COs/POs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	M	M
CO2	S	S	S	M	M
CO3	S	S	S	M	M
CO4	S	S	M	M	M
CO5	S	S	S	M	S

**S Strong**

**M Medium**

**L Low**



193BC2A4DA	NEUROBIOLOGY	SEMESTER IV
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**Total Credits:** 3

**Total Instruction Hours:** 48 h

### Syllabus

#### **Unit I** Morphogenesis of central nervous system and Histology of the Nervous System 11 h

Morphogenesis of central nervous system: Early aspects of development, The spinal cord, The brain (Myelencephalon, Metencephalon, Mesencephalon, Prosencephalon, Diencephalon, Telencephalon, Basal Ganglia, Commissures).

Histology of the Nervous System: The neuron: nerve cell body, nucleus, cytoplasm, dendrites, axon. Axonal Transport: fast anterograde, slow anterograde and fast retrograde transport. Types of neurons: multipolar, bipolar, pseudo-unipolar, and unipolar. Neuroglia: astrocytes, oligodendrocytes, microglia, and ependymal cells. Myelinated axons.

#### **Unit II** Design and functioning of the Nervous System 11 h

Neuron, Sensory Receptors, Effectors, information processing, memory. Major Levels of Central Nervous System Function: spinal cord level, lower brain level and higher brain level. Structure and permeability of neuronal membrane: membrane transport proteins, mode of transport, synapse: types (chemical and electrical), Physiologic Anatomy of the Synapse: Presynaptic Terminals, Action Potential and propagation, equilibrium membrane potential, resting membrane potential, Receptor Proteins, Ion Channels (properties and classification), Second Messenger system, Excitation/inhibition in post synaptic membrane.

#### **Unit III** Neurotransmitters 10 h

Neurotransmitters: definition, properties, classes, mechanism of neurotransmitter release. Synthesis, release, physiological and clinical considerations of acetyl choline, GABA, dopamine, norepinephrine, epinephrine, serotonin, histamine, nitric oxide. Receptors: nicotinic acetyl choline, NMDA and opioid receptors. Mechanisms of Regulation of Receptors: Desensitization and Down-Regulation.

#### **Unit IV** Visual, Olfaction and Taste system 8 h

Visual system: components of eye, different layers of retina, photoreceptors, phototransduction, processing of signals by retinal cells, color vision, visual and retinal fields, visual pathways, visual reflex.





Olfaction and Taste: organisation, receptors, sensory transduction, central pathways for olfaction and taste.

## Unit V Neurological diseases

8 h


Description, neurochemistry, pathology and clinical intervention of neurological diseases: Parkinson's disease, schizophrenia, Huntington's disease, Alzheimer's disease, epilepsy and depression disorder.

### Text Books

- 1 Allan Siegel, Hriday N. Sapru, 2018, "Essential Neuroscience", 4th Edition, Lippincott Williams & Wilkins, a Wolters Kluwer business, United States.
- 2 John E. Hall, Arthur C. Guyton, 2021, "Guyton and Hall Textbook of Medical Physiology", 14th edition, Saunders, an imprint of Elsevier Inc., United States.

### References

- 1 Alan Longstaff, 2011, "Instant notes. Neuroscience", 3rd edition, Taylor & Francis Group, United Kingdom.
- 2 Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel Iamantia, James O. McNamara, S. Mark Williams, 2017, "Neuroscience", 6th edition, Sinauer Associates, Inc. USA
- 3 Kim E. Barrett, Susan M. Barman, Scott Boitano, William F. Ganong, Heddwyn L. Brooks, 2019, "Ganong's Review of Medical Physiology", 26th edition, McGraw Hill Education, United States.
- 4 Harald Sontheimer, 2015, "Diseases of the Nervous System", 1st Edition, Academic Press, United States.

  
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