Dr. N.G.P.ARTS AND SCIENCE COLLEGE

REGULATIONS 2023-24 for Post Graduate Programme

(Outcome Based Education model with Choice Based Credit System)

M.Sc. BIOCHEMISTRY

(For the students admitted during the academic year 2023-24 and onwards)

Eligibility

The eligibility conditions for admission to M.Sc., in Biochemistry is candidates with B.Sc., in Biochemistry, Biotechnology, Microbiology, Biomedical Science, Biomedical Instrumentation Science, Medical Lab Technology, Bioinformatics, Environmental Sciences, Clinical Lab Technology, Biochemistry (Nanotechnology), Chemistry, Life Sciences, Botany, Zoology, Nutrition and dietetics or an Examinations accepted as equivalent there by Academic Council, subject to such conditions as may be prescribed there to are permitted to appear and qualify for the **Master of Science Degree in Biochemistry Examination** of this College after a programme of study of two academic years.

Programme Educational Objectives

1. Instill inquisitiveness in students to explore realms of modern biology (Molecular genetics, Marine biochemistry, Pharmaceutical biochemistry, and Immunology, Enzymology and Clinical biochemistry) through interdisciplinary cutting edge research.

2. Empower students to acquire, develop and demonstrate skills in bioinstrumentation, biostatistical and bioinformatic software and tools, and in the fields of Industrial Biochemistry, and Nanotechnology and Cancer biology to meet the relevant demands of traditional and emerging industries.

PROGRAMME OUTCOMES:

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

PO Number	PO Statement
PO1	Postgraduates are cognizant of progressive principles and concepts in diverse branches of modern biology that govern the integrity of dynamic bio-molecular assembly in varied life forms. Alumni are expressive of mastered wisdom to peers and public to expedite basic understanding of issues of social importance through practice and investigation.
PO2	Postgraduates are comprehensive of complex of biological systems, and they have broadened and perfected competency and skills in principal and contingent areas of modern biology. Thereby, alumni as an individual or as a team member can address, investigate, design, develop and demonstrate solutions to important issues facing humanity and preserve natural ecosystems.
PO3	Postgraduates are advantaged to identify and exploit functionally crucial areas in diverse branches of modern biology, and combine it with modern tools to investigate, design, develop, demonstrate and familiarize solutions to both basic and applied research questions in areas of industry, medicine, agriculture, pharmacy, food technology, biotechnology, etc. Alumni are valuable performers as an individual or in a team.
PO4	Postgraduates are competent to enroll in research programs and modeled to receptive of successful career options in diverse branches of modern biology as scholars, managers, counselors, writers, technical experts, field experts, teachers, entrepreneur and a responsible citizen. Alumni have acquired and developed skills to manage projects and finances as individual or as a team member. While discharging duties at varied capacities, postgraduates are inculcated to keep sustainable environment as a goal, and follow ethics of professional stature.
PO5	Postgraduates are infused with metamorphic qualities of education, and inspired to develop scientific temperament and lead a scientific way of life in facing socio-economical challenges that will benefit the society. Alumni are adept at evaluating their learning's to worldwide events. Thereby, they continue their learning lifelong.

TOTALCREDITDISTRIBUTION

Course	Credits	Total		Total Credits	Cumulative Total
Core	4	13x 100	1300	52	90
Core	3	1X100	100	03	
Core Practical	3	3 x 100	300	09	
Core Practical	2	3 x 100	300	06	
Project Work	8	1 x 200	200	08	
Discipline Specific Elective (DSE)	3	4 x 100	400	12	
Industrial Training	2	1 x 100	100	2	
			2600	**92**	**92**

CURRICULUM

M.Sc.BIOCHEMISTRY PROGRAMME

Course Code	Course Category	Course Name	L	T	P	Exam (hours)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
233BC2A1CA	Core-I	Chemistry of Biomolecules	4	-	-	3	25	75	100	4
233BC2A1CB	Core-II	Biochemical techniques and Instrumentation	4	-	-	3	25	75	100	4
233BC2A1CC	Core-III	Enzymes and Enzyme Technology	4	-	-	3	25	75	100	4
233BC2A1CD	Core-IV	Cellular Biochemistry	4	-	-	3	25	75	100	4
233BC2A1CP	Core Practical-I	Practical: Enzymes and Cellular Biochemistry	-	-	6	6	40	60	100	3
233BC2A1CQ	Core Practical-II	Practical: Biomolecules and Biochemical Techniques	-	-	4	6	40	60	100	2
233MB2A1DA	DSE-I	Microbial Technology	3	1	-	3	25	75	100	3
233BC2A1DA		Cancer Biology, Diagnosis and Therapy								
233BT2A1DA		Applied Biotechnology								
Total			19	1	10				700	24

14/6/2023
BoS Chairman/HoD
Department of Biochemistry
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

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BoS - 14/6/2023 AC - 14/7/2023 GB - 20/7/2023

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Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
233BC2A2CA	Core-V	Immunology	4	-	-	3	25	75	100	4
233BC2A2CB	Core-VI	Metabolism	4	-	-	3	25	75	100	4
233BC2A2CC	Core-VII	Microbial Biochemistry	4	-	-	3	25	75	100	4
233BC2A2CD	Core-VIII	Genetics and Molecular Biology	4	-	-	3	25	75	100	4
233BC2A2CP	Core Practical-III	Practical: Immunology and Molecular Biology	-	-	6	6	40	60	100	3
233BC2A2CQ	Core Practical-IV	Practical: Microbial Biochemistry and Metabolism	-		4	6	40	60	100	2
233MB2A2DA	DSE-II	Bionanotechnology	3	1	-	3	25	75	100	3
233BC2A2DA		Biochemistry of Toxicology								
233BT2A2DA		Forensic Biotechnology								
Total			19	1	10				700	24

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Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
233BC2A3CA	Core-IX	Research Methodology and Biostatistics	4	-	-	3	25	75	100	4
233BC2A3CB	Core-X	Plant Biochemistry and Biotechnology	4	-	-	3	25	75	100	4
233BC2A3CC	Core-XI	Genetic Engineering	4	-	-	3	25	75	100	4
233BC2A3CD	Core-XII	Clinical Biochemistry	4	-	-	3	25	75	100	4
233BC2A3CP	Core Practical - V	Clinical Biochemistry	-	-	6	6	40	60	100	3
233BC2A3CQ	Core Practical-VI	Plant Biochemistry and Genetic Engineering	-	-	4	6	40	60	100	2
233MB2A3DA	DSE-III	Medical Laboratory Techniques	3	1	-	3	25	75	100	3
233BC2A3DA		Free Radicals and Antioxidant System								
233BT2A3DA		Molecular Therapeutics								
233BC2A3CT	IT	Internship	-	-	-	-	40	60	100	2
Total			**19**	**1**	**10**				**800**	**26**

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Course Code	Course Category	Course Name	L	T	P	Exam(h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
233BC2A4CA	Core-XIII	Bioethics and Biosafety	4	1	-	3	25	75	100	3
233BC2A4CB	Core-XIV	Endocrinology and Developmental Biology	4	1	-	3	25	75	100	4
233BC2A4CV	Core	Project and Viva Voce	-	-	16	6	80	120	200	8
233MB2A4DA	DSE-IV	Molecular Diagnostics and Bioinformatics	3	1	-	3	25	75	100	3
233BC2A4DA		Neurobiology								
233BT2A4DA		Stem Cell Technology								
Total			**11**	**3**	**16**				**500**	**18**
Grand Total									**2600**	**92**

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DISCIPLINE SPECIFIC ELECTIVE

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

Semester I (Elective I) List of Elective Courses

S.No	Course Code	Name of the Course
1.	233MB2A1DA	Microbial Technology
2.	233BC2A1DA	Cancer Biology, Diagnosis and Therapy
3.	233BT2A1DA	Applied Biotechnology

Semester II (Elective II) List of elective Courses

S.No	Course Code	Name of the Course
1.	233MB2A2DA	Bionanotechnology
2.	233BC2A2DA	Biochemistry of Toxicology
3.	233BT2A2DA	Forensic Biotechnology

Semester III (Elective III) List of elective Courses

S.No	Course Code	Name of the Course
1.	233MB2A3DA	Medical Laboratory Techniques
2.	233BC2A3DA	Systems Biology
3.	233BT2A3DA	Molecular Therapeutics

Semester IV (Elective IV) List of Elective Courses

S.No.	Course Code	Name of the Course
1.	233MB2A4DA	Molecular Diagnostics and Bioinformatics
2.	233BC2A4DA	Neurobiology
3.	233BT2A4DA	Stem Cell Technology

EXTRACREDIT COURSES

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

S.No.	Semester	Course Code	Course Title
1.	III	233BC2ASSA	Bionanotechnology
2.		233BC2ASSB	Inheritance, Evolution and Behaviour

PG REGULATION (R5)

(2023-24 and onwards)

(OUTCOME BASED EDUCATION WITH CBCS)

Effective from the academic year 2023-24 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, Cognitive Systems, Artificial Intelligence and Machine Learning and Cyber Security and Data Analytics 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 2023–2025 refers to students belonging to a 2-year Degree programme admitted in 2023 and completing in 2025.

1.4 Course: Refers to component 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): Elective courses are offered under main discipline/ subject of study.

d)Internship/Industrial Training (IT)

Students must undertake industrial / institutional training for a minimum of 15 days during the II semester summer vacation. The students will submit the report for evaluation during III semester.

e) 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.

f) 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.

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

2. STRUCTURE OF PROGRAMME

- Core Course
- Extra Departmental Course (EDC)
- Discipline Specific Elective (DSE)
- Industrial Training (IT)
- Project

3. DURATION OF THE PROGRAMME

M.Sc. /M.Com. / M.A. Programme must be completed within 2 Years (4 semesters) and maximum of 4 Years (8 semesters) from the date of acceptance to the programme. If not, the candidate must enroll in the course determined to be an equivalent by BoS in the most recent curriculum recommended for the Programme.

4. REQUIREMENTS FOR COMPLETION OF A SEMESTER

Every student shall ordinarily be allowed to keep terms for the given semester in a program of his/ her enrolment, only if he/ she fulfills at least seventy five percent (75%) of the attendance taken as an average of the total number of lectures, practicals, tutorials, etc. wherein short and/or long excursions/field visits/study tours organised by the college and supervised by the faculty as envisaged in the syllabus shall be credited to his attendance. Every student shall have a minimum of 75% as an overall attendance.

5. EXAMINATIONS

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 as follows,

Mark distribution for Theory Courses

Continuous Internal Assessment (CIA) : 40 Marks

End Semester Exams (ESE) : 60 Marks

Total : 100 Marks

i) Distribution of Internal Marks

S.No.	Particulars	Distribution of Marks
1	CIA I (2.5 Units) (On completion of 45th working day)	5
2	Model (All 5 Units) (On completion of 85th working day)	5
3	Attendance	05
4	Library Usage	05
5	Skill Enhancement *	05
	Total	**25**

Breakup for Attendance Marks:

S.No	Attendance Range	Marks Awarded
1	95% and Above	5
2	90% - 94%	4
3	85% - 89%	3
4	80% - 84%	2
5	75% - 79%	1

Note:

Special Cases such as NCC, NSS, Sports, Advanced Learner Course, Summer Fellowship and Medical Conditions etc. the attendance exemption may be given by principal and Mark may be awarded.

Break up for Library Marks:

S.No	Attendance Range	Marks Awarded
1	10h and above	5
2	9h- less than 10h	4
3	8h - less than 9h	3
4	7h - less than 8h	2
5	6h - less than 7h	1

Note:

In exception, the utilization of e-resources of library will be considered.

***Components for "Skill Enhancement" may include the following:**

Class Participation, Case Studies Presentation/Term paper, Field Study, Field Survey, Group Discussion, Term Paper, Presentation of Papers in Conferences, Industry Visit, Book Review, Journal Review, e-content Creation, Model Preparation, Seminar and Assignment.

Components for Skill Enhancement

Any one of the following should be selected by the course coordinator

S.No.	Skill Enhancement	Description
1	Class Participation	• Engagement in class • Listening Skills • Behaviour
2	Case Study Presentation/ Term Paper	• Identification of the problem • Case Analysis • Effective Solution using creativity/imagination
3	Field Study	• Selection of Topic • Demonstration of Topic • Analysis & Conclusion
4	Field Survey	• Chosen Problem • Design and quality of survey • Analysis of survey

5	Group Discussion	• Communication skills • Subject knowledge • Attitude and way of presentation • Confidence • Listening Skill
6	Presentation of Papers in Conferences	• Sponsored • International/National • Presentation • Report Submission
7	Industry Visit	• Chosen Domain • Quality of the work • Analysis of the Report • Presentation
8	Book Review	• Content • Interpretation and Inferences of the text • Supporting Details • Presentation
9	Journal Review	• Analytical Thinking • Interpretation and Inferences • Exploring the perception if chosen genre • Presentation
10	e-content Creation	• Logo/ Tagline • Purpose • Content (Writing, designing and posting in Social Media) • Presentation
11	Model Preparation	• Theme/ Topic • Depth of background Knowledge • Creativity • Presentation
12	Seminar	• Knowledge and Content • Organization • Understanding • Presentation
13	Assignment	• Content and Style • Spelling and Grammar • References

ii) Distribution of External Marks

Total	:	75
Written Exam	:	75

Marks Distribution for Practical course

Total	:	100
Internal	:	40
External	:	60

i) Distribution of Internals Marks

S. No.	Particulars	Distribution of Marks
1	Experiments/Exercises	15
2	Test 1	10
3	Test 2	10
4	Observation Notebook	05
	Total	**40**

ii) Distribution of Externals Marks

S.No.	Particulars	External Marks
1	Practical	40
2	Record	10
3	Viva- voce	10
	Total	**60**

Practical examination shall be evaluated jointly by Internal and External Examiners.

A) Mark Distribution for Project

Total	:	200
Internal	:	80
External	:	120

i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	30
2	Review II	40
3	Attendance	10
	Total	**80**

ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Project Work & Presentation	100
2	Viva –voce	20
	Total	**120**

Evaluation of Project Work shall be done jointly by Internal and External Examiners.

6 . Credit Transfer

a. Upon successful completion of 1 NPTEL Course (4 Credit Course) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of one **4 credit course** during the 3rd semester. The proposed NPTEL course should cover content/syllabus of exempted core paper in 3rd semester.

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option – 1 Paper title	4
			Option – 2 Paper title	
			Option – 3 Paper title	

b. Upon successful completion of **2 NPTEL Courses** (2 Credit each) recommended by the department, during Semester I to II, a student shall be eligible to get exemption of **one 4 credit course** during the 3rd semester. Out of 2 NPTEL proposed courses, **at least 1 course** should cover content/syllabus of exempted core paper in 3rd semester.

Mandatory

The exempted core paper in the 3rd semester should be submitted by the students for approval before the end of 2nd semester

Credit transfer will be decided by equivalence committee

S. No.	Course Code	Course Name	Proposed NPTEL Course	Credit
1			Option – 1 Paper title	2
			Option – 2 Paper title	
			Option – 3 Paper title	
2			Option – 1 Paper title	2
			Option – 2 Paper title	
			Option – 3 Paper title	

NPTEL Courses to be carried out during semester I – II.

S. No.	Student Name	Class	Proposed NPTEL Course		Proposed Course for Exemption
			Course I	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	Any one Core Paper in 3rd Semester
			Course II	Option 1- Paper Title Option 2- Paper Title Option 3- Paper Title	

Class Advisor **HoD** **Dean**

7. Internship/Industrial Training

Mark Distribution for Internship/ Industrial Training

Total : 100
Internal : 40
External : 60

i) Distribution of Internal Marks

S.No.	Particulars	Internal Marks
1	Review I	15
2	Review II	20
3	Attendance	5
	Total	**40**

ii) Distribution of External Marks

S.No	Particulars	External Marks
1	Internship /Industrial training Presentation	40
2	Viva –voce	20
	Total	**60**

Internship/ Industrial training shall be evaluated jointly by Internal and External Examiners.

9. Extra Credits: 10

Earning extra credit is not essential for programme completion. Student is entitled to earn extra credit for achievement in Curricular/Co-Curricular/ Extracurricular activities carried out other than the regular class hours.

A student is permitted to earn a maximum of 10 extra Credits during the programme period.
A maximum of 1 credit under each category is permissible.

Category	Credit
Self study Course	1
CA/ICSI/CMA (Foundations)	1
CA/ICSI/CMA (Inter)	1
Sports and Games	1
Publications / Conference Presentations (Oral/Poster)/Awards	1
Innovation / Incubation / Patent / Sponsored Projects / Consultancy	1
Representation in State / National level celebrations	1
Awards/Recognitions/Fellowships	1
Advanced Learner Course (ALC)*	2

Credit shall be awarded for achievements of the student during the period of study only.

GUIDELINES

Self study Course

A pass in the self study courses offered by the department.

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

CA/ICSI/CMA(Foundations)

Qualifying foundation in CA/ICSI/CMA / etc.

CA/ICSI/CMA(Inter)

Qualifying Inter in CA/ICSI/CMA / etc.

Sports and Games

The Student can earn extra credit based on their Achievement in sports in University/ State / National/ International.

Publications / Conference Presentations (Oral/Poster)

Research Publications in Journals

Oral/Poster presentation in Conference

Innovation / Incubation / Patent / Sponsored Projects / Consultancy

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

Representation in State/ National level celebrations

State / National level celebrations such as Independence day, Republic day Parade, National Integration camp etc.

Awards/Recognitions/Fellowships

Regional/ State / National level awards/ Recognitions/Fellowships

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

ALC is doing work of a higher standard than usual for students at that stage in their education.

Research work/internships carried out in University/ Research Institutions/ Industries of repute in India or abroad for a period of 15 to 30 days will be considered as Advanced Learners Course.

QUESTION PAPER PATTERN

CIA Test I : [1½ Hours-2.5 Units] - 25 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section – A	8 x 0.5= 04 Marks	MCQ	25 Marks	Marks secured will be converted To 5 mark
Section - B	3 x 2 = 06 Marks	Answer ALL Questions Either or Type ALL Questions Carry Equal Marks		
Section - C	3 x 05 = 15 Marks			

CIA Test II/ Model [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL	Remarks
Section – A	10 x 1 = 10 Marks	MCQ	75 Marks	Marks secured will be converted To 5 mark
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks		
Section - C	5 x 8 = 40 Marks			
Section - D	1 x 10 = 10 Marks	Compulsory Question		

End Semester Examination [3 Hours-5 Units] - 75 Marks

SECTION	MARKS	DESCRIPTION	TOTAL
Section – A	10 x 1 = 10 Marks	MCQ	75 Marks
Section - B	5 x 3 = 15 Marks	Answer ALL Questions (Either or Type Questions) Each Questions Carry Equal Marks	
Section - C	5 x 8 = 40 Marks		
Section - D	1 x 10 = 10 Marks	Compulsory Question	

Course Code	Course Name	Category	L	T	P	Credit
233BC2A1CA	CHEMISTRY OF BIOMOLECULES	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The structural organization and functional properties of biomolecules.
- The structure and functions of biologically important macromolecules.
- The characterization of biological macromolecules

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Assess the importance of carbohydrate containing proteins, homo and heteropolysaccharides.	K4
CO2	Determine the conformational properties of biological proteins.	K4
CO3	Summarize the information about all lipids and their biological significance	K5
CO4	Explain the different forms of DNA& RNA	K5
CO5	Describe the structure and functions of important heterocyclic compounds.	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A1CA	CHEMISTRY OF BIOMOLECULES	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Polysaccharides 10 h

Homo polysaccharides: Structure and biological functions of starch, cellulose, glycogen, chitin, fructans, mannans, xylans, and galactans. Hetero polysaccharides: Structure and biological importance of sugar derivatives- glycosaminoglycans, proteoglycans. Glycoprotein – Blood group and bacterial cell wall polysaccharides, O- linked and N- linked oligosaccharides and Lectins. Isolation and Purification of Polysaccharides.

Unit II Proteins 10 h

Primary structure- determination of amino acid sequence of proteins. Denaturation and renaturation of proteins. The peptide bond: Ramachandran plot. Secondary structure- weak interactions involved, alpha helix, beta sheet and beta turn's. Pauling and Corey model for fibrous proteins. Collagen triple helix. Super secondary structures- helix-loop-helix, zinc finger and leucine zipper. Tertiary structure- alpha and beta domains. Quaternary structure- structure of haemoglobin and myoglobin. Solid state synthesis of peptides. Protein folding

Unit III Lipids 10 h

Classification, structure, function, physical and chemical properties of lipids. Fattyacids-Saturated, Hydroxy and Unsaturated Fattyacids-Triacylglycerol. Phospholipids- classification, structure and functions. Ceramides and sphingomyelins. Eicosanoids: Structure and functions of prostaglandins, thromboxanes, leukotrienes. Types and functions of plasma lipoproteins. Amphipathic lipids- membranes, micelles, emulsions and liposomes. Steroids- structure and biological role of cholesterol, bile acids, bile salts. Lipid Peroxidation and antioxidants.

Unit IV Nucleic Acids 10 h

DNA double helical structure. A, B and Z forms of DNA. Triple and quadruple structures. Physical properties of DNA. Chemicals that react with DNA. Renaturation and denaturation. DNA super coiling and linking number. DNA bending: The Wedge model and Junction model, Protein induced bending.

Cruciform DNA, Left-handed DNA. Types of RNA, Secondary and tertiary structure of RNA.

Unit V Heterocyclic Compounds 8 h

Hetero cyclic rings of biologically important compounds. Structure and biological importance of pyridine, pyrole, quinolene, pyrimidine, purine, pteridine, thiazole, imidazole and indole ring containing compounds. Porphyrine – structure and biologically important compounds containing porphyin ring.

Text Books

1 *David L Nelson and Michael M Cox,* 2017, "**Lehninger Principles of Biochemistry**", *7th edition. Macmillan Publisher, New York.*

2 *Richard R Sinden,* 2012, "**DNA Structure and Function**", *1st Edition, Academic Press, US.*

References

1 *Jeremy M Berg Lubert Stryer John Tymoczko and Gregory Gatto,* 2019, "**Biochemistry**", *9th edition, W.H. Freeman and Company, New York*

2 *Donald Voet, Judith G. Voet , Charlotte W. Pratt,*2018, "**Voet's Principles of Biochemistry**", *5th edition, John Wiley & Sons, New York.*

3 *Theophil Eicher, Siegfried Hauptmann and Andreas Speicher,* 2013, "**The Chemistry of Heterocycles: Structure, Reactions, Synthesis and Applications**", *3rd Edition, Wiley--VCH Verlag & Co, Weinheim.*

4 *Garrett R H and Grisham C M,* 2017, "**Biochemistry**", *6th edition, Brooks/Cole Cengage Learning, Boston.*

Course Code	Course Name	Category	L	T	P	Credit
233BC2A1CB	BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- An overview of the scientific basis of instruments.
- The advantages and limitations of conventional and modern bio-analytical techniques
- The analytical techniques such as Spectroscopy, Centrifugation, Microscopy, Chromatography, Electrophoresis and Radioisotopes.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Distinguish the conventional and recent techniques in the field of spectroscopy like ESR, NMR and MS etc	K5
CO2	Compare and contrast the preparative and analytical ultracentrifugation techniques and the advanced microscopic methods	K5
CO3	Evaluate the advantages and disadvantages of ancient and recent techniques in chromatography.	K5
CO4	Assess and explain the importance of different types of electrophoresis and blotting techniques.	K4
CO5	Differentiate the different biophysical techniques like X- ray diffraction, ORD, CD etc.	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A1CB	BIOCHEMICAL TECHNIQUES AND INSTRUMENTATION	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Spectroscopic techniques 10 h

Principle, instrumentation and applications of Colorimetry, UV-Visible, FTIR, IR, Fluorescence spectrophotometry, Turbidimetry, Luminometry and Flame emission spectrometry, Electron Spin Resonance, Nuclear Magnetic Resonance, Mass and Raman Spectroscopy.

Unit II Centrifugation techniques and Microscopy 10 h

Principle, technique and applications of preparative ultracentrifugation, differential centrifugation, density gradient centrifugation (caesium chloride and sucrose density gradients) and analytical ultracentrifugation.

Basic principles, instrumentation and applications of Microscopes: Light and Compound, Fluorescence, Phase contrast, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM) and Confocal.

Unit III Chromatographic techniques 10 h

Principle, technique and applications of paper, TLC, HPTLC, column, affinity, ion-exchange, gel filtration, hydrophobic interaction and adsorption chromatography. Principle, components, limitations and applications of GC, GC-MS, HPLC, RP-HPLC, LCMS.

Unit IV Electrophoresis and Blotting techniques 9 h

Principle, technique and applications of paper, Gels Electrophoresis: Agarose, Native and SDS- PAGE, Isoelectric focusing, 2D PAGE, Denaturing gels, 3D Electrophoresis and applications. Electrophoresis in DNA sequencing, Peptide mapping, N-terminal sequencing of proteins, Next generation sequencing.

Principle, technique and applications of western, southern and northern blotting. Chemiluminescence and Phosphorimaging.

Unit V Biophysical and Radio-isotopic methods 9 h

Principles and applications of X-ray diffraction, ORD and circular dichroism, Types of radiation, half-life and units of radioactivity, Applications of radioisotopes in disease diagnosis

Detection and measurement of radioactivity– Principle, instrumentation and applications of Liquid scintillation counter and Geiger-Muller counter. Autoradiography and its applications.

Text Books

1 *Sawhney and Singh, 2015,* "**Introductory Practical Biochemistry**", *11th edition, Narosa Publishing house, New Delhi.*

2 *Wilson and Walker, 2018,* "**Principles and Techniques of Biochemistry and Molecular Biology**", *8th edition, Cambridge University Press, London.*

References

1 *Boyer, R.F, 2012,* "**Modern Experimental Biochemistry**", *3rd edition, Pearson Education Inc, NewYork.*

2 *Cooper, T.G, 2011,* "**The Tools of Biochemistry**", *1st edition, John Wiley and Sons, New Jersey.*

3 *Pelczar Jr, Chan and Krieg, 2012,*"**Microbiology**", *5th Edition, Tata Mc Graw Hill, NewYork.*

4 *Srivastava, S, 2010,* "**Molecular Techniques in Biochemistry and Biotechnology**", *1st edition, NewCentral Book Publishers, Kolkata.*

Course Code	Course Name	Category	L	T	P	Credit
233BC2A1CC	ENZYMES AND ENZYME TECHNOLOGY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the structure, function and mechanism of enzymes action
- the current and possible future applications of enzyme technologies.
- the field of biosensors and enzymes immobilization.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Examine the structural and functional properties of enzymes, Isolation and purification of enzymes.	K4
CO2	Analyze the enzyme kinetics, types of enzyme inhibition and its kinetics, solve simple problems related to kinetics	K4
CO3	Evaluate the enzyme specificity, mechanism of enzyme action and regulation of enzyme activity	K5
CO4	Value the use of enzymes in industry and the importance of enzymes in clinical diagnostics and therapeutics.	K5
CO5	Plan a project on enzyme isolation, purification and application of immobilized enzymes.	K6

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A1CC	ENZYMES AND ENZYME TECHNOLOGY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Classification, Purification and Active Site 10 h

Classification of enzymes, isolation and purification of enzymes, criteria of purity-specific activity, molecular weight determination. Active site: structure, determination of active site amino acids, Investigation of 3D Structure of Active site. Models of enzyme substrate binding: Lock and key model and Induced Fit model. Coenzymes and cofactors in enzyme catalysed reaction. Multi-enzyme complex- Pyruvate dehydrogenase, fatty acid synthase. Measurement of enzyme activity: two-point assay, kinetic assay, using radio-labelled substrates.

Unit II Enzyme Kinetics and Inhibition 10 h

Kinetics of single substrate enzyme catalysed reactions: Michaelis-Menten equation, importance of V-max, Km, Kcat and specificity constant (Kcat/Km), turnover number, Lineweaver-Burk plot, Eadie- Hofstee plot, Hanes-Woolf plot and Eisenthal and Cornish-Bowden plot. Kinetics of Allosteric enzymes: MWC and KNF models, Hill' equation coefficient. Sequential and non-sequential bisubstrate and multi-substrate reactions. Enzyme inhibition- types and kinetics. Simple problems related to enzyme kinetics.

Unit III Mechanism of Enzyme Action and Regulation 10 h

Enzyme specificity, Significance and Evaluation of activation energy. Mechanism of enzyme action: general acid-base catalysis, covalent catalysis, proximity and orientation effects, Strain and Distortion theory, mechanism of serine proteases - chymotrypsin, lysozyme, and ribonuclease. Metal activated enzymes and metalloenzymes. Role of metal ions in carbonic anhydrase, superoxide dismutase, carboxy peptidase. Regulation of enzyme activity-covalently modified regulated enzymes, allosteric enzymes, isozymes.

Unit IV Industrial and Clinical uses of Enzymes 9 h

Enzyme applications in food and allied industries: sources of industrial enzymes, thermophilic enzymes, amylases, glucose isomerases, cellulose degrading enzymes, lipases, proteolytic enzymes in meat and leather industry, detergents and cheese production.

Clinical enzymology: Enzymes as thrombolytic agents, anti-inflammatory agents and digestive aids. Therapeutic use of asparaginase, streptokinase. Enzymes and isoenzymes in diagnosis: LDH, CK, transaminases, phosphatases, amylase and cholinesterase.

Unit V Immobilized Enzymes and Biosensors 9 h

Immobilized enzymes: various methods of immobilization, kinetics and applications of immobilized enzyme. Biosensors: Principle, technique and mechanism of Biosensors - Calorimetric biosensors, potentiometric biosensors, Amperometric biosensors, optic biosensors, and immune-sensors. Enzyme engineering: Artificial enzymes. Abzymes and synzymes, Antioxidant enzymes.

Text Books

1 *Palmer, T, 2004,* "**Understanding enzymes**", *1st edition, East West Press Pvt. Ltd., New Delhi.*

2 *Bhatt S.M, 2014,* "**Enzymology and Enzyme technology**", *15th edition, S. Chand publishing Ltd, New Delhi.*

References

1 *Palmer, T and Bonner, P L, 2004,* "**Enzymes: Biochemistry, Biotechnology, Clinical chemistry**", *1st edition, East West Press Pvt. Ltd., New Delhi.*

2 *Price, N C, Stevens, L, 2009,* "**Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins**", *3rd edition, Oxford University Press, United Kingdom.*

3 *Choudhary, N L, Singh, A, 2012,* "**Fundamentals of Enzymology**", *1st edition, Oxford Book Company, New Delhi, India.*

4 *Berg, J M, Tymoczko, J L, Gatto Jr, G J, Stryer, L, 2015,* "**Biochemistry**", *8th edition, W.H. Freeman and Company, New York, USA.*

Course Code	Course Name	Category	L	T	P	Credit
233BC2A1CD	CELLULAR BIOCHEMISTRY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the cellular organization and function
- cellular transport, communication, division, and cancer
- Structure and function of biological membranes

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Distinguish the composition of macromolecules constituting biomembranes and structure and function.	K5
CO2	Distinguish various types of transport system in cells. Compare and contrast different transport process in cells.	K5
CO3	Evaluate the pathways of energy generation and utilization, cytoskeleton organization in a cell.	K5
CO4	Explain the molecules of cellular integration and pathways of cellular communication.	K4
CO5	Examine cell division events and process of cell death. Explain the events leading to cellular transformation.	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A1CD	CELLULAR BIOCHEMISTRY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Membrane Biology 9 h

Biomembrane structure: Fluid Mosaic model, the dynamic nature of the plasma membrane. Membrane lipids: fluidity, asymmetry, phase transition, liposomes, Scott Syndrome. Membrane proteins: Types, orientation, Mobility- Experiments, flippases, proteins on RBC membrane, Bacteriorhodopsin, Porins- aquaporin. RBC ghosts, solubilisation of proteins, lipid anchored proteins. Membrane carbohydrates: cell surface carbohydrates, Lectins.

Unit II Membrane transport 10 h

Membrane transport: Overview, Passive diffusion, Facilitated diffusion in erythrocytes, Carriers and Ion-channels, Uniporter catalyzed transport. Active transport systems: Transport process driven by ATP powered ion Pumps- Calcium ATPase, Na+K+ATPase, Gastric H+K+ATPase, ATPases that transport peptides and drugs, ABC super family- Bacterial PM permeases, Mammalian MDR proteins, Transport process driven by light and ion gradients. Co-transport by Symporters and antiporters. Group translocation, Osmosis and Receptor mediated endocytosis

Unit III Energy metabolism and Cytoskeleton 9 h

Mitochondrial reduction potentials, electron transport chain- overview, complexes, Q-cycle, Cyt-C oxidase complex, translocation of Protons and the establishment of a proton motive force, machinery for ATP formation. Chemiosmotic mechanism, APT Synthase Experiments. Inhibitions of Oxidative phosphorylation- Uncouplers. Microtubules- Organization and dynamics of Kinesin and dynein. Microfilaments- Structures and Assembly of Actin and Myosin. Cilia and Flagella- Structure and functions. Intermediary fi1aments- Assembly and Disassembly. Striated muscle- structure, excitation- contraction.

Unit IV Cellular Integration 10 h

Cell-Cell and Cell-matrix adhesion: An overview. Cell-Cell interaction: ECM-Collagen, hyaluronan & proteoglycans, laminin, integrins and fibronectins. Cell-Cell adhesion- CAMs. Specialized junctions- Desmosomes, Gap junctions. Adhesion molecules-Cadherins, Connexins.

Cell-Cell signaling- Signaling molecules and their receptors: functions of cell surface receptors, pathways of intracellular signal transduction, second messengers - G-protein coupled receptors, receptor tyrosine kinases, MAP kinases.

Unit V Protein Transport and degradation and cell cycle 10 h

Protein targeting: post-translational modifications in prokaryotes and eukaryotes, role of signal peptide, role of endoplasmic reticulum and golgi apparatus. Targeting of proteins to different compartments, translocation, heat shock proteins, molecular chaperons, glycosylation, SNAPs and SNAREs, bacterial signal sequences, mitochondrial, chloroplast and nuclear protein transport, endocytosis-viral entry, ubiquitin tagged protein destruction, Sumoylation

Cell Cycle: Overview and its phases. Regulation of cell cycle and regulatory proteins (Cyclins and CDKCs). Studies of frog oocyte maturation and the discovery of Cyclins. Cell cycle control and check points in yeast and mammalian cells.

Text Books

1. *Rodwell, V.W., Bender, D.A., Botham, K.M., Kennelly, P. and Weil, P.A.*, 2018, "**Harper's Illustrated Biochemistry**", 31st edition, The McGraw-Hill Inc, New York

2. *Verma P S and Agarwal V K*, 2004, "**Cell Biology, Genetics, Molecular Biology, Evolution and Ecology**", 1st edition, S. Chand and Company Limited, New Delhi

References

1. *Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walltre P*, 2015, "**Molecular Biology of the cell**", 6th edition, Taylor and Francis Company, UK.

2. *Kar G, Iwasa J and Marshall M*, 2016. "**Karp's Cell and Molecular Biology: Concepts and Experiments**", 8th edition, John Wiley and Sons, USA

3. *Cooper G M*, 2018, "**The Cell: A Molecular Approach**", 8th edition, Sinauer Associates, Inc., USA.

4. *Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Lawrence Zipursky and James Darnell*, 2016 , "**Molecular Cell Biology**", 8th edition, WH Freeman and Company, New York

233BC2A1CP	CORE PRACTICAL I : ENZYMES AND CELLULAR BIOCHEMISTRY	SEMESTER I

Total Credits: 3
Total Instructions Hours: 72 h

S.No	List of Experiments
1	Partial purification of catalase from natural source
2	Effect of pH, Temperature, Substrate concentration on catalase and determination of Km and Vmax using Lineweaver-Burk graph
3	Assay of enzyme activity and specific activity of catalase
4	Kinetics of activity loss of an enzyme in the presence of trace amounts of metals.
5	Immobilization of enzyme and measurement of its activity
6	Separation of isoenzymes by Native PAGE and SDS PAGE (Demonstration)
7	Preparation of permanent slides and observation of prokaryotic and eukaryotic cells with the help of light microscope
8	Mitosis and cell cycle in Onion root-tip cell
9	Cell counting and viability (Yeast/Bacteria).
10	Determination of osmotic fragility of a cell (Goat RBC) and RBC ghost cell preparation
11	Study of cell viability/ death assay by use of trypan blue or MTT assay
12	Isolation of organelles by subcellular fractionation

References

1 Srivastava S, 2010, "Molecular Techniques in Biochemistry and Biotechnology", 1st edition, New Central Book Publishers, New Delhi..

2 Keith Wilson, John Walker, 2010. "Principle of Practical Biochemistry", 7th edition, Cambridge University Press, England

233BC2A1CQ	CORE PRACTICAL II : BIOMOLECULES AND BIOCHEMICAL TECHNIQUES	SEMESTER I

Total Credits: 2
Total Instructions Hours: 48 h

S.No	List of Experiments
1	Isolation and estimation of Starch from potato
2	Isolation and estimation of Glycogen from the liver
3	Hemagglutination assay of lectins
4	Isolation and estimation of DNA and RNA from goat liver
5	Isolation and Estimation of Phospholipids
6	Isolation and estimation of Casein from Milk
7	Estimation of sodium by Flame photometry
8	Isolation of lymphocytes from Whole blood using Density Gradient Centrifugation
9	Separation of amino acids/ Sugars by thin layer chromatography
10	Separation of plant pigments by column chromatography
11	Agarose gel electrophoresis of genomic and plasmid DNA
12	Analysis of secondary metabolites using HPLC and HPTLC (Demonstration)

References

1 Srivastava S, 2010, "Molecular Techniques in Biochemistry and Biotechnology", 1st edition, New Central Book Publishers, New Delhi.

2 Keith Wilson, John Walker, 2010. "Principle of Practical Biochemistry", 7th edition, Cambridge University Press, England.

Course Code	Course Name	Category	L	T	P	Credit
233MB2A1DA	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 about microbial products and its scale up production through establishing a small scale industry	K2
CO2	Exemplify the ideas about the production and uses of Biofuel and Biofertilizer.	K3
CO3	Demonstrate the commercial production of Biopolymers using Microorganisms.	K4
CO4	Understand the way of cells and enzymes were immobilized for industrial uses.	K3
CO5	Explore the pharmaceutical products and possibilities of converting it to a commercial product.	K4

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233MB2A1DA	MICROBIAL TECHNOLOGY	SEMESTER I

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Microbial products 10 h

Single Cell Protein and its Economic Aspects: Bacterial, 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 10 h

Production, Methods and Uses of Bioethanol (S cerevisiae) – Biodiesel (Chlorella) – Biohydrogen (Chlamydomonas) – Biogas (Methanobacteria). Biofertilizer - N2 fixing, Phosphate Solubilizing, Phosphate Mobilizing, Plant Growth Promoting Rhizobacteria -Mass production and Applications.

Unit III Biopolymer production 8 h

Production and Uses of Polyhydroxybutyrate (PHB) – Xanthan – Alginate – Cellulose – Cyanophycin – Levan - Melanin - Welan - Succinoglucan- Curdlan- Chitosan - Polyhydroxyalkanoates - Hyaluronic acid.

Unit IV Immobilization of Cells & Enzymes 10 h

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

Unit V Microbial products with pharmaceutical importance 10 h

Vaccines – Steps of Manufacturing – Growing the microbes and separation – Preparation of Live and killed vaccine – Preparation of Toxoid and uses – BCG Vaccine – Cholera vaccine – Rabies vaccine – Diptheria toxoid. Pharmaceutical industry - certification & accreditation required. Bioentreprenurship opportunities and Funding sources - Government funds, Venture capital, NGOs, Crowd funding and Incubation centers. Antimicrobial compounds from soil microbes - Case study

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 and Allman A R,* 2012, **Fermentation Microbiology and Biotechnology**, *3rd Edition, CRC Press, USA*

References

1 *Bernard R Glick, Jack J Pasternek and Cheryl L Patten,* 2010, **Molecular Biotechnology - Principles and Applications of Recombianant DNA**, *4th Edition, ASM Publishers, USA]*

2 *Nidhi Goel,* 2013, **Pharmaceutical Microbiology**, *1st Edition, Narosa Publishing House, New Delhi*

3 *Puvanakrishnan R, Sivasubramanian S and 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*

Course Code	Course Name	Category	L	T	P	Credit
233BC2A1DA	CANCER BIOLOGY,DIAGNOSIS AND THERAPY	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- Molecular basis of cancer, mutations causing cancer, and repair mechanisms.
- The basic principles of cancer development and available therapeutic options
- The different diagnostic and treatment methods for cancer.

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 and the morphological characteristics of cancer cells.	K4
CO2	Justify the molecular basis of cancer. Distinguish interdisciplinary areas in cancer biology.	K5
CO3	Evaluate the molecular mechanism of oncogenesis, tumor biology and the role of cell cycle in cancer.	K5
CO4	Validate the role of tumor suppressor genes and apoptosis. Explain about epigenetics.	K5
CO5	Summarize on the choice of diagnosis and therapy available for cancer patients.	K6

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A1DA	CANCER BIOLOGY, DIAGNOSIS AND THERAPY	SEMESTER I

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Introduction 9 h

Introduction: Cancer cell-morphology and growth characteristics. Metastasis and cytoskeleton. 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 9 h

Cancer epidemiology and 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. Mutation Types-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 carcinogenecity, Ames test. Aberrant metabolism during cancer development.

Unit III Tumor Markers and Signal Transduction 10 h

Oncogenes - RNA and DNA tumor viruses, retroviruses and viral oncogenes and abrupt activation. Src and Ras gene, mechanism and characteristic of cell transformation. Molecular mechanism of oncogenesis- protooncogenesis, oncoproteins, tumor suppressor genes involved in cancer. Radiation- effect of ionizing radiations on DNA, chromosomal aberrations. Cancer Markers: Genetic basis of cancer, 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-α and TGF-β and growth factor receptors. Free radicals and antioxidants in cancer. Diet and cancer.

Unit IV Cell Cycle, Cell Death and Cancer 10 h

Cell Cycle Regulation cancer: control of the cell cycle - cyclins and CDKs, and tumor suppressor genes p53, p21Rb, BRAC1 and BRAC2. Telomeres, and Immortality; Epigenetics- role of DNA methylation in gene silencing- epigenetic silencing of tumor - suppressor genes. Death - signaling pathways - mitochondrial and death receptor pathways, (Intrinsic- extrinsic pathways). Mechanism and Impact of apoptosis.

Unit V Cancer Diagnosis and Cancer Therapy, Stem Cells and Cancer 10 h

Principles and methods of cancer diagnosis - biochemical, genetic, cytotoxic, cell growth and viability tests. Diagnosis of cancer by histopathology, MRI scans, PET scan, cytogenetics test, kariotype, FISH. Strategies of anticancer drug therapy–chemotherapy, gene therapy, immuno therapy, radiotherapy and surgical therapy. Principles of cancer biomarkers and their applications.

Text Books

1 Mc Kinnell R.G et al, 2012, "The Biological Basis of Cancer", 2nd edition, Cambridge University Press, London.

2 Weinberg R.A, 2014, "The Biology of Cancer", 2nd edition, Garland Science, New York & London.

References

1 Vincent T. De Vita M. D et al, 2020, "Principles and Practice of Oncology: Primer of Molecular Biology in Cancer", 3rd edition, Lippincott Williams and Wilkins, Philadelphia.

2 Pelengaris S and Khan M, 2010, "The Molecular Biology of Cancer - A bridge from bench to bed side", 2nd edition; Wiley Black well, London.

3 Hesketh R, 2013, "Introduction to Cancer Biology", 1st edition, Cambridge University Press, London.

4 Pezzella F et al, 2019, "Oxford textbook of Cancer Biology", 1st edition, Oxford University Press, London

Course Code	Course Name	Category	L	T	P	Credit
233BT2A1DA	APPLIED BIOTECHNOLOGY	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- the applications of biotechnology in plant , animal and Environmental field
- the applications of biotechnology in health care sector
- the products obtained from fermentation and its applications.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the fundamental applications of Biotechnology	K1
CO2	Know the basics and fundamentals of biotechnology applications in environment.	K2
CO3	Discuss about the disease and disease prevention.	K3
CO4	Discuss the applications of Enzymes in various fields.	K4
CO5	Discuss the production and application of products obtained from fermentation technology.	K1

MAPPING WITH PROGRAMME OUTCOMES

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

	Skill Development	✓	Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BT2A1DA	APPLIED BIOTECHNOLOGY	SEMESTER I

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Agricultural, Plant Biotechnology and Animal Biotechnology 10 h

Applications of transgenic crop technology: Herbicide resistance (Glyposate Resistance plants), Pest resistance (Bt Cotton) and Virus Resistance. Enhancement of micro-nutrients (Vitamin A &, Vitamin E). Delayed Fruit Ripening. Molecular pharming in plants. Transgenic animals (Transgenic mice and Transgenic cattle). Production and recovery of products from animal tissue cultures (Blood clotting factors, Growth hormones, insulin).

Unit II Environmental Biotechnology 08 h

Bioremediation- (Bioaugmentation and Biostimulation). Biodegradation of Xenobiotic componds . Bioleaching. Microbially Enhanced Oil Recovery. Biotechnological methods for hazardous waste management. Bioindicators –Biomarkers –Biosensors –Management for effluent toxicity, heavy metal pollution, thermal and radioactive pollution

Unit III Health Care Biotechnology 10 h

Disease prevention – vaccines: conventional vaccines, purified antigen vaccines, recombinant vaccines. DNA vaccines, synthetic vaccines. Disease Diagnosis – Probes, monoclonal antibodies and detection of genetic diseases. Disease treatment – interferons, monoclonal antibodies. gene therapy, enzyme therapy and replacement. Forensic medicine.

Unit IV Enzyme Biotechnology 10 h

Enzyme used for Diagonistic purpose- (acid phosphatase, alanine aminotransferase and alkaline phosphatase). Cardiac Biomarkers. Enzymes used for screening liver and kidney diseases. Enzymes used in food Industry, leather industry, wool industries,dairy industry and Textile industry.

Unit V Fermentation Biotechnology 10 h

Production, harvest, recovery and uses – enzymes, Antibiotics (Tetracycline), vitamins (B2), Aminoacids (glutamic acid), Organic solvents (ethanol); Organic acids (lactic acid). Single Cell Protein (algae), beverages (Wine). Formulation of Biofertilizer (Rhizobium), Biopesticides.

Text Books

1 *Bernard R Glick and Jack J Pasternak*, 2010, **Molecular Biotechnology: Principles and Applications of recombinant DNA,** *4th Edition. ASM Press*

2 *Slater, Scott, and Fowler*, 2008, **Plant Biotechnology: The genetic manipulation of plants.** *2nd Edition. Oxford University Press, UK*

References

1 *S. S. Marwaha & K. Arora*, 2000, **Food processing Biotechnological application**, *Asiatech Publishers INC, New Delhi*

2 *T. Palmer, Bonner PLR*, 2014, **Enzymes: Biochemistry, Biotechnology and Clinical Chemistry**, *2nd Edition. Woodhead Publishing Limited, Oxford.*

3 *P.F. Stanbury and A.Whitaker*, 2005, **Principles of Fermentation technology**, *2nd Edition. Pergamon press.*

4 *El-.Mansi, C.F.A. Bryce, A.L. Demain, A.R. Allman* , 2007, **Fermentation microbiology and Biotechnology,** *2nd edition, Taylor and Francis.*

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APPROVED

BoS	AC -	GB -
14/6/2023	14/7/2023	20/7/2023

Academic Council
CHAIRMAN
Dr.N.G.P. Arts and Science College

Course Code	Course Name	Category	L	T	P	Credit
233BC2A2CA	IMMUNOLOGY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the immune system and its components
- the defense mechanisms against infection, and Immune-related diseases
- basic immunological principles involved in research, clinical/applied science

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Distinguish primary & secondary responses, humoral & cell mediated immunity, innate & adaptive immunity	K4
CO2	Explain the concepts of antigen, antibody & antigen-antibody interaction	K4
CO3	Analyze complement activation, identify cytokines, infer immune responses to infections & AIDS	K4
CO4	Evaluate the basis of allergic responses, transplantation and tumor immunology	K5
CO5	Justify the practical application of vaccines & immunological techniques	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment/ Ethics		

233BC2A2CA	IMMUNOLOGY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Cells of Immune System and Immune Responses 10 h

Cells of Immune System: Hematopoiesis, hematopoietic growth factors, Regulation of hematopoiesis, clinical uses of stem cells. Lymphoid cells and myeloid cells, CD antigens and membrane molecules of immune cells. Development, maturation, activation and differentiation of T-cells and B-cells, adhesion molecules. Immune Responses: Humoral and cell-mediated immune responses, primary and secondary immune responses, Clonal selection theory.

Unit II Antigens, Antigen Recognition, Immunoglobulins and Antigen antibody interaction 10 h

Antigens: B-cell epitopes, T-cell epitopes, antigenicity and immunogenicity, factors influencing immunogenicity, Haptens, adjuvants; Immunoglobulins: Structure and functions, Isotype, allotypes, Idiotypes; Classes, Immunoglobulins super family. Organization and expression of immunoglobulin genes, generation of antibody diversity. Class switching. T-cell receptor and its diversity. Antigen Recognition: MHC-Genetic organization and inheritance, Antigen processing and presentation (Cytosolic and Endocytic pathway).

Unit III Complement, Cytokines, Cytotoxicity, Immune Responses to Infections and AIDS 9 h

Complement system: components of complement activation and its biological consequences - classical, alternative and lectin pathways. Cytokines: IL, IFN, TNF, CSF- role in immune regulation, Cytokine receptors, Cytokine antagonists. Cell mediated immunity: CTL mediated cytotoxicity, NK cell mediated toxicity. Primary and secondary immunodeficiency diseases. AIDS: Structure of HIV, destruction of T cells, CD4+/CD8+ ratio, immunity to HIV virus, AIDS vaccine.

Unit IV Hypersensitivity, Autoimmunity, Animal Models, Transplantation and Cancer immunology 9 h

Hypersensitivity reactions: Type I, II, III & IV. Autoimmunity - organ specific (Hashimoto's thyroiditis) and systemic (Rheumatoid arthritis, Systemic lupus erythematosus) diseases. Experimental Animal Models: inbred strains, SCID mice,

nude, knockout mice. Transplantation immunology: Immunologic basics of Graft rejection, MHC antigens in transplantation and HLA tissue typing, Immunosuppressive therapy. Cancer immunology: Immune response to tumors, Immunological surveillance of cancer, Cancer immunotherapy.

Unit V Vaccines and Immunotechniques 10 h

Vaccines: Active and passive immunization, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, multivalent subunits vaccines, COVID 19 vaccine. Immunotechniques: Hybridoma technology - Introduction, Antibody engineering (production of monoclonal antibodies). Agglutination, precipitation, immune-diffusion, immuno-electrophoresis, ELISA, RIA, western blot, Avidin – biotin mediated immunoassay. Immunohistochemistry – immunofluorescence, immunoferritin technique. Fluorescent immunoassay, fluorescence activated cell sorting (FACS). Cytokines assay: ELISPOT. Lymphocytes transformation test (LTT); Lymphoblastoid cell lines. Chemiluminesence.

Text Books

1. Kindt, T., Goldsby, R.A and Osborne, B.A. 2018, "Kuby Immunology", 8th Ed, Prentice Hall, New Delhi.
2. Kenneth M. Murphy, Paul Travers, Mark Walport., 2011 "Janeway's Immunobiology", 8th edition, Garland Science, New York.

References

1. Delves, Martin, Burton, Roitt. 2001, "Roitt's Essential Immunology", 11th Edition, Blackwell Publishers, Oxford.
2. Abbas, A.K., Lichtman, A.H., and Pillai S. 2015, "Cellular and Molecular Immunology", 8th Edition, Elsevier Saunders. (eBook at: http://library.anu.edu.au/record=b3609426)
3. Parham P. 2014, "The Immune System", 4th Edition, Garland Science, New York.
4. Fathimunisa Begum, 2014, "The Elements of Immunology", 1st Edition, PHI Learning Private Limited, New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
233BC2A2CB	METABOLISM	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- energy generation and utilization in a biological system
- catabolic and anabolic pathways of biologically vital macromolecules
- the regulation of metabolic pathways

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Illustrate the bioenergetics principles, Electron transfer and oxidative phosphorylation	K3
CO2	Analyze the carbohydrate metabolism. Distinguish the regulation and analysis of metabolic pathways	K4
CO3	Demonstrate the lipid metabolism and its regulation	K3
CO4	Evaluate amino acids metabolic pathways and predict the metabolic interaction among the major organ	K5
CO5	Analyze the Porphyrin metabolism, Nucleic acid metabolism and its regulation	K4

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A2CB	METABOLISM	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Bioenergetics, ETC and Oxidative Phosphorylation 10 h

Enthalpy, Entropy, Spontaneous and non-spontaneous thermodynamic reaction, equilibrium constant and concept of free energy, Free energy change in a reaction, Importance of coupled process in living things, Phosphoryl group transfers and ATP, Biological Oxidation -Reduction reactions. Electron Transfer reaction in Mitochondria: Components of ETC and its organization, Sequence of Electron Transport. Oxidative Phosphorylation: ATP synthase- Structure and Mechanism of action, Inhibitors of ETC, Uncouplers, P/O ratio, Mitochondrial Transport systems - Glycerophosphate shuttle system, Malate-aspartate shuttle system.

Unit II Pathway regulation, analysis and Carbohydrate Metabolism 10 h

Pathway Regulation: Regulation of Intermediary metabolism, Role of regulatory enzymes,Energy charge. Strategies for pathway analysis: Single step and Multistep pathway analysis. Glycolysis and gluconeogenesis: Pathway, Key enzymes and Co-ordinate regulation. Pyruvate dehydrogenase complex and the regulation of this enzyme through reversible covalent modification. The citric acid cycle and regulation. The pentose phosphate pathway, Glucuronic acid pathway. Metabolism of glycogen and regulation. Metabolism of galactose and fructose. The glyoxylate cycle, Cori cycle, Anaplerotic reactions, Futile cycles and their applications.

Unit III Lipid Metabolism 9 h

Lipid metabolism: Lipogenesis-Biosynthesis of long chain fatty acid, Fatty acid synthase complex, Control of acetyl CoA carboxylase, Role of hormones, Effect of diet on fatty acid biosynthesis. Biosynthesis of triacylglycerol and phospholipids. Biosynthesis and degradation of cholesterol and its regulation. β Oxidation of fatty acids, Regulation of fatty acid metabolism. Ketogenesis and Ketolysis. Composition and synthesis of lipoproteins and their transport in the body. Biosynthesis of Prostaglandins, Thromboxanes and Leukotrienes.

Unit IV Metabolism of Amino acids and and Integrated Metabolism 10 h

Amino acids metabolism: An overview on Gamma-glutamyl cycle. An overview Methionine as methyl donor (SAM pathway). An overview & regulation of urea cycle. Biosynthesis of Alphaketoglutarate family, Pyruvate family. 3-

Phosphoglycerate family, Aspartate family and Aromatic amino acid family. Allosteric regulation of glutamine synthase. Integration of metabolism: Three forms of energy storage, Metabolism in a multicellular organism, Metabolic interaction among major organ systems-Brain, Muscle, Heart, Adipose tissue and Liver.

Unit V Porphyrin and Nucleic acids metabolism 9 h

Porphyrin metabolism: Biosynthesis and degradation of heme, chlorophyll and cytochrome and their regulation. Nucleic acid metabolism: Pathways of purines and pyrimidines biosynthesis (both de novo and salvage pathways) and degradation. Regulation of purine biosynthesis: PRPP aminotransferases. Regulation of pyrimidine biosynthesis: Aspartate carbamoyltransferase.

Text Books

1 Nelson D L and Cox M M, 2017, "Legninger's Principles of Biochemistry", 7th Edition, Macmillan Learning, New Delhi

2 Garrett R H and Grisham, 2017, "Biochemistry",6th Edition, Brooks/Cole Cengage Learning, Boston

References

1 Rodwell V W, Bender, D A, Botham, KM, Kennelly P and Weil P A, 2018, "Harper's Illustrated Biochemistry" 31st Edition, The McGraw-Hill Inc, New York

2 Veer Bala Rastogi and Aneja K R , 2016, "Zubay's Principle of Biochemistry", 5th Edition, Medtec Publishers, New Delhi

3 Berg J M, Tymoczko, J L , Gatto Jr, G J and Stryer, L, 2019, " Biochemistry", 9th Edition, W H Freeman and Company, New York

4 Voet D and Voet J G, 2011, " Biochemistry" 4th Edition, John Wiley and Sons, New York

Course Code	Course Name	Category	L	T	P	Credit
233BC2A2CC	MICROBIAL BIOCHEMISTRY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the major metabolic and energy exchange pathways in microbial cell homeostasis
- the applications of biotechnology in diverse areas of agriculture, medicine and environmental biology
- the production of antibiotics, amino acids, vitamins and single cell protein from microbial source

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Evaluate the importance of microbial nutrition, bacterial growth and its growth kinetics	K5
CO2	Summarize the central metabolic pathways existing in microbes	K5
CO3	Compare different types of fermentation technology	K6
CO4	Value the application of microbes in agriculture, mining, and energy production and food industry	K6
CO5	Explain the production of antibiotics, amino acids and single cell protein from microbial source	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A2CC	MICROBIAL BIOCHEMISTRY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Microbial Nutrition, Medium, Growth and Measurement 10 h

Microbial Nutrition: nutritional requirements and uptake of nutrients by microbial cells; Transport of sugars into bacterial cell– the bacterial phosphotransferase system. Transport of non-PTS sugars. Membrane bound transport systems- E.Coli lactose permease, Beta-methyl galactoside system. Nutritional groups of microorganisms (autotrophs, heterotrophs and mixotrophs). Growth media: synthetic, complex, selective, enrichment and differential media. Microbial Growth- different phases of growth in batch cultures, synchronous, continuous and biphasic growth. Factors influencing microbial growth. Methods for measuring microbial growth. Bacterial Cell cycle.

Unit II Microbial Energy and Synthesis Biology 9 h

Energy yielding metabolism: carbohydrates– EMP, HMP, TCA– importance in bacteria. Phosphoketolase pathway, ED pathway, characteristics of electron transport in bacteria. Bacterial Chemotaxis and quorum sensing. Biosynthesis of cell wall– peptidoglycan, teichoic acid, lipids; biosynthesis of straight and branched chain fatty acids, unsaturated fatty acids and cyclopropane fatty acids. Synthesis of triacylglycerols, phospholipids, glycolipids and polyisoprenoids. Aminoacid synthesis in microbes. Metabolism of purines and pyrimidines.

Unit III Fermentation Technology 9 h

Fermentation technology: Principles of fermentation, surface, submerged and solid-state fermentations. Batch, fed batch, semi-continuous and continuous culture techniques. Strain improvement for better yield, Downstream processing. Specialized Bioreactors. Design of fermenter- parts of the fermenter and their functions. Types of fermentors: Waldhof, tower, cylindro-conical, air-lift, deep-Jet, cyclone column, packed tower and rotating disc fermenter. Types of reactions in fermentations.

Unit IV Environmental and Agricultural Technology 10 h

Genetically modified organisms. Production of biogas from agricultural wastes. Production of bio-insecticides from bacteria and fungi. Bio fertilizers - bacteria and blue-green algae. Environmental Microbiology: Microbiology of food-food

spoilage, controlling food spoilage, types of food borne diseases, microbiology of fermented food, Applied environmental microbiology- water purification and sanitary analysis. Waste water treatment. Bio-degradation, bioremediation and bio-augmentation.

Unit V Industrial and Pharmaceutical Biotechnology 10 h

Production of antibiotics: source, production, recovery and uses of penicillin, tetracycline, streptomycin, amoxicillin. Production of bacterial and fungal polysaccharides; Commercial production of xanthan gum. Single cell protein-production and application. Microbial production of Primary metabolites: organic acids (Acetic acid, lactic acid, and citric acid), Amino acids (glutamic acid, lysine, threonine, phenylalanine) and Vitamins (B12, B2, and vitamin-C). Enzymesamylase, proteases, streptokinase.

Text Books

1 Joanne. M. Willey, Linda M. Sherwood, Christopher. J. Wollverton, 2011, "Prescott's Microbiology", 8th Edition, Mc Graw Hill International, New York

2 El-Mansi, E.M.T. Bryce C.F.A. Daou, B, Sanchez.S, Demain .A.L., 2014, "Fermentation Microbiology & Biotechnology", (3rd Edition, Taylor & Francis Group, UK

References

1 Lanshing M, Prescott, John. P. Harley, Donald A Klein, 2009, "Microbiology", 4th Edition, Mc Graw Hill International Edition, New York.

2 Srivastava M L, (2008). "Fermentation Technology", 1st Edition, Narosa Publishing House, NewDelhi.

3 Prave P, Faust U, Sittig W, Sukatsch D A, 2004, "Fundamentals of biotechnology", 2nd Edition, Panima Publishing Corporation, New Delh

4 Patel A H, 2016,"Industrial Microbiology", 2nd Edition, Trinity Press, New Delhi

Course Code	Course Name	Category	L	T	P	Credit
233BC2A2CD	GENETICS AND MOLECULAR BIOLOGY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The core principles of genetics and molecular biology
- How genetic information flows from DNA to RNA to protein and its regulation mechanisms
- Demonstrate knowledge of the molecular machinery of living cells

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Illustrate basic principles of Mendelian & Non-Mendelian inheritance and core genetic concepts	K3
CO2	Summarize the mechanisms of DNA replication and recombination	K2
CO3	Explain the mechanisms of Transcription and Translation	K2
CO4	Analyze the processes of gene regulation and predict how a gene will be expressed under specific circumstances	K4
CO5	Compare and contrast various molecular events of DNA damage & repair	K4

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A2CD	GENETICS AND MOLECULAR BIOLOGY	SEMESTER II

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Genetics 10 h

Mendelian Principles: Segregation, Independent Assortment, Dominance relations, Multiple alleles, Incomplete dominance, Over dominance. Gene interaction, Epistasis, lethal genes, Sex determination and sex linkage, linkage, crossing over and chromosome mapping. Chromosomal theory of inheritance, Chromosomal aberrations and evolutions, Extrachromosomal Inheritance, maternal effects. Introduction to Population genetics, gene frequency, factors affecting gene frequency, Hardy-Weinberg Law. Genetic drift, Pedigree analysis and genetic counseling, Eugenics. Fine structure of Gene, cistron, recon, Structures of Eukaryotic and Prokaryotic genes. Experimental evidence for DNA as the genetic material

Unit II Replication and Recombination 10 h

Replication in prokaryotes: Replication in circular chromosomes- Cairns model, rolling circle model. Eukaryotic replication, replication fidelity. Replication in RNA virus (retroviruses). Inhibitors of replication. DNA recombination: Homologous recombination: Holliday Model and Rec BCD pathway. Site-specific recombination: Lambda phage integration, and excision rearrangement. Transposition: Prokaryotic transposition, conservative and replicative transposition. Eukaryotic transposable elements: Retro-Transposons, DNA -Transposons

Unit III Transcription and Translation 10 h

Transcription: coding strand, template strand, sense strand and antisense strand, promotor, DNAdependent RNA polymerase, role of Pribnow box, template binding, prokaryotic transcription, Rho-dependent and independent transcription, posttranscriptional processing in prokaryotes, alternative splicing, RNA editing. Nuclear export of mRNA- mRNA stability. Inhibitors of transcription Eukaryotic transcription, post-transcriptional modifications of eukaryotic RNAs, RNA splicing, introns and splicing reactions, exons and enhancers Genetic code: deciphering of the genetic code, Salient features, prokaryotic and eukaryotic protein biosynthesis: initiation, elongation, translocation and termination, polysomes, Regulation of translation, Inhibitors of translation, Post translational modification of proteins.

Unit IV Gene Regulation 10 h

Regulation of gene expression in prokaryotes: operon model- lac, trp, araBAD operons, Riboswitches, Heat shock response in E.coli, Flagellar variation in salmonella; Lux Operon and quorum sensing, Two component systems in nutrient sensing. Regulation of gene expression in eukaryotes: Britten-Davidson model, transcriptional regulation. C-value paradox, repetitive DNA. Genes controlling yeast mating types, Xenopus 5S rRNA in oocytes, Silk fibroin gene, Drosophila sex determination, Chicken globin genes and Environmental gene regulation.

Unit V DNA Damage and Repair 8 h

Mutagenesis: Spontaneous and Induced mutations - Physical and Chemical mutagenesis, Molecular mechanisms of mutagenesis - Transition, Transversion, Frame Shift, missense and nonsense mutations. Detection of mutations: CLB Method and attached method. DNA repair - Direct reversal repair, double strand break repair in mammals, Excision repair - base and nucleotide excision repair, mismatch repair, recombination repair, SOS response and mutagenic repair

Text Books

1 Ajoy Paul, 2011, "Text book of Genetics", 1st Edition, Books and Allied (P) Ltd, Kolkatta

2 Jeyanthi GP, 2009, "Molecular Biology", 1st Edition, MJP Publisher, Chennai

References

1 Robert F. Weaver, 2011, "Molecular biology", 5th Edition, McGraw Hill Education, London.

2 Karp G, Iwasa J and Marshall W, 2015, "Karp's Cell and Molecular Biology: Concepts and Experiments", 8th Edition, John Wiley and Sons, New Jerssey

3 Klug WS, Cummings MR, Spencer CA, Palladino MA and Killian D, 2018, "Concepts of Genetics", 12th Edition, Pearson Education, London.

4 Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh, H, Amon A and Martin KC, 2016, "Molecular Cell Biology", 8th Edition, W.H. Freeman, New York

233BC2A2CP	CORE PRACTICAL : IMMUNOLOGY AND MOLECULAR BIOLOGY	SEMESTER II

Total Credits: 3
Total Instructions Hours: 72 h

S.No	Contents
1	Raising of antibodies in animal model and isolation of antibodies.
2	Partial purification of antibodies - Ammonium sulphate precipitation and Dialysis.
3	Precipitin Ring Test.
4	Detection of antigens/antibodies by ELISA technique (CMIA, ECLIA-Industrial Visit).
5	Immuno-electrophoresis of antigens.
6	Precipitation reaction - Single and Double Immunodiffusion.
7	Latex agglutination test - widal Test.
8	Blood smear identification of leucocytes by Giemsa staining.
9	Isolation of chromosomal DNA from bacterial culture and separation on agarose gel electrophoresis.
10	Isolation of plasmid DNA from bacterial culture and separation on agarose gel electrophoresis.
11	Isolation of total RNA from yeast/E.coli and separation on agarose gel electrophoresis.
12	Transformation of E.coli cells with plasmid DNA and blue or white colony test for lac+/lac-
13	Effect of UV dose on survival rate of bacteria.
14	Determination of DNA damage by comet assay (Demonstration).
15	Karyotyping (Demonstration).

Note:

References

1 Frank C. Hayand Olwyn, M.R. Westwood, 2002, "Practical Immunology", 4th Edition, Blackwell Science, United States.

2 Stevens CD, 2010, Clinical immunology and serology - A laboratory perspective, 3rd edition, F.A. Davis company, Philadelphia.

3 Gakhar SK, 2013, "Molecular Biology -A laboratory manual", 1st Edition, I.K International, NewDelhi.

4 Sharma RK, 2008, "Basic techniques in Biochemistry and Molecular Biology", 1st Edition, IK international Pvt Ltd, NewDelhi.

233BC2A2CQ	CORE PRACTICAL : MICROBIAL BIOCHEMISTRY AND METABOLISM	SEMESTER II

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Determination of microbial growth-turbidity method
2	Biochemical Characterization of Bacteria IMViC test, Hydrogen sulphide test, Oxidase test, Catalase test, Urease test, Nitrate reduction test, Triple sugar Iron agar test.
3	Determination of Antibiotic Sensitivity.
4	Production and assay of amylase activity by shake flask method by batch fermentation
5	Production and estimation of red wine from grapes.
6	Production and estimation of acetic acid by Aspergillus niger
7	Estimation of Glucose by DNS Method.
8	Estimation of pyruvate by DPNH (2, 4-dinitrophenylhydrazine) method.
9	Estimation of Methionine.
10	Estimation of Protein by Bradford's method
11	Estimation of MDA as an index of Lipid Peroxidation.
12	Estimation of Lipoproteins.
13	Estimation of Iron by Wong's Method.

References

1 Kannan N, 1996, "Laboratory Manual of General Microbiology", 1st Edition, Panima Publishing House, New Delhi, India.

2 Aneja K R, 2012, "Experiments in Microbiology, Plant Pathology, and Biotechnology", 4th Edition, New Age Publishers, New Delhi, India.

3 Rajan S, Selvi Christry R, 2018, "Experimental Procedures in Life Sciences", CBS Publishers and Distributors Pvt. Ltd. India

4 James G Cappuccino, Natalie Sherman, 2013, "Microbiology: : A Laboratory Manual", 10th Edition, Pearson Publication, London, United Kingdom

Course Code	Course Name	Category	L	T	P	Credit
233MB2A2DA	BIONANOTECHNOLOGY	DSE	3	1	-	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 characterization 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	Explore the basics of Nanosciences and its applications	K3
CO2	Synthesize nanoparticles at the laboratory scale	K4
CO3	Analyze the nanoparticles by spectral and electron microscopic techniques	K4
CO4	Apply bionanomaterials in drug development and delivery	K4
CO5	Criticize the merits and demerits of nanomaterial applications	K4

MAPPING WITH PROGRAMME OUTCOMES

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

COURSE FOCUSES ON

☑ Skill Development	☑ Entrepreneurial Development
☑ Employability	☑ Innovations
☑ Intellectual Property Rights	Gender Sensitization
Social Awareness/ Environment	Constitutional Rights/ Human Values/ Ethics

233MB2A2DA	BIONANOTECHNOLOGY	SEMESTER II

Total Credits: 3

Total Instruction Hours: 48 h

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, Nanofiber, Dendrimeter. Emergence of Bionanotechnology.

Unit II Synthesis of nanoparticles 10 h

Synthesis - Top-down approach & bottom-up approach - Types of nanoparticles production - principle and mechanism of synthesis – physical - Sonicator, Ball mill, ablation, evaporation-condensation; chemical - reducing method - chemical reduction, irradiation, electrochemical, photoreduction; biological - microbes, plants. Green synthesis

Unit III Characterization of Nanoparticles 10 h

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, FTIR, NMR.

Unit IV Applications of bionanotechnology 10 h

Targeted drug delivery, biosensors and biomarkers, food and agriculture, DNA nanotech, nanoviricides, tissue engineering, gene delivery. Antibacterial activities of nanoparticles. Toxicology in nanoparticles – Dosimetry. Molecular nanotechnology – nanomachines – collagen.

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. Bioinformatic tools in nanotechnology: molecular modeling, docking, computer assisted molecular design.

Case study- merits and demerits of nanoparticles in health and environment safety

Text Books

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

References

1. *Bernd Rehm, 2006,* **Microbial Bionanotechnology: Biological Self-assembly Systems and Biopolymer-based Nanostructures**. *Horizon Scientific Press.*
2. *David E Reisner and Joseph D Bronzino,2008,* **Bionanotechnology: Global Prospects.** *CRC Press, New Delhi.*
3. *Ehud Gazit, 2006,* **Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology.** *Imperial College Press.*
4. *Kamali Kannangara, 2005,* **Nanotechnology: Basic science and Emerging technologies**- *Mick Wilson, Overseas Press.*

Course Code	Course Name	Category	L	T	P	Credit
233BC2A2DA	BIOCHEMISTRY OF TOXICOLOGY	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- The biochemical basis of toxicology.
- The effects & metabolism of toxins
- General toxicology, methods of toxicity testing, toxins from microbes, carcinogenic & teratogenic toxins, pesticide, metal and chemical toxicology.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Conclude the importance of toxicology.	K5
CO2	Distinguish and evaluate the biochemical effects of toxic agents on cellular macromolecules and tissues.	K5
CO3	Compare and perceive different genetic methods used for testing toxicity.	K5
CO4	Assess the effects and metabolism of various microbial Toxins, teratogens and carcinogens.	K5
CO5	Justify the mode of action of toxic pesticides, heavy metals, chemicals and air pollutants.	K5

MAPPING WITH PROGRAMME OUTCOMES

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

COURSE FOCUSES ON

☑ Skill Development	☑ Entrepreneurial Development
☑ Employability	☑ Innovations
☑ Intellectual Property Rights	Gender Sensitization
☑ Social Awareness/ Environment	Constitutional Rights/ Human Values/ Ethics

Course Code	Course Name	Category	L	T	P	Credit
233BC2A2DA	BIOCHEMISTRY OF TOXICOLOGY	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- The biochemical basis of toxicology
- The effects & metabolism of toxins
- General toxicology, methods of toxicity testing, toxins from microbes, carcinogenic & teratogenic toxins, pesticide, metal and chemical toxicology

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the importance of toxicology	K2
CO2	Distinguish and evaluate the biochemical effects of toxic agents on cellular macromolecules and tissues	K4
CO3	Compare the different genetic methods used for testing toxicity	K4
CO4	Analyze the effects and metabolism of various microbial Toxins, teratogens and carcinogens	K4
CO5	Assess the mode of action of toxic pesticides, heavy metals, chemicals and air pollutants	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A2DA	BIOCHEMISTRY OF TOXICOLOGY	SEMESTER II

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Introduction to Toxicology 9 h

Definition and scope of toxicology, Classification of toxic agents. Dose-response relationship: Synergism and Antagonism, Determination of ED50 and LD50. Acute and chronic exposures, Factors influencing toxicity - Abiotic and Biotic factors, Chemical interactions - Bioaccumulation and Bio-magnification.

Unit II Biochemical basis of Toxicology 9 h

Toxicokinetics–ADME (Absorption, Distribution, Metabolism and Excretion) and Toxicodynamics. Mechanisms of Toxicity, Interaction of toxicant with target molecules - Disturbance of excitable membrane function. Altered calcium homeostasis. Covalent binding to cellular macromolecules. Organ toxicology, Genetic and reproductive toxicology, Toxicogenomics.

Unit III Principles and procedures of testing for acute toxic effects 10 h

Toxicity testing - Genetic toxicity testing and mutagenesis assays - In-vitro test systems - Bacterial mutation tests: Reversion test, Fluctuation tests, Ames test, Eukaryotic mutation test. In-vivo mammalian mutation tests - Host mediated assay and Dominant lethal test. Use of drosophila in toxicity testing. DNA Repair assays, Chromosome damage test. Toxicity testing in animals. Toxicological evaluation of Recombinant DNA – derived proteins.

Unit IV Effects and Metabolism of toxins 10 h

Fungal toxins, Mycotoxins - Aflatoxins, Bacterial toxins – Exotoxins and Endotoxins, Viral toxins, Algal toxins, Teratogens, Carcinogens, Mutagens, Snake venom toxin, Spider, Scorpion and Jellyfish toxins, Antivenom. Xenobiotic metabolism: Phase 1– III reactions, Cytochrome-P450. Free radical theory of oxygen toxicity

Unit V Pesticide toxicology, Metal toxicology, Chemical toxicology, Air and water pollutants 10 h

Mechanism and site of action of Chlorinated organics (DDT, BHC), organophosphates and carbamates. Fungicides, Herbicides. Environmental consequences of pesticide toxicity. Biopesticides, Mode of action of toxic heavy

metals - arsenic, mercury, cadmium and lead. Biochemical effects of ozone, peroxyacetyl nitrate (PAN) carbon monoxide, nitrogen oxides, sulphur dioxide and cyanide. Drug induced toxicity –example- Paracetamol. Common air pollutants, water pollutants and their sources, air pollution due to methyl - isocyanate (MIC) and asbestos. Toxicology of food additives, case studies

Text Books

1 Klaassen Curtis D, 2019, Casarett and Doull's Toxicology - The basic Science of Poisons, 9th Edition, McGraw Hill Education, London

2 Klaassen Curtis D, 2019, Casarett and Doull's Toxicology - The basic Science of Poisons, 9th Edition, McGraw Hill Education, London

References

1 Robert S.M and James R.C, 2015, Principles of Toxicology: Environmental and Industrial Applications, 3rd Edition, John Wiley and Sons, New York

2 De A.K, 2017, Environmental Chemistry, 8th Edition, Newage International Publishers, NewDelhi.

3 Gupta P.K, 2016, Fundamentals of Toxicology – Essential concepts and Applications, 1st Edition, Academic Press, Cambridge, USA

4 Gupta R, 2019, Biomarkers in Toxicology, 2nd Edition, Academic Press, Cambridge, USA

Course Code	Course Name	Category	L	T	P	Credit
233BT2A2DA	FORENSIC BIOTECHNOLOGY	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- Basics and fundamentals of the sample collection and examination in forensic aspects
- Different types of DNA profiling and DNA databases used in Forensic analysis
- Applications of Forensic Biotechnology in various fields

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the sample collection for forensic examinations.	K2
CO2	Know the methods to characterize the different samples on forensic prospective.	K3
CO3	Interpret and examine forensic evidence by DNA profiling methods	K3
CO4	Analyze and interpret the forensic DNA Statistics and Database	K4
CO5	Conclude the significance and applications of Forensic Biotechnology	K4

MAPPING WITH PROGRAMME OUTCOMES

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

COURSE FOCUSES ON

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
✓	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BT2A2DA	FORENSIC BIOTECHNOLOGY	SEMESTER II

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Introduction and Forensic Sample Collection 08 h

Forensic science - History, scope, branches and functions. Forensic science in international perspectives, including set up of INTERPOL and FBI. Duties of forensic scientists. Forensic laboratories in India-Central Forensic Science Laboratory. Collection and Preservation of Blood, Semen, Saliva, Urine, Faeces and Milk samples for forensic examinations.

Unit II Forensic Sample Examination 10 h

Forensic characterization: Hair- morphology and types, their importance, nature, location, collection, evaluation and tests for their identification. Blood- Properties and blood grouping, presumptive and confirmatory tests. Sperm-composition, morphology of spermatozoa, presumptive and confirmatory tests (including Azoospermic semen stains), seminal fluid isozymes typing, forensic significance of sperm, collection and analysis of evidences in rape cases.

Unit III Forensic Sample DNA Profiling 10 h

DNA Profiling: Introduction, history of DNA typing, molecular biology of DNA, variations, polymorphism, DNA extraction-organic and inorganic extraction. Comparison of extraction methods and commercial kits. DNA typing systems-RFLP, PCR amplifications and Sequence polymorphism. Analysis of SNP, YSTR and mitochondrial DNA. Ancient DNA typing and evaluation of DNA typing results.

Unit IV Statistics and DNA databank 10 h

DNA Statistics: frequency estimate calculations, interpretations, allele frequency determination, Paternity/Maternity index, Sibling index, Probability of match. Human Genome Project: introduction, history, goals, benefits, social, ethical and legal issues. DNA forensic databases, ethical, legal, and social issues associated with DNA Data banking, potential benefits of DNA Data banking, quality control, certification and accreditation.

Unit V Applications of Forensic Biotechnology 10 h

Forensic significance of DNA profiling: Applications in disputed paternity cases, child swapping, missing person's identity- civil immigration, veterinary, wildlife and agriculture cases. Legal perspectives- legal standards for admissibility of DNA profiling, procedural and ethical concerns, status of development of DNA profiling in India and abroad. New and future technologies: SNPs, DNA chips, DNA Barcoding and limitations of DNA profiling.

Text Books

1. Richard Saferstein E, 2020, "Forensic Science Handbook", 2nd Edition, Prentice Hall, New Delhi.
2. Allan Jamieson and Scott Bader, 2016, "A Guide to Forensic DNA Profiling", 10th Edition, John Wiley & Sons, UK.

References

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

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COIMBATORE | INDIA

Course Code	Course Name	Category	L	T	P	Credit
233BC2A3CA	RESEARCH METHODOLOGY AND BIOSTATISTICS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The role of statistics in research
- Testing of hypothesis for small and large samples
- The fundamental knowledge of the concepts of probability and standard distributions which can describe real life phenomenon.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain the objectives of conducting research, Formulation of research problem.	K5
CO2	Determine the methods for collecting and analyzing qualitative and quantitative data	K5
CO3	Interpret data using measures of central tendency, variation, correlation and regression analysis.	K5
CO4	Evaluate the utility of sampling theory, probability and theoretical distributions in conducting research.	K6
CO5	Discuss various tests of significance for the purpose of making inferences based on available data.	K6

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A3CA	RESEARCH METHODOLOGY AND BIOSTATISTICS	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Research Methodology 10 h

Research: General-Introduction, types and classification of research-diagnostic, descriptive, and exploratory research. Topology for literature research-scientific methods-components of scientific methods. Research Design - Classification of research designs, need for research design, features of good research design, experimental research design. Plagiarism, Formation of hypothesis. Synopsis writing. Thesis writing. Publication in a scientific journal. Preparation of Abstract and manuscript. National and International Research funding agencies. Importance of Ethical clearance in Research.

Unit II Methods for Collection of Data 9 h

Organising a statistical survey, Planning and executing the survey. Sampling of variables (large samples and small samples). Concepts of sampling. Source of data – Primary and secondary data. Collection – observation, interview, enquiry forms, questionnaire schedule and check list. Classification and tabulation of data. Diagrammatic & graphic presentation of data. Parametric and non parametric tests.

Unit III Statistical Measures 11 h

Measures of central tendency: arithmetic mean, median, mode, quartiles, deciles and percentiles. Measures of variation: range, quartile deviation, mean deviation and standard deviation, Coefficient of variation. Correlation analysis: Scatter diagram, Karl Pearson's coefficient of correlation and Spearman's rank method. Regression analysis - Regression line, Regression equation. Introduction to R programming. Statistical analysis using Excel. Introduction to SPSS package. Free online software tool (Demo).

Unit IV Probability 8 h

Definition, concepts, Addition and Multiplication theorems (proof of the theorems not necessary) and calculations of probability. Theoretical distributions: Binomial, Poisson distribution. Normal distribution: importance, properties, conditions and constants of the distribution (proof not necessary)

Unit V Sampling distribution and test of significance 10 h

Types and Testing of hypothesis, Errors in hypothesis testing, standard error and sampling distribution. Student's 't' distribution and its applications. Chi - square test & goodness of fit. Analysis of variance- one way and two-way classification. Duncan's Multiple Range Test. Design of experiment - completely randomized block design and randomized block design.

Text Books

1 Gupta S P, 2014, "Statistical Methods", 43rd edition, Sultan Chand and Sons publications, New Delhi.

2 Pillai R S N and Bagavathi, 2017," Statistical Theory and Practices", 8th edition, S. Chand and company Ltd, New Delhi

References

1 Ajai S Gaur and Sanjaya S. Gaur, 2009," Statistical methods for practice and Research: A guide to data analysis using SPSS". 2nd edition, Sage Publications Pvt. Ltd., New Delhi.

2 Kothari C R, 2019, "Research Methodology Methods and Techniques", 2nd edition; New Age International, New Delhi.

3 Devore J L, 2014, "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, New Delhi.

4 Gupta S C and Kapoor V K, 2017," Fundamentals of Mathematical statistics", Sultan Chand & Sons, New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
233BC2A3CB	PLANT BIOCHEMISTRY AND BIOTECHNOLOGY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The primary metabolic pathways occurring in plants, various kind of plant metabolites, their industrial potential and its production
- Plant tissue culture, molecular aspects of plant breeding and gene transfer technology
- Plant cell physiology and the role of hormones in plant growth

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Outline biochemical events associated with plant cell and explain photosynthesis.	K2
CO2	Explain the mechanism of Nitrogen fixation & Identify the biochemical events of plant growth & development	K2
CO3	Demonstrate the importance of plant growth regulators & secondary metabolites in industries.	K3
CO4	Analyze proper genetic engineering tools for the improvement of crops	K4
CO5	Develop skills and knowledge to conduct basic research work in plant biochemistry and biotechnology	K4

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A3CB	PLANT BIOCHEMISTRY AND BIOTECHNOLOGY	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Photosynthesis and Water Absorption 8 h

Introduction to Plant cell. Photosynthesis: Apparatus, role of photosynthetic pigments, Biochemistry of Dark and light reaction - photo systems I and II, Photosynthetic electron transport - cyclic and non-cyclic photophosphorylation. Carbon reactions in Calvin cycle (C3 plants), Hatch slack pathway (C4 plants), Crassulacean acid metabolism, factors affecting photosynthesis. Biochemical basis of photorespiration (PR pathway) – C2 cycle. Water absorption – Mechanism of water absorption, symplast and apoplast concept, Transpiration – types, mechanism and factors affecting transpiration.

Unit II Nitrogen Metabolism and Plant growth and development 9 h

Nitrogen metabolism: Development and structure of root nodules, Role of nod factors in nodule development. Structure of plant nitrogenase system, Nitrogen fixation in symbiotic and non-symbiotic. Formation and assimilation of ammonia. Sulphate metabolism in leaf; sulfite reduction and Sulphur cycle. Biochemistry of seed development, dormancy, germination, fruit development, ripening and Senescence. Structure and function of phytochrome, flowering,photoperiodism and vernalization.

Unit III Plant Hormones and Secondary Metabolites 12 h

Plant hormones: Structure, biosynthesis and biochemical mode of action of auxins, gibberellins, cytokinins, abscisic acid and ethylene. Secondary metabolites: classification, biosynthesis and functions of terpenoids, alkaloids, phenolics, tannins, lignin, waxes and anthocyanins. Secondary metabolites in clinical, cosmetic and food industries (each with any two examples).Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. Overview on Toxins of plant origin and Antioxidative defense system in plants.

Unit IV Soilless cultivation 9 h

Introduction to tissue culture - Media composition and preparation. Micropropagation, callus induction, cell suspension and protoplast culture, organogenesis and somatic embryogenesis. Haploid production – Anther, pollen, embryo and ovule culture.

Selection of hybrid cells, cybrids, somaclonal variation. Germplasm storage and

cryopreservation. Applications of tissue culture for crop improvement and for the overproduction of plant secondary metabolites (Bioreactors).

Alternative technqiues – hydroponics, Aquaponics

Unit V Transgenics in Plants 10 h

Importance of RFLP, RAPD and SCAR in plant breeding management. Agrobacterium and crown gall tumors – Ti plasmid and Ri plasmid vectors. Mechanism of T-DNA transfer to plants. Plant viral vectors, Direct transformation of plants by physical methods. Promoters, Selectable markers and reporter genes used in plant vectors. Application of transgenesis in crop improvement – Insect resistance, disease resistance, virus resistance, herbicide resistance, and abiotic stress resistance. Ethical issues in Plant genetic engineering. Transgenic plants - Bt cotton, Bt brinjal, Plant genome-Rice. Pros and Cons of GM crops. Biosafety of transgenic plants

Text Books

1 Biju Dharmapalan, 2019, "Plant Biochemistry", New edition, Narosa Publication, New Delhi.

2 Singh B D, 2021, "Plant Biotechnology", 4th edition, Medtech Publishers, Kerala

References

1. Buchanan B B, Gruissem W and Jones R L, 2015, "Biochemistry and Molecular Biology of Plants", 2nd edition, Wiley Blackwell, New Jersey.

2 Chawla H.S, 2020, "Introduction to Plant Biotechnology", 3rd edition, Oxford and IBH publishing, England

3 Altman A and Hasegawa P M, 2017, "Plant Biotechnology and Agriculture: Prospects for the 21st Century", 1st edition, Academic Press, Cambridge, United States.

4 Heldt H W and Piechulla B, 2016, "Plant Biochemistry", 4th edition, Academic Press, Cambridge, United States.

Course Code	Course Name	Category	L	T	P	Credit
233BC2A3CC	GENETIC ENGINEERING	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the basics of gene cloning, role of enzymes, vectors for genetic engineering
- the techniques of genetic engineering, genome mapping and gene therapy
- applications of genetic engineering and gene transfer methods

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Experiment with DNA modifying enzymes.	K3
CO2	Illustrate the knowledge in gene manipulation techniques and tools.	K3
CO3	Analyze on basic characteristic features of cloning vectorsand vectors that are highly suitable for expression of desirable genes in respective host cells.	K4
CO4	Examine cloning strategies, various methods adapted for confirmation of rDNA expression and gene transfer methods	K4
CO5	Assess the significance and applications of recombinant DNA technology.	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A3CC	GENETIC ENGINEERING	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Introduction to genetic engineering and gene modifying enzymes 7 h

Introduction to genetic engineering, basic steps in gene cloning and applications of rDNA technology. Isolation and purification of Nucleic Acids. Restriction Modification enzymes in recombinant DNA technology and cloning: Restriction endonuclease (nomenclature, types, recognition sites, mode of action, applications), DNA ligase, E. coli DNA polymerase I and Klenow enzyme, T4 DNA polymerase, reverse transcriptase, polynucleotide kinase, alkaline phosphatase, nuclease and terminal transferase. Methods of ligation of insert and vector DNA, Linkers and adapters.

Unit II Probes and Techniques in genetic engineering 12 h

Probes - Types and their applications. Nucleic acid hybridization techniques – Southern and northern hybridization, dot blot and zoo blot technique, in situ hybridization, Fluorescence in situ hybridization (FISH). Polymerase chain reaction (PCR) – Principle, types and applications. Restriction mapping.DNA fingerprinting - Principle, methods and applications. DNA sequencing methods - Principle of chemical and enzymatic method, automated sequencing, Next generation sequencing and Introduction to Illumina or Pyro-sequencing, RNA sequencing. DNA foot printing. Chromosome walking and jumping.

Unit III Cloning vectors and Expression vectors 11 h

Vectors for molecular cloning: Plasmid vector - pBR322, pUC18; Phage (lambda and M13) vector; Cosmids; Phagemids; High-capacity cloning vectors -BAC,YAC, PAC, MAC and HAC; Viral vectors - SV 40. Gene expression in prokaryotes - Tissue specific promoter, wound inducible promoters, strong and regulatable promoters, vectors with tags (Histidine tags, signaling peptides for exportation), Fusion proteins; Mammalian cell expression: Two – vector expression, two – gene expression vectors; Yeast Expression vectors; Shuttle vectors.

Unit IV Gene transfer methods and Cloning, Screening strategies 8 h

Choice of host organisms for cloning. Gene transfer methods: calcium phosphate coprecipitation, electroporation, lipofection, biolistics, viruses, microinjection.

Construction of genomic and cDNA library. Selection and screening methods for recombinants; Immunological screening for expressed genes.

Unit V Applications of genetic engineering 10 h

Gene targeting and gene tagging. Gene knockout and knock-in. Generation of transgenic animals and its application (any two). Therapeutic applications - Insulin, Growth hormones, Hepatitis B vaccines. Diagnostic probe of genetic diseases. Gene therapy: Stem cell gene therapy, Somatic cell gene therapy, Gene therapy for ADA and cystic fibrosis. Gene Editing - Cre-loxP recombination technology, CRISPR Cas 9, ZnF, TALEN and RNA interference. Ethical, social and biosafety aspects of GMO's (Overview).

Text Books

1 Brown, T.A., 2020, "Gene Cloning and DNA analysis: An introduction", 8th edition, Wiley-Blackwell, New Jersey.

2 Bernard R. Glick and Cheryl L. Patten., 2022, "Molecular Biotechnology: Principles and Applications of Recombinant DNA", 6th edition, ASM Press, United states.

References

1 Brown T.A., 2018, "Genomes 4", Garland Science, New York.

2 Nicholls D.T.S., 2008, "Introduction to Genetic Engineering", 3rd edition, Cambridge University Press, England.

3 Primrose S.B., and Twyman R., 2006, "Principles of Gene Manipulation and Genomics", 7th Edition, Wiley Blackwell, New Jersey.

4 Winnaker E.L., 2003, "From genes to clones: Introduction to gene technology" 4th edition, Panima Publishing Corporation, New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
233BC2A3CD	CLINICAL BIOCHEMISTRY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the metabolic disorders, diagnosis and management of disease through the analysis of blood, urine and other body fluid by different techniques
- tests to identify the functions of the organs
- the relevance of biochemistry to health and disease

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Summarize about the Specimen collection and processing, and use of biochemical data and Automation in Clinical Laboratory	K4
CO2	Explain about the factors that influence disorders associated with coagulation and hemoglobin	K4
CO3	Analyze the relation between biomolecules and diseases	K4
CO4	Assess the function of organ by clinical diagnosis and outline on Clinical Enzymology	K5
CO5	Predict the importance of molecular diagnosis of disease and forensic biochemistry	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A3CD	CLINICAL BIOCHEMISTRY	SEMESTER III

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Specimen collection and processing, use of Biochemical data, Automation 10 h

Specimen collection and processing: Collection of blood by various methods, anticoagulants of blood. Collection of urine-timed urine specimens, urine preservatives. Collection of feces and Amniotic fluid. Handling of specimen for testing-Use of Biochemical data in clinical medicine-Diagnosis, Management, Screening, Acquisition and interpretation of biochemical data, Test Request, Factors Affecting Test Results, Interpretation of Results, Predictive Value of Tests. Automation in the clinical biochemistry: Processes, Laboratory information systems, robotics, Types of automation. Overview of clinical laboratory setup

Unit II Blood and coagulation 9 h

Blood and coagulation: The coagulation cascade, Laboratory tests of coagulation, Interpretation of coagulation-tests. Blood Transfusion- Blood group antigens, Laboratory transfusion tests, Investigation of suspected transfusion-reaction, Haemolytic disease of the newborn: Porphyrias- erythropoietic and hepatic , Haemolysis -Anemia- Iron deficiency anaemia, Inherited and acquired haemolyticanaemias, Diagnosis of Haemolysis, Haemoglobinopathies- sickle cell anemia, Thalassemia- Alpha and Beta, Laboratory Diagnosis of Haemoglobinopathies.

Unit III Metabolic disorders 9 h

Disorders of carbohydrate metabolism: glycogen storage diseases, galactosemia, fructosuria. Hypoglycemia, Diabetes mellitus-classification, metabolic abnormalities, diagnosis and management, lactose intolerance.

Disorders of lipid metabolism: lipoproteinaemias. Lipid storage diseases-Gaucher's and Taysach's disease. Fatty liver and Atherosclerosis.

Disorders of amino acid metabolism:, Phenylketonuria, Cysteinuria, albinism, and maple syrup urine disease.

Unit IV Liver and Renal functions tests, Clinical Enzymology 10 h

Liver function tests: Jaundice- Definition, types, Causes, consequences, Laboratory diagnosis and treatment in jaundice, Tests related to excretory (bile pigments)

synthetic (plasma proteins, prothrombin time) detoxifying (hippuric acid, NH3, aminopyrine) and metabolic (galactose) functions.

Renal function tests: clearance of tests, urinary calculi, renal hypertension, principles of peritoneal and hemodialysis - urinalysis for normal and abnormal constituents.

Clinical Enzymology- plasma functional and nonfunctional enzymes. Enzymes in health and disease- Creatinine kinase, Amonotransferases, amylase and alkaline phosphatase.

Unit V Molecular clinical and Forensic Biochemistry 10 h

Molecular clinical Biochemistry-Techniques of Genetic Analysis, Detection of specific sequences in DNA, Detection of mutations, Applications of DNA Analysis - Prenatal diagnosis-Screening-Inherited diseases: Cystic fibrosis. Multifactorial and polygenic disease: Familial hypercholesterolaemia. Gene Therapy -Stem cells in gene therapy, Gene therapy in cancer.

Forensic biochemistry- Samples and Sampling-Poisoning with Endogenous Agents: γ-Hydroxybutyrate, Insulin. Post-Mortem Biochemistry:Vitreous humour. Specific Diagnostic Problems: Anaphylaxis reactions, Diabetes

Overview- Point of Care Technology Instruments. Use of AI in diagnostics, Quality assurance in clinical laboratories : Six Sigma concept

Text Books

1 William J Marshal, Marta Lapsley, Andrew P Day and Ruth M Ayling, 2014, "Clinical Biochemistry: metabolic and Clinical aspects", 3rd edition, Churchill Livingstone, London.

2 Burtis and Bruns, 2014, "Tietz fundamentals of Clinical Chemistry and Molecular Diagnostics", 7th edition, Saunders, US.

References

1 Gerhard Meiserbag & Willian H Simmons, 2016, "Principles of Medical Biochemistry", 4th edition, Elsevier Health Sciences, US.

2 Luxton R, 2008, "Clinical Biochemsitry", 2nd Edition, Scion Publishing Limited, England

3 Gowenlock A H, 2006, "Varley's Practical clinical biochemistry", 6th edition, CBS Publishers, New Delhi.

4 Rifai N, 2017, "Tietz Text book of clinical chemistry and molecular diagnosis", 6th edition, Elsevier Health Sciences, US.

233BC2A3CP	CORE PRACTICAL : CLINICAL BIOCHEMISTRY	SEMESTER III

Total Credits: 3
Total Instructions Hours: 72 h

S.No	Experiments
1	Estimation of blood glucose by DNS method
2	Glucometer (demonstration)
3	Estimation of Serum cholesterol by modified Zak's method
4	Estimation of serum total proteins and albumin by biuret method
5	Estimation of creatinine by picric acid method in serum/ urine/ Creatinine clearance
6	Paper chromatography of amino acids in urine
7	Assay of serum acid phosphatase and alkaline phosphatase activity
8	Assay of serum AST/ALT activity
9	Estimation of amylase activity in serum
10	Estimation of Bilirubin in Serum
11	Estimation of Iron by wong's thiocyanate method
12	Specimen collection, processing and preservation: Blood and Urine(Training in Hospital)

References

1. Gowenlock A H, 2006, "Varley's Practical clinical biochemistry", 6th edition, CBS Publishers, New Delhi.
2. Victor J Temple, Rachael Rowe, Nigani Willie and Samson Grant, 2013, "A Practical Manual in Biochemistry & Clinical Biochemistry", 4th edition, University of Papua New Guinea Press, Papua New Guinea.
3. Luxton R, 2008, "Clinical Biochemsitry", 2nd Edition, Scion Publishing Limited, England.
4. William J Marshal, Marta Lapley,Andrew P Day, Ruth M Ayling, 2014, "Clinical Biochemistry: metabolic and Clinical aspects", 3rd edition, Churchill Livingstone, London.

233BC2A3CQ	CORE PRACTICAL :PLANT BIOCHEMISTRY AND GENETIC ENGINEERING	SEMESTER III

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Experiments
1	Qualitative analysis of secondary phytochemicals in medicinal plants.
2	Estimation of total alkaloids.
3	Estimation of total phenols.
4	Estimation of total flavonoids.
5	Estimation of phytosterols.
6	Plant Tissue Culture - Sterilization and media preparation
7	Callus Induction - Carrot and Micropropagation - Rose.
8	Restriction digestion analysis of plasmid DNA
9	Gene amplification by Polymerase Chain Reaction (PCR).
10	Random amplified polymorphic DNA (RAPD)
11	Ligation of DNA into plasmid and visualization through agarose gel electrophoresis.
12	Agrobacterium mediated genetic transformation (Demonstration).

References

1. Carson S, Miller H B, Srougi M and Witherow D S, 2019, "Molecular Biology Techniques: A classroom laboratory manual", 4th edition, Academic Press, Cambridge, England.
2. Sadasivam S and Manickam A, 2018, "Biochemical Methods", 3rd edition, New Age International Publishers, New Delhi.
3. Green M R and Sambrook J, 2014, "Molecular Cloning - A Laboratory Manual", 4th Edition, Cold Spring Harbor Laboratory Press, USA.
4. Giri C C and Archana G, 2007, "Plant Biotechnology – Practical Manual", 1st edition, I.K. International, New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
233MB2A3DA	MEDICAL LABORATORY TECHNIQUES	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- The organization of clinical laboratory
- The processing of clinical samples
- The importance of SOP in laboratory testing

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Understand the organization of clinical laboratory	K1
CO2	Apply suitable antiseptics and disinfectants in laboratory conditions	K1
CO3	Analyze various clinical samples.	K2
CO4	Calibrate the instruments for quality assurance.	K2
CO5	Formulate SOP in clinical laboratory	K3

MAPPING WITH PROGRAMME OUTCOMES

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

Course Focuses on

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233MB2A3DA	MEDICAL LABORATORY TECHNIQUES	SEMESTER III

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Introduction to Clinical laboratory 9 h

Basic laboratory principles - Organization of clinical laboratory - Biosafety in containment laboratory - National and International GLP (Good laboratory Practices) - Role of medical laboratory technician - personnel hygiene and safety measures.

Unit II Antiseptics & Disinfectants 9 h

Definition -Types - Mode of Action – Uses. Antimicrobial agents and Antibiotics: Introduction, mechanism of action, classification and uses, Antibiotic susceptibility testing - Stokes, Kirby-Bauer method, Minimal Inhibitory Concentration and Minimal Bactericidal Concentration.

Unit III Collection and processing of blood 10 h

Collection and processing of blood sample- separation of serum and plasma - Sampling errors - Preservation of samples. Determination of Total Count, Differential Count, Erythrocyte Sedimentation Rate, Hemoglobin concentration (Hb), Bleeding Time & Clotting Time. ABO Blood group system. Detection of blood glucose, Urea, Cholesterol and Bilirubin. Profiling - Liver function test, Renal function tests. Hormones - T3, T4, TSH, FSH, LH, Prolactin, Insulin.

Unit IV Processing of Urine, Stool and Sputum sample 10 h

Collection, transport and Storage of Urine, Stool and Sputum sample. Macroscopic and Microscopic examination - Urine: sugar, albumin, bile salts, bile pigments and ketone bodies - Pregnancy Test. Stool – Cyst, Ova, Mucus, Pus, RBC, Reduced sugar, Occult blood. Sputum –Petroff's method, AFB staining.

Unit V Maintenance of Laboratory 10 h

Maintenance of Laboratory Equipment's – Centrifuge, calorimeter, microscope, incubator, autoclave. Laboratory Certification process – National Accreditation Board for Laboratories, Indian Standard Organization - Standard Operating Procedure - Clinical Laboratory records. Biomedical waste management – Bureau of Indian Standards- danger signs and Symbols.

Case study: A patient comes to you with a doctor's prescription asking you to analyze the thyroid profiling of the patient. The patient has memory issues, drying of skin, hair fall, weight gain etc. What are the tests that you would perform under thyroid profiling? What could probably be the ailment surrounding the patient with your limited knowledge on the patient and his history. Based on your report, what could probably the doctor prescribe the patient?

Text Books

1 Ananthanarayanan R and CK Jayaram Panicker, (2020). Textbook of Microbiology. (11Edn.) Delhi: Orient Longman..

2 Monica Cheesbrough, (2018). District Laboratory Practice in Tropical Countries. (2Edn.) USA: Cambridge University Press..

References

1 Bailey and Scotts,. (1994). Diagnostic Microbiology. (9 Edn.) New Delhi: Baron and FinegoldCVMosby Publications.

2 Jawetz E Melnic JL and Adel berg EA,. (1998). Review of Medical Microbiology. (10 Edn.) USA: Lange Medical Publications.

3 Mackie and McCatney,. (1994). Medical Microbiology. (14 Edn.) New Delhi: Church will Livingston.

4 Patrick.K.Murray,I.N. (2012). Medical Microbiology. (4 Edn.) USA: Mosboy Publishers.

Course Code	Course Name	Category	L	T	P	Credit
233BC2A3DA	FREE RADICALS AND ANTIOXIDANT SYSTEM	DSE	3	1		3

PREAMBLE

This course has been designed for students to learn and understand

- the concepts of free radicals, ROS & RNS, and their chemical characteristics.
- the importance of enzymic antioxidants in preventing oxidative damage
- the role of antioxidants as immunomodulators and their impacts on body.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Demonstrate the formation of free radicals, ROS, and RNS in biological systems and their sources	K3
CO2	Examine the effects of free radicals in various disease conditions and effect of exercise on antioxidants	K4
CO3	Analyze the chemistry, mechanism and effect of enzymic and synthetic antioxidants	K4
CO4	Evaluate the chemistry, mechanism and functions of different non-enzymic antioxidants	K5
CO5	Assess the role of antioxidant in therapeutics and gain insights into future perspectives and challenges in the field	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
✓	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A3DA	FREE RADICALS AND ANTIOXIDANT SYSTEM	SEMESTER III

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Introduction to Free Radicals and Oxidative Stress 10 h

Definition of free radicals, Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS). Formation and physiological roles of free radicals. Mechanism of oxidative damage to biomolecules (DNA, proteins, lipids). Techniques for measuring ROS/RNS levels.

Unit II Reactive Oxygen Species and Disease 10 h

Oxidative stress in atherosclerosis, obesity and metabolic syndrome, hypertension, Alzheimer's, Parkinson's, Mitochondrial dysfunction, skin aging processes, Air pollution and respiratory diseases. Exercise-induced ROS production, Redox balance and muscle recovery. Effects of exercise on antioxidant defense systems.

Unit III Enzymic Antioxidants and synthetic Antioxidants 8 h

Enzymic antioxidants- Chemistry, mechanism, antioxidant effect of superoxide dismutase (SOD), Catalase, Glutathione Peroxidase and the glutathione system

Synthetic antioxidants: BHA (butylated hydroxyanisole), BHT (butylated hydroxytoluene), TBHQ (tert-butylhydroquinone), and their chemical properties.

Unit IV Non Enzymic Antioxidants 10 h

Non Enzymic antioxidants- source, chemistry, toxicity, biochemical functions, bioavailability, bioassays, Antioxidant effects of Vit A, Vit C (ascorbic acid), Vit E (tocopherols and tocotrienols), glutathione and selenium.

Unit V Emerging Topics in Free Radicals and Antioxidant system 10 h

Mitochondrial-targeted therapeutics .Antioxidants as immunomodulators. Antioxidant strategies for stem cell therapy. Redox modulators in cancer therapy- Redox-active compounds in drug discovery. Clinical trials and future perspectives.

Antioxidant supplementation and disease prevention. - Personalized nutrition and antioxidant requirements

Text Books

1. Steven I Baskin, Harry Salem, 2020 "Oxidants, Antioxidants, and free Radicals", 1st Edition, CRC Press, Florida
2. Donald Armstrong, 1994, "Free Radicals in Diagnostic Medicine: A systems approach to Laboratory Technology, Clinical Correlations and Antioxidant Therapy; v. 366", 4th edition, Springer Science, LLC.

References

1. Barry Halliwell and John M.C. Gutteridge, 1998, "Free Radicals in Biology and Medicine", 3rd Edition, Oxford University Press, United Kingdom
2. Vibila Rani, 201 5, "Free Radicals in Human health and Disease", 5th edition, Springer, New York, USA
3. Helmut Sies, 1991, "Oxidative Stress: Oxidants and Antioxidants", 2nd edition, Academic Press, London, United Kingdom
4. Dietmar Spengler, 2015, "The Redox Theory of Aging: Physiological Roles and Mechanisms of Aging", 3rd edition, Springer, New York, USA

Course Code	Course Name	Category	L	T	P	Credit
233BT2A3DA	MOLECULAR THERAPEUTICS	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- The types of gene therapy and drug delivery.
- The importance of cell therapy and recombinant therapy.
- The basis of microbial pathogenesis and various immunological approaches.

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	Evaluate the use of stem cells and tissue engineering in therapy	K4
CO3	Summarize recombinant gene therapy	K5
CO4	Integrate pathogenic diseases and metabolic disorders	K5
CO5	Design the concept of immunotherapy and its applications	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment	✓	Constitutional Rights/ Human Values/ Ethics

233BT2A3DA	MOLECULAR THERAPEUTICS	SEMESTER III

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Concepts of Gene Therapy and Drug Delivery 09 h

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

Unit II Stem cells and Tissue Engineering 10 h

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

Unit III Recombinant Gene therapy 10 h

Introduction to 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

General concept of infectious disease, types of infectious diseases. 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

Introduction to Immunotherapy, Monoclonal antibodies and their role in cancer treatment, role of recombinant interferons, Immunostimulant and Immunosupressors in organ transplants, role of cytokine therapy in cancer. MAMP, RAMP and DAMP triggered immunity. Vaccines: types, recombinant vaccines and their 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. and Stein, G.S, 1998, "Stem Cell Biology and Gene Therapy", 1st Edition, John Wiley and Sons Publications, USA

233BC2ASSA	SELF STUDY : BIONANOTECHNOLOGY	SEMESTER III

Total Credit: 1

Syllabus

Unit I Nanotechnology

An introduction. Development of nanobiotechnology - Historical background overview. Nanosized effects surface to volume ratio. Types of nanostructure and physicochemical properties of nanomaterials. Nanoparticles, quantum dots, nanotubes, nanowires, Graphenes, Fullerenes, Nano Peapods, and Semiconductor Nanoparticles. Metal-based Nanostructures, dendrimers.

Unit II DNA based Nanostructures

DNA-protein nanostructures-Methods- Self assembled DNA nanotubes—Nucleic acid Nanoparticles, DNA as a Biomolecular template-DNA branching-Metallization- Properties. Nanobiosensors: Science of Selfassembly - From Natural to Artificial Structures. Nanoparticles in Biological Labeling and Cellular Imaging.

Unit III Protein and Peptide based Nanostructures

Chemistry and structure, Assembly, recrystalisation, diagnosis- Engineered Nanopores- Methods of production. Microbial nanoparticles production-Magnetosomes- Bacteriorhodopsins- Nanoproteomics.

Unit IV Synthesis & Characterization of Nanomaterials

Top-down (Nanolithography, CVD), Bottom-up (Sol-get processing, chemical synthesis). Bio-synthesis of nanomaterials - Green synthesis. Characterization of Nano material: Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM.

Unit V Applications of Nanobiotechnology

Miniaturized devices in nanobiotechnology - types and applications, lab on a chip concept. Nanotechnology in biomedical and Life Sciences: Nanomedicine, drug delivery, nanocapsule; nanorobots; nanopharmacology. Nanobiotechnological applications in Environment and food - detection and mitigation.

Text Books

1 Nicolini C, 2009, "Nanobiotechnology and Nanobiosciences", 1st edition, Jenny Stanford Publishing Pvt. Ltd., Singapore

2 Vo-Dinh T, 2019, "Nanotechnology in Biology and Medicine: Methods, Devices, and Applications", 2nd edition, CRC Press, Florida

References

1 Mirkin C A and Niemeyer C M, 2007, "Nanobiotechnology – II: more concepts and applications". Wiley VCH, New Jersey.

2 Shoseyov O and Levy I, 2008, "Nanobiotechnology: Bioinspired Devices and Materials of the Future", 1st edition, Humana Press, New Jersey.

3 Sharon M, Sharon M, Pandey S and Oza G, 2012, "Bio-nanotechnology Concepts and applications", 1st edition, Ane Books Pvt. Ltd, New Delhi.

4 Saudagar P and Divakar K, 2019, "Recent Trends in Nanobiotechnology: Food and Biomedical Applications", Central West Publishing, Australia.

233BC2ASSB	SELF STUDY : INHERITANCE, EVOLUTION AND BEHAVIOUR	SEMESTER III

Total Credit: 1

Syllabus

Unit I Inheritance Biology

Introduction to Mendelian principles, deviations and Extensions of Mendelian principles. Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids. Extra chromosomal inheritance: Inheritance of mitochondrial and chloroplast genes. Microbial genetics: Methods of gene transfers - transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, fine structure analysis of genes. Human genetics: Karyotypes and genetic disorders. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.

Unit II Emergence of evolutionary thoughts

Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis. Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

Unit III Paleontology and Evolutionary History

The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo. Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

Unit IV The Mechanisms

Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

Unit V Brain, Behavior and Evolution

Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

Text Books

1. Pierce B A, 2017, "Genetics: A Conceptual Approach", 6th edition, W.H. Freeman, New York.
2. Workman L and Reader W, 2015, "Evolution and Behaviour", 1st edition, Routledge - Taylor and Francis, United Kingdom.

References

1. Gardner E J, Simmons M J and Snustad D P, 2006, "Principles of Genetics" 8th edition, John Wiley & Sons, New York.
2. Rastogi V B, 2018, "Organic evolution (Evolutionary Biology)", 13th edition, Medtech Publishers, New Delhi.
3. Bateson P, 2017, "Behaviour, Development and Evolution". Open Book Publishers, United Kingdom.
4. Cartwright J, 2008, "Evolution and Human Behaviour: Darwinian Perspectives on Human Nature", 2nd edition, MIT Press, Cambridge, MA.

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CHAIRMAN
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Course Code	Course Name	Category	L	T	P	Credit
233BC2A4CA	BIOETHICS AND BIOSAFETY	CORE	4	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- Concepts of patent rights and regulatory framework for the product safety
- The patenting of biotechnological processes, regulation of bioethics and the biosafety rules, the laws governing biotechnology
- Basic and Good Laboratory Practices (GLP), Standard Operating Procedures (SOP), ethical perspective of handling potentially harmful biomaterials

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Explain biosafety and bioethics concepts, good laboratory practices and standard operating procedures for research	K2
CO2	Apply biosafety practices in appropriate Biosafety labs	K3
CO3	Analyze the basic principles and legal frame work of IPR and its application to biotechnology	K4
CO4	List the basic issues of IPR, Biosafety &Bioethics	K4
CO5	Create awareness on the Biosafety, Bioethics and patenting of biotechnological processes and products	K6

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability	✓	Innovations
✓	Intellectual Property Rights		Gender Sensitization
✓	Social Awareness/ Environment	✓	Constitutional Rights/ Human Values/ Ethics

233BC2A4CA	BIOETHICS AND BIOSAFETY	SEMESTER IV

Total Credits: 3

Total Instruction Hours: 60 h

Syllabus

Unit I Introduction to Biosafety 12 h

Introduction to Bio-safety; Different levels of Bio-safety; Basic Laboratory and Maximum Containment Laboratory; Containments-Types; Biological weapons; The Cartagena Bio-safety protocol (CAB); Role of IBSC; Guidelines for rDNA research activities; General guidelines for research in transgenic plants; Role of RCGM; Assessment of risks associated with GMO; General issues related to environmental release of transgenic plants, animals and microorganisms; Role of GEAC; Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP)

Unit II Bioethics Principles and Practices 12 h

Introduction to Bioethics; Four main principles of bioethics; Animal Right to life, Animal research; Ethical, Legal and Social Implications (ELSI) of Human Genome Project; Ethical issues related to research in embryonic stem cell research and cloning. Case studies in human and animal research. (Three R's in research)

Unit III Introduction to Intellectual Property Rights (IPR) – Global concepts 12 h

Definitions: Physical and Intellectual Property, Tangible and Intangible Property; General Agreement on Trade and Tariff (GATT); TRIPS; World Trade Organizations (WTO); Establishment and functions of GATT, WTO and WIPO; WTO-Guidelines and Summits.

Unit IV IPR applications 12 h

Different types of intellectual property rights (IPR): Patents, Trade mark, Trade secret, Copy right and Geographical Indications; Requirement of patentability; Compulsory licenses; Case studies in patent, trademark, trade secret, copyright, Traditional Knowledge in biotechnological areas.

Unit V Patent application 12 h

Patent application; Rules governing patents; Patent related cases: Licensing of Flavr Savr™ tomato as a model case; Bio-piracy case studies on patents (Basmati rice, Turmeric, and Neem); Indian Patent Act, 1970; Recent amendments, Biodiversity act of 2002

Text Books

1. Subbaram N.R, 2003, "What Everyone Should Know about Patents?",2nd Edition, Pharma Book Syndicate, Hyderabad, India
2. Sree Krishna V, 2007, "Bioethics and Biosafety Biotechnology",1st Edition, New Age International (P) Limited Publishers, New Delhi, India

References

1. Glick, Bernard R, Pasternack, Jack J and Patten, Cheryl L, 2010,"Molecular Biotechnology: Principles and Applications of Recombinant DNA", 4th Edition, ASM Press, Washington, DC, USA
2. Chawla H.S, 2020, "Introduction to Plant Biotechnology", 3rd revised Edition, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi, India
3. Sateesh M.K, 2008, "Bioethics and Biosafety",I.K.International Publishing House Pvt. Ltd, New Delhi, India
4. Prabuddha Ganguli. 2008, "Intellectual Property Rights", 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, India

Course Code	Course Name	Category	L	T	P	Credit
233BC2A4CB	ENDOCRINOLOGY AND DEVELOPMENTAL BIOLOGY	CORE	4	1	-	4

PREAMBLE

This course has been designed for students to learn and understand

- the endocrine system and its specific secretions
- the various disorders related to each hormone due to their hypo and hyper secretion
- mechanisms involved in growth and development of complex organisms

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Describe the role of endocrine system in maintaining homeostasis and signal transduction	K2
CO2	Illustrate and evaluate the biochemical and physiological effects of pituitary, hypothalamic, Thyroid hormones	K2
CO3	Evaluate the molecular, biochemical and physiological effects Adrenal, Gonadal and Neurohormones	K5
CO4	Explain the basic concepts of developmental biology that occur within all living organisms, and fundamental processes of fertilization	K3
CO5	Explain the basic concepts in the organogenesis, cell death and regeneration	K3

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A4CB	ENDOCRINOLOGY AND DEVELOPMENTAL BIOLOGY	SEMESTER IV

Total Credits: 4

Total Instruction Hours: 60 h

Syllabus

Unit I Homeostasis and Signal Transduction 12 h

Hormones and homeostasis: Neuroendocrine Integration in homeostasis. Classes of chemical messengers. Hormone secretion. Transport and clearance. Neuroendocrine regulation -Feedback control of secretion. Signal transduction: Plasma membrane receptors, Adenylate kinase, Role of G Proteins, protein kinases, tyrosine kinases, MAPK, inositol phosphates, diaceyl glycerol and calcium. Steroid hormone and thyroid hormone receptors

Unit II Hypothalamic, Pituitary, pineal and pancreatic hormones 12 h

The endocrine hypothalamus- Hypophysiotropic hormones- Chemistry & biochemical functions. Pituitary gland- Hormones of the pituitary gland, Chemistry & biochemical functions. Growth Factors-PGDF, EGF, IGF-II and erythropoietin; Pineal gland- Hormones of the pineal gland- Chemistry& biochemical functions; Thyroid gland- Thyroid hormones- Chemistry and Biochemical functions; Pancreas- Insulin/glucagon, Somatostatin– chemistry and biochemical functions.

Unit III Adrenal, Neuro and Reproductive hormones 12 h

Adrenal gland- Hormones of Adrenal gland-Chemistry and biochemical functions; Gastrointestinal hormones- cholecystokinin, substance P, neuroendocrine control of GI Neurohormones- The brain- Renin- Angiotensin and Urotensin, Opioid peptides – endorphins & enkephalins.

Hormones of female reproductive system: ovarian steroid hormones- Chemistry & biochemical functions, Hormonal changes during pregnancy and lactation Hormones of Male reproductive system: Source, synthesis, chemistry and metabolism of Androgens Hormones involved in calcium metabolism

Unit IV Fertilization, Embryonic development in plants and animals 12 h

Developmental Biology - an overview: Introduction of animal development: Development among unicellular eukaryotes –Acetabularis, Naegleria. The origins of sexual reproduction; Fertilization: structure of gametes, recognition of sperm and egg –action at distance and contact of gametes Early Embryonic Development in animals: Blastula formation, Types of Cleavage, Gastrulation and formation of

germ layers in animals.

Early Embryonic Development in plants: Gametogenesis, Fertilization, Embryo sac development and double fertilization in plants

Unit V Organogenesis and Cell death and regeneration 12 h

Organogenesis in animals – an overview: Tissue organization and stem cells; development of nervous system, mesodermal and endodermal organs. Organogenesis –vulva formation in Caenorhabditis elegans; Cell death and regeneration: Concept of regeneration; programmed cell death, necrosis, aging and senescence

Text Books

1 Handley M.E, 2009, "Endocrinology",6th Edition, Prentice Hall, USA

2 Gilbert S.F, Singer S.R, 2006,"Developmental Biology", 8th Revised Edition, Sinauer Associates Inc, USA

References

1 Hall J.E, 2015, "Guyton and Hall Textbook of medical physiology", 13th Edition, W.B. Saunders company publisher, USA

2 Rodwell, V.W, Bender, D.A, Botham, K.M, Kennelly, P and Weil, P.A, 2018, "Harper's Illustrated Biochemistry", 31st Edition, The McGraw-Hill Inc,USA

3 Verma P.S, V.K. Agarwal V.K, 2010, "Chordate Embryology Developmental Biology", 1st Edition, S. Chand publishers, India

4 Slack. J.M.W, 2012, "Essential Developmental Biology", 3rd Edition, WileyBlackwell publishers, USA

Course Code	Course Name	Category	L	T	P	Credit
233MB2A4DA	MOLECULAR DIAGNOSTICS AND BIOINFORMATICS	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn

- Microbes and its involvement in causing life threatening diseases
- The identification and characterization of microbes using different molecular techniques
- The basics of bioinformatics and its tools.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Recognize the concept of molecular diagnosis of Infectious diseases and apply the immunoglobulins for molecular diagnosis.	K3
CO2	Identify the disease by using Nucleotides and Sequencing	K3
CO3	Experiment the nucleic acid amplification by PCR and Analyze the molecules by hybridization process	K3
CO4	Able to explore the biological data to solve several issues in healthcare Domains.	K4
CO5	Apply the knowledge of computational tools to address the clinical problems	K3

MAPPING WITH PROGR6AMME OUTCOMES

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

COURSE FOCUS ON:

☑ Skill Development	☐ Entrepreneurial Development
☑ Employability	☐ Gender Sensitization
☐ Intellectual Property Rights (IPR)	☐ Social Awareness / Environment
☐ Innovations	☐ Constitutional Rights / Human Values / Ethics

233MB2A4DA	MOLECULAR DIAGNOSTICS AND BIOINFORMATICS	SEMESTER IV

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I — Introduction to Molecular diagnosis and Immunoglobulin's in diagnosis — 12 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. Monoclonal and polyclonal antibodies. Agglutination - RIA, ELISA's, chemiluminescence, immunofluorescence, Western blots.

Unit II — Molecular Diagnosis using Nucleotides — 9 h

Automated DNA sequencing- Principles, Methods and InstrumentationAdvances in DNA sequencing - Whole Genome Sequencing, Target Sequencing, New Generation sequencing Methods, Pyrosequencing, Microarrays, Metagenomics.

Unit III — PCR and Hybridization — 12 h

Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Inverse PCR, Ligase Chain Reaction. RACE, RNA fingerprinting. Nucleic acid and Protein extraction and analysis (AGE & PAGE); Western Blot, Southern, northern, dot/slot blot; electrophoresis, nucleic acid probe preparation

Unit IV — Introduction to bioinformatics — 8 h

Definition, Basics of Bioinformatics, Scope and Applications. Introduction and types: Biological data bases, Importance of databases, DNA sequence databases (NCBI, EMBL, DDBJ, Genbank)- Protein databases (UniProt, Swissprot, PROSITE) and Structural databases (PDB, CATH).

Unit V — Bioinofrmatics tools — 7 h

Drug designing Softwares (AutoDock, Schrodinger, ChemSketch) - DNA and Protein similarity searching: BLAST and FASTA, Multiple sequence alignment (ClutalW). Phylogenetic tree types and construction (MEGA).

Text Books

1 William B Coleman, Gregory J Tsongalis, 2005, Molecular Diagnostics: For the Clinical Laboratorian, 2nd Edition, Hanuma Publishers, New Delhi.

2 Thomas J Kindt, Barbara A Goldsby, Richard Osborne 2018, Kuby's, Immunology, 8th Edition, W. H. Freeman Publishers, New York.

References

1 George P. Patrinos (Editor), Wilhelm Ansorge (Editor), Phillip B. Danielson Dr. (Editor),. 2016, Molecular Diagnostics, 3rd Edition, Academic press, USA.

2 Lele Buckingham and Maribeth L. Flaws, 2019, Molecular Diagnostics: 2 Fundamentals, Methods & Clinical applications, 3rd Edition, F. A. Davis Company, Philadelphia.

3 Keith Willson and John Walker, 2010, Principles and Techniques of 3 Biochemistry and Molecular Biology, 7th Edition, Cambridge University Press, US.

4 TK Attwood and DJ Parry-Smith, 2003. Introduction to Bioinformatics Pearson PLC Publisher, UK.

5 S.C. Rastogi, 2008, Bioinformatics Concepts Skills and Application, PHI Learning, New Delhi.

6 Jenny Gu, Philip E. Bourne, 2011, Structural Bioinformatics, 2nd edition, Wiley-Blackwell, Publishers, US.

7 https://microbenotes.com/bioinformatics-databases-software-tools/

8 https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291612341467kuaum_yadav_Bioinformatics.pdf

Course Code	Course Name	Category	L	T	P	Credit
233BC2A4DA	NEUROBIOLOGY	DSE	3	1	-	3

PREAMBLE

This course has been designed for students to learn and understand

- Overview of nervous system organization 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	Analyze the morphogenesis of the central nervous system and histology of the nervous system.	K4
CO2	Examine the functioning of the components of the nervous system	K4
CO3	Elaborate the role of different neurotransmitters in nerve impulse conduction	K5
CO4	Evaluate the process of vision, olfaction and taste sensation in detailed pathways	K5
CO5	Explain the neurologic process behind the different neurological diseases	K5

MAPPING WITH PROGRAMME OUTCOMES

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

✓	Skill Development		Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
	Social Awareness/ Environment		Constitutional Rights/ Human Values/ Ethics

233BC2A4DA	NEUROBIOLOGY	SEMESTER IV

Total Credits: 3

Total Instruction Hours: 48 h

Syllabus

Unit I Morphogenesis of central nervous system and Histology of the Nervous System — 10 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 and other novel neurotransmitters. 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 9 h

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

Text Books

1 Allan Siegel, Hreday 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, GeorgeJ. Augustine, David Fitzpatrick, William C. Hall Anthony-Samuel lamantia, 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 Heddwen 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.

Course Code	Course Name	Category	L	T	P	Credit
233BT2A4DA	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	K3
CO2	Understand the stem cell importance in plants	K4
CO3	Gain knowledge on the stem cells in animals	K5
CO4	Interpret the role of haemopoietic stem cell	K5
CO5	Analyze the stem cell therapies and its application	K5

MAPPING WITH PROGRAMME OUTCOMES

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

COURSE FOCUES ON

✓	Skill Development	✓	Entrepreneurial Development
✓	Employability		Innovations
	Intellectual Property Rights		Gender Sensitization
✓	Social Awareness/ Environment	✓	Constitutional Rights/ Human Values/ Ethics

233BT2A4DA	STEM CELL TECHNOLOGY	SEMESTER IV

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. Isolation and harvesting of plant stem cells and their limitations.

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. Haematopoietic Stem Cells harvesting and limitations, Applications of haematopoietic 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.

7/11/24

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