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

(An Autonomous Institution, Affiliated to Bharathiar University, Coimbatore)
Approved by Government of Tamil Nadu and Accredited by NAAC with 'A++' Grade (3rd Cycle-3.64 CGPA)
Dr. N.G.P. - Kalapatti Road, Coimbatore-641048, Tamil Nadu, India
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Regulations 2023-24 for Post Graduate Programme

(Outcome Based Education model with Choice Based Credit System)

M.Sc. Biotechnology Degree

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

Programme: Biotechnology

Eligibility:

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

Programme Educational Objectives:

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

1. This programme will enable students to acquire knowledge on the fundamentals of Biochemistry, Cell biology, Microbiology and Molecular biology. It helps them to understand emerging and advanced concept in modern biology and guide them to take up their carrier in this field.

2. This programme will facilitate the students to acquire knowledge in fields such as Genetic Engineering, Protein Engineering and Molecular Therapeutics.

3. The programme will aid the students to learn the recent developments in the field of Genomics, Proteomics, Stem cell biology and Tissue Engineering approach.

PROGRAMME OUTCOMES:

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

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

TOTAL CREDIT DISTRIBUTION

Courses	Credits	Total Marks		Credits	Cumulative Total credits
Core Theory	4	13 X 100 =	1300	52	78
Core Theory	3	1 X 100 =	100	03	
Core Lab	3	3 X 100 =	300	09	
Core Lab	2	3 x100 =	300	06	
Project and Viva Voce	8	1 X 200=	200	08	
Elective	3	4X 100 =	400	12	12
Internship	2	1X100	100	02	2
		Total	**2700**	**92**	**92**

CURRICULUM

M.Sc. BIOTECHNOLOGY

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
First Semester										
233BT2A1CA	Core - I	Molecular Biology & Genetics	4	-	-	3	25	75	100	4
233BT2A1CB	Core - II	Biochemistry	4	-	-	3	25	75	100	4
233BT2A1CC	Core - III	Microbiology	4	-	-	3	25	75	100	4
233BT2A1CD	Core - IV	Biodiversity & Bioprospecting	4	-	-	3	25	75	100	4
233BT2A1CP	Core Practical - I	Molecular Biology, Genetics and Biochemistry	-	-	5	6	40	60	100	2
233BT2A1CQ	Core Practical - II	Microbiology and Biodiversity & Bioprospecting	-	-	5	6	40	60	100	2
233BT2A1DA	DSE - I	Applied Biotechnology	3	1	-	3	25	75	100	3
233MB2A1DA		Microbial Technology								
233BC2A1DA		Cancer Biology, Diagnosis and Therapy								
Total			**19**	**1**	**10**	-	-	-	**700**	**23**

BoS Chairman/HoD
Department of Biotechnology
Dr. N. G. P. Arts and Science College
Coimbatore – 641 048

Dr.N.G.P. Arts and Science College
APPROVED
BoS-15th 10/06/2023
AC-15th 14/07/2023
GB-20th 05/08/2023

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Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Second Semester										
233BT2A2CA	Core - V	Immunotechnology	4	-	-	3	25	75	100	4
233BT2A2CB	Core - VI	Genetic Engineering	4	-	-	3	25	75	100	4
233BT2A2CC	Core - VII	Environmental Biotechnology	4	-	-	3	25	75	100	4
233BT2A2CD	Core - VIII	Bioprocess Technology	4	-	-	3	25	75	100	4
233BT2A2CP*	Core Practical – III	Immunotechnology and Bioprocess Technology	-	-	4	6	40	60	100	2
233BT2A2CQ	Core Practical – IV	Genetic Engineering and Environmental Biotechnology	-	-	6	6	40	60	100	3
233BT2A2DA	DSE - II	Forensic Biotechnology	3	1		3	25	75	100	3
233MB2A2DA		Bionanotechnology								
233BC2A2DA		Biochemistry of Toxicology								
Total			**19**	**1**	**10**	-	-	-	**700**	**24**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Third Semester										
233BT2A3CA	Core - IX	Research Methodology & IPR	4	-	-	3	25	75	100	4
233BT2A3CB	Core - X	Genomics and Proteomics	4	-	-	3	25	75	100	4
233BT2A3CC	Core -XI	Marine Biotechnology	4	-	-	3	25	75	100	3
233BT2A3CD	Core - XII	Plant Biotechnology	4	-	-	3	25	75	100	4
233BT2A3CE	Core - XIII	Animal Biotechnology	4	-	-	3	25	75	100	4
233BT2A3CP	Core Practical - V	Plant, Animal Biotechnology, Genomics & Proteomics	-	-	6	6	40	60	100	3
233BT2A3DA	DSE - III	Molecular Therapeutics	3	1	-	3	25	75	100	3
233MB2A3DA		Medical Laboratory Techniques								
233BC2A3DA		Free Radicals and Antioxidant System								
233BT2A3CT	Internship		-	-	-	3	40	60	100	2
Total			**23**	**1**	**6**	**-**	**-**	**-**	**800**	**27**

Course Code	Course Category	Course Name	L	T	P	Exam (h)	Max Marks			Credits
							CIA	ESE	Total	
Fourth Semester										
233BT2A4CA	Core - XIV	Pharmaceutical Biotechnology	4	-	-	3	25	75	100	4
233BT2A4CP	Core Practical - VI	Pharmaceutical Biotechnology	-	-	6	6	40	60	100	3
233BT2A4CV	Project	Project and Viva Voce	-	-	16	-	80	120	200	8
233BT2A4DA	DSE - IV	Stem Cell Technology	3	1	-	3	25	75	100	3
233MB2A4DA		Molecular Diagnostics & Bioinformatics								
233BC2A4DA		Neurobiology								
Total			**7**	**1**	**22**				**500**	**18**
Grand Total									**2700**	**92**

DISCIPLINE SPECIFIC ELECTIVE

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

Semester I (Elective I) List of Elective Courses

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

Semester II (Elective II)

List of Elective Courses

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

Semester III (Elective III) List of Elective Courses

S. No.	Course Code	Name of the Course
1.	233BT2A3DA	Molecular Therapeutics
2.	233MB2A3DA	Medical Laboratory Techniques
3.	233BC2A3DA	Free Radicals and Antioxidant System

Semester IV (Elective IV)

List of Elective Courses

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

EXTRA CREDIT COURSES

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

S. No.	Course Code	Course Title
1.	233BT2ASSA	Food Biotechnology
2.	233BT2ASSB	Developmental Biology

CERTIFICATE COURSES

S. No.	Course Code	Course Name
1	233BT5A1CA	Plant Tissue Culture
2	233BT5A2CA	Molecular Diagnosis

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
233BT2A1CA	MOLECULAR BIOLOGY & GENETICS	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The replication and repair mechanism in prokaryotic and eukaryotic cells
- The Transcription, translation and protein targeting mechanisms
- The concept of human genetics, disorders and inheritance pattern

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Appraise the mode of DNA replication and repair mechanisms	K3
CO2	Formulate transcriptional events and its role in gene regulation	K3
CO3	Infer translational events and its role in gene expression & protein targeting	K4
CO4	Integrate the human genetics and various genetic disorders	K5
CO5	Generalize the inheritance pattern and population genetics	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

233BT2A1CA	MOLECULAR BIOLOGY & GENETICS	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Replication and Recombination 10 h

Introduction to Replication & Experimental proof for Semiconservative method. Enzymes & accessory proteins involved in DNA replication. DNA Replication and Regulation mechanism in prokaryotic & Eukaryotic. Other Replication models – Theta and Rolling circle model. DNA Repair mechanism - Nucleotide excision, Base excision, Mismatch repair, Double-Strand Breakage Repair, Photo-reactivation, SOS and recombination repair. Recombination: Homologous and site-specific recombination.

Unit II Transcription and Posttranscriptional Mechanisms 10 h

Importance of DNA binding Proteins, RNA polymerase. Mechanism of Transcription in prokaryotes & Eukaryotes. Transcriptional regulatory elements and mechanisms of transcription regulation. Transcriptional and post-transcriptional gene silencing. mRNA Stability and Localization. RNA processing - r-RNA & t- RNA processing, mRNA 5′ capping, 3′-end processing and polyadenylation, RNA splicing, RNA Editing, Nuclear export of mRNA and mRNA based therapeutics.

Unit III Translation and Post Translational Modifications 10 h

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

Unit IV Mendelism and Non Mendelism 09 h

Overview on mendelian and non-mendelian inheritance. Human Genetics - Introduction to Human Genetics. Chromosomal changes resulting in abnormal phenotype: Numerical (Aneuploidy) changes resulting in genetic syndromes eg: Turner, Down & Klinefelter Syndromes. Structural changes resulting in genetic diseases: eg: Cri-du-chat syndrome. Genetic Diseases and Inheritance Pattern:

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

Unit V Analysis of inheritance pattern 09 h

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

Text Books

1. Harvey Lodish, Arnold Berk, Chris A Kaiser, Monty Krieger, Anthony Bretscher, 2021, "Molecular Cell Biology", 9th edition, W H Freeman & Co. USA
2. Thomas D Pollard, William C Earnshaw, Jennifer Lippincott-Schwartz, Graham T Johnson, 2017, "Cell biology", 3rd edition, Elsevier, Inc., USA.

References

1. George M Malacinski, 2015, "Freifelders Essentials Of Molecular Biology", 4th edition, Jones & Bartlett Publisher. USA
2. Jocelyn E Krebs, Elliott S Goldstein, Stephen T Kilpatrick, 2017, "Lewin's GENE XII", 12th edition, Jones and Bartlett Publishers. USA
3. David L Nelson and Michael Cox, 2021, "Lehninger Principles of Biochemistry", 8th edition, W.H. Freeman & Co Ltd., USA
4. Nancy Craig, Rachel Green, Carol Greider, Gisela Storz and Cynthia Wolberger, 2021, "Molecular Biology: Principles of Genome Function", 3rd edition, OUP Oxford. UK

Course Code	Course Name	Category	L	T	P	Credit
233BT2A1CB	BIOCHEMISTRY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The Structure of Biomolecules
- The function and biosynthesis of the biomolecules
- The metabolism and their regulatory pathways.

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Experiment the physical properties, Classification, metabolism and disorders of carbohydrates	K4
CO2	Interpret the concepts of structure andfunction, metabolism and disorders of lipid and fatty acid	K4
CO3	Summarize the biosynthesis of amino acids and disorders related to amino acids	K4
CO4	Integrate the mechanism, kinetics and inhibition of enzymes and coenzymes	K5
CO5	Appraise the regulatory mechanism of different metabolic activities and their disorders of nucleic acid	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

233BT2A1CB	BIOCHEMISTRY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Carbohydrates 10 h

Classification and reactions: occurrence, properties and biological reactions. Structural features of carbohydrates and Conjugated carbohydrates (Glycoproteins and Glycolipids), Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Gluconeogenesis; interconversion of hexoses and pentoses. Carbohydrate metabolic disorders. Glycogen storage diseases. Lectins – characteristics and functions in biological systeM.

Unit II Lipids 10 h

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

Unit III Amino Acids and Proteins 8 h

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

Unit IV Enzymes and coenzymes 10 h

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

Unit V Nucleic Acids 10 h

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

Text Books

1 Lehninger AL and Cox M M, 2013, "Principles of Biochemistry", 6th edition, W. H. Freeman and Company, New York

2 Rodwell VW, Bender DA, Botham KM, Kennelly PJ, and Weil PA, 2018, "Harper's Illustrated Biochemistry", 31st edition, McGraw Hill publications, New Delhi.

References

1 Berg JM, Stryer L et al., 2015, "Biochemistry", 8th edition, Palgrave Macmillan Publications, India

2 Ramadevi K, 2016, "Ambika Shanmgam's Fundamentals of Biochemistry for Medical Students". 8th edition, Wolters Kluwer (India) Pvt, Ltd., New Delhi.

3 Voet D and Voet J G, 2011, "Biochemistry". 4th edition. John Wiley and Sons Inc. USA

4 Fromm HJ and Hargrovem , 2012, "Essentials of Biochemistry", Springer publisher

Course Code	Course Name	Category	L	T	P	Credit
233BT2A1CC	MICROBIOLOGY	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The microbial diversity and the molecular identification techniques
- The role of Microbes in Food and Agriculture
- The interaction of microbes with host and the control measures

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Interpret the Microbial classification and their preservation	K4
CO2	Infer the techniques used in Microbial identification	K4
CO3	Relate the role of microbes in agricultural field	K5
CO4	Analyze the causes for various infections	K5
CO5	Find the solutions to control the spread of infections	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

233BT2A1CC	MICROBIOLOGY	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Microbial Diversity 08 h

Concepts of species and hierarchical taxa – Bacterial nomenclature– Bergey's system of Classification, Classification of Fungi and Viruses, Polyphasic taxonomy, Preservation and maintenance of microbes, Microbial Culture Collection centers – India and International organizations, Modern methods to study microbial diversity: NGS.

Unit II Microbial Identification Techniques 10 h

Microbial Identification through physiological and biochemical methods (BIOLOG, Vitex). Techniques used in diversity analysis – Fatty Acid Methyl Ester (FAME), 16S rRNA & 18s rRNA gene sequencing. Mol % G+C analysis, DNA-DNA hybridization, Molecular methods to study complex microbial communities: DGGE, SSCP, T-RFLP and FISH.

Unit III Food and Agricultural Microbiology 10 h

Spoilage of food – Principles and types; Food preservation: physical and chemical- Food sanitation – Food poisoning – Food borne pathogens – Quality control and Food laws. Role of microorganisms in soil fertility – Role of nif gene in Biological nitrogen fixation, Plant microbe interaction: Biopesticides (B. thuringiensis and NPV) - Biofertilizers - PGPR –mycorrhiza

Unit IV Microbial Interactions and Infection 10 h

Bacterial Diseases: Host-parasite relationship, epidemiology, pathogenesis, prevention and treatment – Mycobacterium, Salmonella and Yersinia. Viral Diseases: Epidemiology, pathogenesis, prevention and Treatment - H1N1, HIV, SARS-COV-2. Fungal Diseases: Infections caused by yeast: Candida. Filamentous Fungi: Aspergillus sp. Protozoan Diseases: Malaria, Leishmaniasis.

Unit V Control of micro-organisms 10 h

Concept of sterilization and disinfection. Physical and chemical methods of microbial control. Chemotherapeutics, susceptibility test (broth procedures and diffusion methods), mode of action of antibiotics, narrow and broad spectrum (Penicillin, ampicillin, sulfonamide, vancomycin, tetracycline, chloramphenicol),

antifungals(clotrimazole, fluconazole), antiretroviral (tenofovir, AZT).

Text Books

1. Pelczar MJ Jr., Chan ECS and Kreig NR., 1993, "Microbiology", 5th edition, Tata McGraw Hill, New Delhi.
2. Vijaya Ramesh, K, 2020, "Food Microbiology"1st edition, MJP Publishers, Chennai.

References

1. Joanne Willey, Kathleen Sandman, Dorothy Wood, 2020, "Prescott's Microbiology", 11th edition, McGraw Hill Education, New York.
2. David H. Persing, Fred C. Tenover, James Versalovic, Yi-Wei Tang, Elizabeth R. Unger, David A. Relman, Thomas J. White, 2004, "Molecular Microbiology- Diagnostic Principles and Practice, 1st edition, ASM Press, Washington, DC
3. William C. Frazier, Dennis C. Westhoff, 2021, "Food Microbiology", 1st edition, McGraw Hill Education, India.
4. David Greenwood, Richard C.B. Slack, John F. Peutherer, 2002, "Medical Microbiology – A Guide to Microbial Interactions: Pathogenesis, Immunity, Laboratory Diagnosis and Control", 16th edition, Churchill Livingstone, Edinburgh.

Course Code	Course Name	Category	L	T	P	Credit
233BT2A1CD	BIODIVERSITY & BIOPROSPECTING	CORE	4	-	-	4

PREAMBLE

This course has been designed for students to learn and understand

- The importance of biodiversity and various methods of conservation
- The Bioprospecting potentials of available natural resources
- The regulations related with biodiversity and bioprospecting

COURSE OUTCOMES

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

CO Number	CO Statement	Knowledge Level
CO1	Articulate the types of biodiversity, the threats to the biodiversity and Biodiversity hotspots	K2
CO2	Illustrate the discovery of medicinal compounds from natural products and their significance	K2
CO3	Infer the sustainable utilization of microbial resources and benefit sharing	K3
CO4	Report the screening and purification process of various bioactive substances	K4
CO5	Formulate regulations and laws for biodiversity	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

233BT2A1CD	BIODIVERSITY & BIOPROSPECTING	SEMESTER I

Total Credits: 4

Total Instruction Hours: 48 h

Syllabus

Unit I Biodiversity- Overview and Acts 10 h

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

Unit II Natural products from plants 10 h

Drugs derived from plants, Antitumor agent - Etoposide, Colchicine, Taxol, Vinblastine, Vincristine. Cardiotonic – Convallatoxin, Acetyldigoxin, Adoniside. Antiinflammatory – Aescin, Bromelain. Choleretic – Curcumin. Laxatives, Antimalarial Quinine- Cinchona. Morphine-Opium plant- analgesic. Volatile, pigments and terpenes, Phenols, flavonoids.

Unit III Bioprospecting of Microbial Products 10 h

Screening for bioactivity, antimicrobials, pharmacologically active agents of microbial origin, bioprospecting for industrial enzymes, plant growth promoting agents, antifoulants and anti-biofilm agents from microbes. Bioprospecting of marine organisms. Bio piracy issues.

Unit IV Techniques used in bioprospecting 10 h

Drug discovery and product development: Discovery from traditional medicine. Modern tools in drug discovery. Role of chromatography in drug analysis including HPLC, GC and LC and GC Mass spectrometry, FTIR, -NMR their principles and merits. Product development procedures and policies.

Unit V Bioprospecting Regulations 08 h

Regulations on bio-prospecting, access and benefit-sharing (National Environmental Management: Biodiversity act, 2004)- Rules and regulations in patenting and Intellectual Property Rights of Bio-Prospecting products in India.

Text Books

1 Russell Paterson, Nelson Lima, 2004, "Bioprospecting: Success, Potential and Constraints", 1st edition, Springer Publications

2 Upadhyay, 2021, "Bioprospecting of Plant Biodiversity for Industrial Molecules", 1st edition, Wiley, USA.

References

1 Jeffries MJ, 2006, "Biodiversity and Conservation", 2nd edition, Routledge, USA

2 Vanesha S, 2010, "Marine Bioprospecting and Natural Product Research", 1st edition, LAP Lambert Academic Publishing, Germany

3 Dubey KN and Yadav GP, 2011, "Biodiversity - Threats to Conservation", 1st edition, Axis Publication, India.

4 Krishanmurthy KV, 2018, "An Advanced Textbook on Biodiversity", 1st edition, Oxford and IBH Publishing Co Pvt Ltd., India

233BT2A1CP	CORE PRACTICAL - I : MOLECULAR BIOLOGY, GENETICS AND BIOCHEMISTRY	SEMESTER I

Total Credits: 2
Total Instructions Hours: 60 h

S.No	Contents
1	Isolation of genomic DNA from human blood sample
2	Bacterial conjugation
3	Bacterial Transformation
4	Molecular analysis using RAPD
5	RFLP analysis
6	Estimation of total Protein and albumin from serum
7	Estimation of glucose from serum
8	Estimation of Vitamin C from Citrus fruit
9	Estimation of total amino acids from serum
10	Estimation of DNA & RNA
11	Determination of blood cholesterol
12	Separation of amino acids from serum Paper Chromatography

References

1 Sambrook, J. and Green, M.R., 2012, "Molecular Cloning: A Laboratory Manual", 4th Edition, Cold Spring Harbor, USA

2 Mertens, T.R., and Hammersmith, R.L., 1997, "Genetics Laboratory Investigations", 11th edition, Benjamin Cummings, USA

3 Sadasivam, S. and Manickam, A, 1996, "Biochemical Methods", 4th edition, New Age International, India

4 Varghese, N., 2014, "Microbiology Laboratory Manual", 1st edition, Aromatic and Medicinal Plant Research Station, India

233BT2A1CQ	CORE PRACTICAL - II: MICROBIOLOGY AND BIODIVERSITY & BIOPROSPECTING	SEMESTER I

Total Credits: 2
Total Instructions Hours: 48 h

S.No	Contents
1	Isolation of enzyme producing Bacteria from soil
2	Isolation of Antibiotic producing microorganisms against pathogen
3	Isolation of Fungi from spoiled food
4	Sampling and analysis of microbial load on food contact surfaces.
5	Morphological Analysis of Microbes using stereomicroscope
6	Observation of fungal morphology using Phase contrast microscopy
7	Methylene blue reductase test for milk.
8	To identify and classify 5 different types of pollen and note the observation under stereomicroscope
9	Observation of bacterial growth curve
10	Phytochemical Analysis of same plant species grown in different geographic locations
11	TLC analysis of the secondary metabolites of same plant species grown in different geographic locations
12	To run column chromatography of a single phytochemical (alkaloid, flavonoid, tannin) obtained from different sources (fruits, vegetables,leaves etc)

References

1 Demain AL and Davies JE, 1999, " Manual of Industrial Microbiology and Biotechnology", ASM Press, Washington, D.C., USA.

2 Doyle MP, Beuchat LR and Montville TJ, 1997, "Food Microbiology: Fundamentals and Frontiers", ASM Press, Washington D.C., USA.

3 Paterson Russell and Lima Nelson, 2017, "Bioprospecting: Success, Potential and Constraints", Springer Publications.

4 Judith A Scheppler, Patricia E Cassin and Rosa M Gambier, 2014, "Biotechnology explorations: Applying the fundamentals", ASM Press

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 diagnostics 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 industry, 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. Marwaha SS & Arora K, 2000, "Food processing: Biotechnological application", Asiatech Publishers INC, New Delhi
2. Palmer T, Bonner PLR, 2014, "Enzymes: Biochemistry, Biotechnology and Clinical Chemistry", 2nd edition, Woodhead Publishing Limited, Oxford.
3. Stanbury PF and Whitaker A, 2005, "Principles of Fermentation technology", 2nd edition. Pergamon press.
4. Stanbury PF and Whitaker A, 2007, "Fermentation microbiology and Biotechnology", 2nd edition, Taylor and Francis

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

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BoS- 15th	AC - 15th	GB - 20th
10/06/2023	14/07/2023	05/08/2023

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