

2021

B.Sc BIOTECHNOLOGY

Course Structure and Syllabus

(For the candidates admitted from the academic year 2021-2022 onwards)

CHOICE BASED CREDIT SYSTEM (CBCS)



THANTHAI HANS ROEVER COLLEGE

(AUTONOMOUS)

(Approved by NAAC, Affiliated to Bharathidasan University)

ELAMBALUR, PERAMBALUR – 621 220



**Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621
220B.ScBIOTECHNOLOGY-UGCourse Structure underCBCS
(For the candidates admitted from the academic year 2021-2022 onwards)**

Semester	Part	Course Code	Title of the Course	Ins. Hours/ Weeks	Credits	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
1	I	20UT1	Tamil-I(Ilakiyam-Kavithai,Sirukathai,Urainadai, Ilakkiya Varalaru)	6	3	3	25	75	100
1	II	20UE1	English-I(Communicative English)	6	3	3	25	75	100
1	III	20UBT1CC1	General Microbiology	5	4	3	25	75	100
1	III	20UBC1AC1	Biochemistry	5	3	3	25	75	100
1	III	20UBT1CP1	General Microbiology-Lab	4	3	3	40	60	100
1	III	20UBT1PE1	Stream-B Professional English for Life Science-I	2	2	3	25	75	100
1	IV	20UVE	Value Education	2	2	3	25	75	100
Total				30	20	-	-	-	700
2	I	20UT2	Tamil-II(Idaikkala Ilakiyam,Nadagam,Puthina m,Ilakkiyavaralaru)	6	3	3	25	75	100
2	II	20UE2	English-II(Communicative English)	6	3	3	25	75	100
2	III	20UBT2CC2	Cell Biology	4	4	3	25	75	100
2	III	20UBC2AC2	Applied Biochemistry	4	3	3	25	75	100
2	III	20UBT2CP2	Cell Biology-Lab	3	3	3	40	60	100
2	III	20UBC2AP1	Biochemistry-Lab	3	2	3	40	60	100
2	III	20UBT2PE2	Stream-B Professional English for Life Science-II	2	2	3	25	75	100
2	IV	20UES	Environmental Studies	2	2	3	25	75	100
Total				30	22	-	-	-	800
3	I	20UT3	Tamil-III(Kappiya Ilakkiyam, Nadagam,Ilakkiyavaralaru)	6	3	3	25	75	100
3	II	20UE3	English-III(Communicative English)	6	3	3	25	75	100
3	III	20UBT3CC3	Molecular Biology	6	4	3	25	75	100
3	III	20UBT3CP3	Molecular Biology- Lab	3	3	3	40	60	100
3	III	20UBI3AC3	Bioinformatics	4	3	3	25	75	100
3	IV	20UBI3AP2	Bioinformatics-La2b	3	2	3	40	60	100

3	IV	NME1	Biotechnology For Human Welfare	2	2	3	25	75	100
Total				30	20	-	-	-	700
4	I	20UT4	Tamil-IV(PalanIlakkiyam,Ilakiya varalaru,Podhu Katturai)	6	3	3	25	75	100
4	II	20UE4	English-IV(Communicative English)	6	3	3	25	75	100
4	III	20UBT4CC4	rDNATechnology	6	4	3	25	75	100
4	III	20UBT4CP4	rDNATechnology-Lab	3	3	3	40	60	100
4	III	20UZO4AC4	DevelopmentalBiology	5	3	3	25	75	100
4	IV	NME2	PharmaceuticalBiotechnology	2	2	3	25	75	100
4	IV	20UBT4SBE1:1	1.MushroomandVermitechnology	2	2	3	25	75	100
		20UBT4SBE1:2	2.FoodandNutrition3.PhytochemicalsandHerbalMedicine						
		20UBT4SBE1:3							
Total				30	20	-	-	-	800
5	III	20UBT5CC5	PlantBiotechnology	5	5	3	25	75	100
5	III	20UBT5CC6	AnimalBiotechnology	5	5	3	25	75	100
5	III	20UBT5CC7	BiostatisticsandBiosafety	5	5	3	25	75	100
5	III	20UBT5CP5	Plantand AnimalBiotechnology-Lab	4	4	3	40	60	100
5	III	20UBT5MBE1:1	1.Immunology	5	3	3	25	75	100
		20UBT5MBE1:2	2.BioInstrumentation						
		20UBT5MBE1:3	3.Nanotechnology						
5	IV	20UBT5SBE2:1	1.Medical lab technology2.Biofertilizer	2	2	3	25	75	100
		20UBT5SBE2:2							
		20UBT5SBE2:3	3.Dairytechnology						
5	IV	20UBT5SBE3:1	1.Aquaculture	2	2	3	25	75	100
		20UBT5SBE3:2	2.Apiculture3						
		20UBT5SBE3:3	.Sericulture						
5	IV	20USSD	SoftSkillDevelopment	2	2	3	25	75	100
Total				30	30	-	-	-	800
6	III	20UBT6CC8	MicrobialBiotechnology	6	6	3	25	75	100
6	III	20UBT6CC9	IPRandBioethics	6	6	3	25	75	100
6	III	20UBT6CP6	MicrobialBiotechnology-Lab	5	4	3	40	60	100
6	III	20UBT6MBE2:1	1.Food technology2.Enzymetechnology	6	5	3	25	75	100
		20UBT6MBE2:2							
		20UBT6MBE2:3	3.Biodiversityandconservation						

6	III	20UBT6MBE3:1 20UBT6MBE3:2 20UBT6MBE3:3	1.EnvironmentalBiotechnology 2.CancerBiology 3.StemCellBiolog3	6	5	3	40	60	100
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6	V		ExtensionActivities	-	1	-	-	-	-
6	V	20UGS	GenderStudies	1	1	3	25	75	100
Total				30	28	-	-	-	600
GrandTotal				180	140				4400

LanguagePart-I	-	4
EnglishPart-II	-	4
Stream-B-ProfessionalEnglishfor lifeSciences	-	2
CorePaper	-	9
CorePractical	-	6
AlliedPaper	-	4
AlliedPractical	-	2
Non-MajorElective	-	2
SkillBasedElective	-	3
MajorBasedElective	-	3
EnvironmentalStudies	-	1
ValueEducation	-	1
SoftSkillDevelopment	-	1
Gender Studies	-	1
ExtensionActivities	-	1

(Creditonly)

*forthosewhostudiedTamilupto10th+2(RegularStream)

+ Syllabus for other Languages should be on par with Tamil at degree

level#thosewhostudiedTamilupto10th+2butoptforotherlanguagesin
degreelevel underPartIshouldstudyspecialTamilin PartIV

**ExtensionActivitiesshallbeoutsideinstructionhours

NonMajorElectiveI&II-forthosewhostudiedTamilunderPartI

- a) BasicTamilI &II forother languagestudents
- b) SpecialTamilI&IIforthosewhostudiedTamilupto10thor+2but
optforotherlanguagesindegreeprogramme

Note:	Internal Marks	ExternalMarks
1.Theory	25	75
2.Practical	40	60

FOR THEORY

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10marks] The passing minimum for University Examinations shall be 40% out of 75 marks [i.e. 30marks]

FOR PRACTICAL

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16marks] The passing minimum for University Examinations shall be 40% out of 60 marks [i.e. 24marks]

List of Skill Based Elective Courses

Skill Based Elective	Course Code	Title of the Courses
Skill Based Elective -1	20UBT4SBE1:1 20UBT4SBE1:2 20UBT4SBE1:3	Mushroom and Vermitechnology Food and Nutrition Phytochemicals and Herbal Medicine
Skill Based Elective-2	20UBT5SBE2:1 20UBT5SBE2:2 20UBT5SBE2:3	Medical lab technology Biofertilizer Dairy technology
Skill Based Elective -3	20UBT5SBE3:1 20UBT5SBE3:2 20UBT5SBE3:3	Aquaculture Apiculture Sericulture

List of Non Major Elective Courses

Non Major Elective Courses	Course Code	Title of the Courses
Non Major Elective Courses-1	20UBT3NME1	Biotechnology For Human Welfare
Non Major Elective Courses-2	20UBT4NME2	Pharmaceutical Biotechnology

THANTHAIHANSROEVERCOLLEGE(Autonomous)

ProgrammeOutcomes(POs)

UndergraduateProgrammes

Upon completion of the programme, the undergraduate will be able to

1. Acquire knowledge, understand concepts and apply new ideas which enable them to be employable or self-employed
2. Demonstrate motivation in advancing to higher learning programmes
3. Engage in socially responsible behaviour and have value-added education
4. Have exposure to technical proficiency, analytical capability, soft skills and life skills development
5. Develop broad understanding in the basic concepts of

Languages/Commerce/Management Studies/Physical Sciences/Computing Sciences/Biological Sciences/Life Sciences

B.Sc.,Biotechnology Programme Specific Outcomes(PSOs)

1. Acquire knowledge on the fundamentals of biotechnology, Environmental Biotechnology, Nanobiotechnology, animal and plant biotechnology, Industrial Biotechnology, genetic engineering, immunology, bioinformatics for research activities in the department research center or in collaboration with other research institutes
2. Understand the applications of biotechnology in all spheres of agriculture and develop crops with improved productivity thereby increasing farmers' income, better human health and decreased environmental pollution.
3. The objective of the Biotechnology is to equip the students to apply knowledge of molecular mechanisms of cellular processes in living systems including microbes, plants, and higher order organisms to applied aspects.
4. Interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments, recognition of the need for, and an ability to engage in life-long learning.
5. Recognize the importance of biotechnological applications as to usher next generation entrepreneurship

SEMESTER-I

Course Code:20UBT1CC1
InstructionHours:5
Credits:4

ExamHours:3
InternalMarks:25
ExternalMarks: 75

CORE COURSE-I

GENERAL MICROBIOLOGY

Courseoutcomes

- The course supports to understand the microbial world in various aspects of structure, growth, classification & characterization.
- Have developed a good knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field.
- Have developed a very good understanding of the properties, structure and cultivation of different types of microorganisms.
- Described the nutritional requirements of microorganism for growth.
- Have acquired a fairly good knowledge of microbial application in industry.

UNIT-I

Definition and scope of microbiology - History of microbiology-Classification and nomenclature of microorganism - Microscopic examination of microorganisms- Microscopy: simple, compound light microscope, Dark Field, Phase contrast and Electron Microscopy-Principles of different staining techniques like Simple, Gram staining, acid fast, Capsular staining.-Recent methods of microbial identification

UNIT-II

Microbial association - General structure and function of microorganism - Bacteria, Fungi, Virus - Algae and Protozoa.

UNIT-III

Methods in microbial culture - Microbial Energetics - Nutritional requirements of bacteria and

different media used for bacterial culture- types of Nutrition (Phototrophs, autotrophs and Chemoautotrophs) - Microbial growth curve- Aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules - Factors affecting microbial growth, pH, light, temperatures, desiccations, osmotic pressure, radiation-pure culture techniques-pour plate, spread plate and streak plate

UNIT-IV

Sterilization of microorganisms- Physical and chemical methods of sterilization -physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) and chemical (alcohols, aldehydes, phenols, halogens and hypochlorite)

UNIT-V

Microbes application in agriculture-Biofertilizer- Microbes as a source of protein-Single Cell Protein- Microbes in medicine; Antibiotics, Penicillin - Microbes in the production of acetic acid and Amylase.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
25	10	5	5	15	Local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Prasad B.N., "A Text Book of Biotechnology", (2003) Budha Academic Enterprises, G.P.O., Box 20195, Kathmandu, Nepal.
2. Pelczar M.J., Chan E.C.S. and Krein N.R., (1993) Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Ananthanarayanan R. & Jayaram Panicker, C.K. (2005) Textbook of Microbiology, Orient Longman.

References

1. Prescott, L.M.J.P. Harley and C.A. Klein, Microbiology 2nd edition (1995). Wm, C. Brown publishers.
2. Talaron K, Talaron A, Casita, Pelczar and Reid. (1993) Foundations in Microbiology, W.C. Brown Publishers.
3. Michael T. Madigan John M. Martin & Jack Parker, (1984) Biology of Microorganisms Prentice Hall International, Inc., London.
4. Edward A. Birge, (1992), Modern Microbiology-Principles and application..C. Brown Publishers, Inc. U.S.A.

5. Gerard J. Tortora, Berdell R. Funke, Christine & L. Case, (2001), Microbiology- An Introduction. Benjamin Cummings, U.S.A.
6. Rajan Sand Selvi Christy R. Essentials of Microbiology, Anjana Book House, Chennai, 2011.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	20UBT1CC1	General Microbiology					5	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓		✓		✓	✓	✓		✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of Matches (l) = 44 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

Course Code:20UBC1AC1

InstructionHours:5

Credits:3

ExamHours: 3

InternalMarks:25

ExternalMarks: 75

ALLIED COURSE - I BIOCHEMISTRY

Course outcomes

- Developed a very good understanding of various biomolecules which are required for development and functioning of a bacterial cell.
- Have developed how the carbohydrates make the structural and functional components such as energy generation and as storage food molecules for the bacterial cell.
- Well conversant about multi farious function of proteins and al so knowledge about lipids and nucleic acids.
- To understand working principle of various instruments used in biological studies.
- Apply the recent advances in Biochemistry and Biophysical techniques in Clinical Chemistry and Life science Research.

UNIT-I

Structure of atoms and biomolecules-Atomic theory, valency, atomic weight, molecular weight, Molarity, molality and normality, Chemical Bonding-Isomerism, anomeric form and mutarotation-Properties of Water, ionization constant, pH and buffers-Isomerism, anomeric form and mutarotation.

UNIT-II

Macromolecules - Carbohydrates, Structure, classification, properties and functions of mono, di and polysaccharides - Metabolism concepts, Glycolysis,TCA cycle, pentose phosphate shunt and Respiratory chain, ATPsynthesis - Metabolic disorders associated with carbohydrates - composition and functions of peptidoglycan and agarose.

UNIT-III

Protein, Structure, Classification, properties and function-Classification, Properties and function of amino acids - Metabolism concepts, Nitrogen metabolism and urea cycle - Biosynthesis of six essential amino acids (Met,Thr,Lys,Ile,Val,Leu) and aromatic

amino acids - Metabolic disorders associated with chain and aromatic amino acid degradation-Stereoisomerism, zwitter ion in aqueous solutions, physical and chemical properties, titration of amino acids.

UNIT-IV

Lipids, Classification, Structure, Properties and function - Vitamins, Classification, Properties and its functions

UNIT-V

Instrumentation pH meter colorimeter, Spectrophotometer, centrifuge- Methods for detecting radio activity GM and Scintillation counter- Principle and applications of Chromatography Paper and Column Chromatography - Electrophoretic techniques, PAGE, SDS PAGE

Total Number of Topics	Local	Regional	National	Global	Category Based on %
22	5	3	12	15	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. MichaelCox.,David.L.Nelson,(2004).Lehninger,PrinciplesofBiochemistry,KalyaniPublishers,New Delhi.
2. H.S.Srivastava(2006).ElementsofBiochemistry,RastogiPublications,Meerut.
3. Jain,J.L.,Jain,SandJain,N.,FundamentalsofBiochemistry,S.Chand&Company.NewDelhi.
4. SathyanarayanaUandChakrapaniU.Biochemistry,4thedition, ElsevierPublishers. 2013.
5. Biophysicalchemistry- Upadhyay,HimalayaPublication,edition3,2005.

References

1. Stryer.L.(2003)Biochemistry,V.Edition.W.H.Freeman&Co.NY.
2. RobertK.MurrayDarylK.Granner,Peter.A.Mayes.&VictorW.Rodwell(2004)HarpersBiochemistry-PrenticeHallInternational,ISBN-8385-3612-3.

3. Geoffrey L. Zubay, William W. Passon, Dennis L. Vance, (1988), Principles of Biochemistry, IV edition, W. M. C. Brown Publishers, Australia.
4. Murray, R. K. A. Grannon, D. K. Mayes, P. A. and Rodwell V. W. (2000) Harper's Biochemistry, McGraw Hill Pvt. Ltd., New Delhi.
5. Voet D & Voet J. G (1990) Biochemistry, John Wiley & Sons, New York.
6. Zubay G (1998). Biochemistry 2/e, McMillan Publishers New York, Collier McMillan Company, London.

SEMESTER-I

CourseCode:20UBT1CP1
InstructionHours: 4
Credits: 3

ExamHours:3
InternalMarks: 40
ExternalMarks: 60

COREPRACTICAL-I GENERAL MICROBIOLOGY(P)

Course outcomes

- This practical is designed to give an understanding a bout the basic techniques in Microbiolog.
- To know about isolation of microorganism from different sample
- Describe the basic principles of sterilization and media preparation.
- Differentiate organisms based on structural and biochemical properties.
- Develop skills associated with isolating and enumerating microorganisms from various sources.
- Apply knowledge and skills gained in this course to be useful in furher research

1. Good Laboratory Practice, Maintenance of hygienic conditions in the laboratory and legal disposal of laboratory wastes.
2. Microscope and its functions, preparation of culture media and sterilization methods.
3. Methods of staining techniques- simple, grams, spore and capsular staining.
4. Bacterial culture technique-streaking, pour plate and spread plate method. Fungal culture techniques.
5. Motility of bacteria, Growth studies of bacteria.
6. Isolation of microbes and slide preparation-quantitative methods of microbes. Characterization biofertilizer microbes
7. Colony counting
8. Identification of products of metabolic pathways (IMViC)

Total Number of Topics	Local	Regional	National	Global	Category Based on %
8	5	2	4	0	Local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. Buckner, J.M.,Caldwell,C.A.,Zachgo,E.A.1990.ALaboratorycourse,AcademicPress.
2. HaroldJ.Berson1994.MicrobialApplications.WM.C.BrownPublishers.
3. WilliamClaus.G.W.1989.UnderstandingMicrobes-ALaboratorytextbookforMicrobiology,
W.H. Freemanand Co.,NewYork.
CappuccinoJ.G.&ShermanN.(2002).Microbiology:Alaboratorymanual, AddisonWesley.

RelationshipMatrixfor COs,POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
I	20UBT1CP1	GeneralMicrobiology-Lab					4	3				
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓		✓	✓	✓	✓			
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓		✓	✓	✓	✓		✓	✓	✓		
CO4	✓	✓		✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓		
NumberofMatches(l) =44Relationship:High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-I

Course Code: 20UMB1PE1

Instruction Hours:2

Credits:2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

STREAM B - PROFESSIONAL ENGLISH FOR LIFE SCIENCES-I

Objectives:

- To develop the language skills of students by offering adequate practice in professional contexts.
- To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students
- To focus on developing students' knowledge of domain specific registers and the required language skills.
- To develop strategic competence that will help in efficient communication
- To sharpen students' critical thinking skills and make students culturally aware of the target situation.

Course outcomes:

- Recognise their own ability to improve their own competence in using the language
 - Use language for speaking with confidence in an intelligible and acceptable manner
 - Understand the importance of reading for life
 - Read independently unfamiliar texts with comprehension
 - Understand the importance of writing in academic life
 - Write simple sentences without committing error of spelling or grammar
- (Outcomes based on guidelines in UGC LOCF - Generic Elective)

NB: All four skills are taught based on texts/passages.

UNIT 1: COMMUNICATION

Listening: Listening to audio text and answering questions-Listening to Instructions.

Speaking: Pair work and small group work. Reading: Comprehension passages -

Differentiate between facts and opinion. Writing: Developing a story with pictures.

Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 2: DESCRIPTION

Listening: Listening to process description.-Drawing a flow chart. Speaking: Role play

(formal context). Reading: Skimming/Scanning- Reading passages on products, equipment

and gadgets. Writing: Process Description -Compare and Contrast.Paragraph-Sentence

Definition and Extended definition- Free Writing. Vocabulary: Register specific -

Incorporated into the LSRW tasks.

UNIT 3: NEGOTIATION STRATEGIES

Listening: Listening to interviews of specialists / Inventors in fields (Subject specific).

Speaking: Brainstorming. (Mind mapping). Small group discussions (Subject- Specific).

Reading: Longer Reading text. Writing: Essay Writing (250 words). Vocabulary:

Register specific - Incorporated into the LSRW tasks

UNIT 4: PRESENTATION SKILLS

Listening: Listening to lectures. Speaking: Short talks. Reading: Reading Comprehension passages. Writing: Writing Recommendations. Interpreting Visuals inputs. Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 5: CRITICAL THINKING SKILLS

Listening: Listening comprehension- Listening for information. Speaking: Making presentations (with PPT- practice). Reading: Comprehension passages -Note making. Comprehension: Motivational article on Professional Competence, Professional Ethics and Life Skills). Writing: Problem and Solution essay- Creative writing -Summary writing. Vocabulary: Register specific - Incorporated into the LSRW tasks.

SEMESTER-II

Course Code:20UBT2CC2

InstructionHours: 4

Credits:4

ExamHours:3

InternalMarks:25

ExternalMarks: 75

CORE COURSE - II CELL BIOLOGY

Courseoutcomes

- Discuss and differentiate the basic structure and function of cell components in prokaryotes and eukaryotes cells.
- In this course the students will learn different areas of cellular biology including the structure and functions of cell,its organelles, bioenergetics;cellular communication;
- Summarize the processes of energy transduction in cells and explain their significance
- Explain cell cycle and its regulation
- Getting so undknowledge on principle and applications of various microscopy.Gain expertise in the isolation of various cell organelles and staining of cellular

UNIT- I Fundamentals of cell structure

Discovery of cells - Basic properties of cells - Overview of cells-Different classes of cells-Prokaryotic and eukaryotic cells - Cell division-Cell cycle, mitosis, meiosis-binary fission.

UNIT -II Cellular membranes and matrices

Chemical composition and fluidity of membranes - dynamic nature of membranes -mechanism and action of receptors- transportation across cell membrane - membrane potentials - extracellular matrices- structure and function -cytoskeleton - structure and function.

UNIT-III Cellular organelles in metabolism

Endoplasmic reticulum - smooth & rough, function of endoplasmic reticulum - Golgi complex structure and function - Ribosomes, Types, structure and function - Morphology and functions of peroxisomes and glyoxisomes - Plant cell vacuoles, endocytic pathways - endocytosis-phagocytosis-membrane trafficking.

UNIT- IV Cellular organelles in energy metabolism

Mitochondria, structure and function - Chloroplast, structure and function - Structure of nucleus, nuclear

membrane, nucleolus, chromatin - structure of nucleic acids.

UNIT-V Methods in cell biology

Microscope-Light microscope, TEM, SEM - Use of radio isotopes - Staining procedures.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
32	5	2	7	28	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1. Freifelder D. 1985. Molecular Biology, Narosa Publishing House, New Delhi.
2. Lewin B. 2007. Genes IX. Oxford University Press, London.
3. Ajoy Paul. 2011. Textbook of Cell and Molecular Biology. Books and Allied Ltd.
4. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. 2008. Molecular Biology of Cell. 6th Edition. Garland Science, Taylor & Francis Group Publishers.
5. Harvey Lodish, Arnold Berk, Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell. 1995. Molecular Cell Biology. 3rd Edition. W. H. Freeman Publishers.

References

1. Watson JD, Gilman M, Witkowski J and Zoller M. 1992. Recombinant DNA. Scientific American Books. 2nd Edition. New York.
2. Blackburn GM and Gait MJ. 1996. Nucleic Acids in Chemistry and Biology. Oxford University Press.
3. Lodish H, Baltimore D, Beck A, Zipursky SL, Matsudaira P and Darnell J. 1995. Molecular Cell Biology. Scientific American Books.
4. Cooper M. 1995. The Cell Molecular Approach. 2nd Edition. ASM Press.
5. Lewis J, Kleinsmith and Valerie M Kish. 1980. Principle of Cell and Molecular

Biology 2nd Edition. Benjamin-Cummings Publishing Company.

6. DeRobertis, E.D. and E.M. DeRobertis. 1980. Cell and Molecular Biology. 7th Edition. Saunders Company.
7. T.A. Brown. 2011. Introduction to Genetics: A Molecular Approach. 1st Edition. Garland Science.
8. J.D. Watson, Tania A. Baker, Stephen P. Bell, Michael Levine and Richard Losick. 2013. Molecular Biology of the Gene. 7th Edition. Benjamin/Cummings Publ. Co., Inc., California.
9. Benjamin Lewin. 2008. Genes XI. 9th Edition. Jones & Bartlett Learning.
10. R.A. Meyers. 1995. Molecular Biology and Biotechnology. A Comprehensive Desk Reference. (Ed) Wiley-Blackwell Publishers.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20UBT2CC2	Cell Biology					4	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓	✓	✓	✓		✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (l) = 43		Relationship: High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

Course Code:20UBC2AC2

InstructionHours: 4

Credits:3

ExamHours:3

InternalMarks:25

ExternalMarks: 75

ALLIED COURSE-II APPLIED BIOCHEMISTRY

Course outcomes

- To provide knowledge about the techniques used in studying biological structure and Function.
- Develop competence in handling various chromatographic techniques and apply the minisolating and characterizing different biological molecules.
- Understanding the applications of centrifugation and chromatography in biological investigations.
- Understanding the principles of Electrophoresis, Spectrophotometry and X-Ray diffraction and their applications in biological investigations/ experiments.
- To provide ample opportunity for the students to specialize in instruments in centrifugation, chromatography, electrophoresis, spectroscopy and crystallography

UNIT-I Centrifugation

Basic principles of sedimentation - Types of centrifuges - Preparative, analytical, high speed, low speed, ultra centrifuge, differential and density gradient-Determination of molecular weight, sedimentation velocity and sedimentation equilibrium.

UNIT- II Chromatography

General principle of chromatographic separation - Principle, instrumentation and applications of Partition Chromatography - Adsorption Chromatography, Paper Chromatography - TLC, HPTLC, Ion Exchange Chromatography - Gel permeation Chromatography- Affinity Chromatography - GC, GLC ,HPLC, GC,MS,LC,MS.

UNIT- III Electrophoresis

Basic principle and types of electrophoresis, Electrophoretic mobility, Factors affecting electrophoretic migration - Technique and uses of agarose gel electrophoresis-PAGE, SDS,PAGE - Two dimensional electrophoresis and Isoelectric focusing.

UNIT-IV Spectroscopy

Beer, Lambert law and its limitations - **Principles of Beer Lambert law** - Light absorption and transmission - Extinction coefficient- Basic design of photoelectric colorimeter and spectrophotometer - Applications of uv, visible spectroscopic techniques - Flame Photometry, Atomic absorption spectro photometry - Circular Dichroism and Optical Rotatory Dispersion - Principle and application of NMR- ESR techniques.

UNIT- V Crystallography

Principle, instrumentation and applications of X - Ray Crystallography - **Advantages and disadvantages of X Ray Crystallography**- X-ray diffraction - Bragg equation, Reciprocal lattice-Miller indices-Unit cell - Concept of different crystal structure - determination of crystal structure (concept of rotating crystal method, powder method).

Total Number of Topics	Local	Regional	National	Global	Category Based on %
32	10	13	5	10	Regional

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1. P.Palanivelu and M.Salihi. 2009. Analytical Biochemistry and Separation Techniques. 4th Edition, MKU, Madurai.
2. Friefelder, D.M. 1983. Physical Biochemistry: Applications to Biochemistry and Molecular Biology. 2nd Revised edition. W.H. Freeman, USA.

References

1. Upadhyay and Upadhyay Nath. 2009. Biophysical Chemistry, Principles and Techniques. Himalaya Publishing House.
2. Boyer, R.F. 2000. Modern Experimental Biochemistry, 3rd Edition, Prentice Hall publishers, USA.
3. Hammes, G.G. 2007. Physical Chemistry for the Biological Sciences, 1st Edition. Wiley-Interscience, USA.
4. Pavia, D.L., Lampman, G.M., Kriz, G.S. 2000. Introduction to Spectroscopy. 3rd Revised edition. Brooks/Cole Publishing Company, USA.
5. Wilson and Walkar. 2000. A Biologist's Guide to Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, UK.
6. P. Asokan. 2003. Analytical Biochemistry. 2nd Edition. China Publications.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20UBC2AC2	Applied Biochemistry					4	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓		✓	
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓		✓	✓	✓		✓	
CO4	✓	✓		✓		✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Number of Matches (I) = 42		Relationship: High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

CourseCode:20UBT2CP2
InstructionHours: 3
Credits:3

ExamHours:3
InternalMarks:40
ExternalMarks:60

CORE PRACTICAL - II CELL BIOLOGY LAB

Course outcomes

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

- The students will learn, understand & develop the skill and hands on training in fundamentals of cell biology.
- Utilize laboratory skills to enhance understanding of cell structure and function while Participating in a group environment
- Develop responsible conduct of laboratory skills appropriate to the field of cell biology
- Apply the cell biology techniques to biotechnological approaches
- To gain knowledge about the cell organelle separation in both Prokaryotic and Eukaryotic cells

1. Microscope-Bright field and Dark field
2. Micrometry
3. Structure observation- Prokaryotic &Eukaryoticcell
4. Cell count-Prokaryotic & Eukaryotic cell
5. Observation - Different types of cells-parenchyma, collenchymas, sclerenchyma, epithelium
6. Size and shape of an organism (prokaryote)- simple staining,use of ocular micrometer
7. Motility of an organism-Hanging drop
8. Cell Staining -Cytochemical methods- Demonstration of Cellular and sub-cellular components
9. Sub cellular fractionation
10. Osmosis and tonicity
11. Cell division -Mitotic stages -Preparation of Onion Root Tip
12. Cell division- Meiotic stages- Preparation of Trade scantia Flower bud
13. Cell division- Binary fission of yeast
14. Polytene and diplotene chromosome-Chirinamous larva
15. Microtome-Temporary & permanent slide preparation.
16. Measurement of cells using ocular and stage micrometer
17. Cell plating -Disc diffusion method

Total Number of Topics	Local	Regional	National	Global	Category Based on %
17	6	3	4	4	Local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. David A.Thompson.2011.CellandMolecularBiologyLab. Manual.
2. P.Gunasekaran.2007.LaboratoryManualinMicrobiology.NewAgeInternational.
3. DOHall,SEHawkins.1974.LaboratoryManualofCellBiology.BritishSocietyfor CellBiology,PublishedbyCrane,Russia.
4. MaryL. Ledbetter. 1993. CellBiology:LaboratoryManual. Edition:2. PublishedbyRonJonPublishing.Incorporated.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
II	20UBT2CP2	CellBiology-Lab					3	3			
CourseOutcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓		✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
NumberofMatches(l)=43Relationship:High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-II

CourseCode:20UBC2AP1
InstructionHours: 3
Credits:2

ExamHours:3
InternalMarks:40
ExternalMarks: 60

ALLIED PRACTICAL - I BIOCHEMISTRY(P)

Courseoutcomes

- Developed understanding of principals, and applications of different microscopic and spectrophotometric methods.
- Obtain hands-on training in basic separation techniques in biochemistry
- Developed understanding of principals, and applications of different separation techniques especially chromatographic, electrophoretic and centrifugation techniques.
- Skills in handling and use of spectrophotometer and centrifugation equipment to study/analyze various biological samples.
- Have developed a very good understanding and skills of Mitochondria and chloroplast isolation.
- To expose the students to the biophysical methods used to study the biomolecules.

1. All basic instruments- Principle & SOP (Demo)
2. Isolation of Mitochondria from rat liver.
3. Isolation of chloroplasts from spinach leaves.
4. Preparation of the sub-cellular fractions of rat liver cells.
5. Separation of amino acids/ sugars/ nucleic acids/ pigments using paper and thin layer chromatography.
6. Separation of Amino acids by Ion-Exchange Chromatography
7. SDS - PAGE analysis of proteins (Demo).
8. Gel Filtration Chromatography (Demo).
9. Separation of Blood, plasma and serum.
10. Extraction of Proteins from biological materials
11. Protein separation methods: Precipitation, chromatographic, electrophoretic methods
12. Lipid estimation
13. Protein estimation

Total Number of Topics	Local	Regional	National	Global	Category Based on %
13	4	5	4	2	Regional

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. ArunRastogi, Mathur, N.B.LMathur, N.B. L.2010. AnIntroductiontoPracticalBiochemistry.AnmolPublications,India.
2. Rajan,S.2010.ExperimentalProceduresinLife Sciences.AnjanaaBookHouse.
3. Jayaraman.2011.LaboratorymanualinBiochemistry. NewageInternationalprivatelimited.
4. P.Palanivelu and M.SaliHu. 2009. Analytical biochemistry andseparationtechniques. 4thEdition,MKU,Madurai.
5. Sadasivam.SandManickamA.2009. IntroductiontoPracticalBiochemicstry. 2ndEdition.New AgeInternationalPrivate Ltd.Publishers.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
II	20UBC2AP1	Biochemistry-Lab					3	2				
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓		✓	✓	✓	✓	✓		
CO2	✓	✓	✓		✓	✓	✓	✓		✓		
CO3	✓	✓		✓	✓	✓	✓		✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓	✓			

CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓
NumberofMatches(1)= 41Relationship:High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-II

Course Code: 20UMB2PE2

Instruction Hours: 2

Credits: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

STREAM B- PROFESSIONAL ENGLISH FOR LIFE SCIENCES-II

Objectives:

- The Professional Communication Skills Course is intended to help Learners in Arts and Science colleges,
- Develop their competence in the use of English with particular reference to the workplace situation.
- Enhance the creativity of the students, which will enable them to think of innovative ways to solve issues in the workplace.
- Develop their competence and competitiveness and thereby improve their
- Help students with a research bent of mind develop their skills in writing reports and research proposals.

Course outcomes:

At the end of the course, learners will be able to,

- Attend interviews with boldness and confidence.
- Adapt easily into the workplace context, having become communicatively competent.
- Apply to the Research & Development organisations/ sections in companies and offices with winning proposals.
- Acquire a knowledge on creativity and imagination
- Students can develop their competence skills

Unit 1- Communicative Competence

Listening - Listening to two talks/lectures by specialists on selected subject specific topics - (TED Talks) and answering comprehension exercises (inferential questions). Speaking: Small group discussions (the discussions could be based on the listening and reading passages- open ended questions. Reading: Two subject-based reading texts followed by comprehension activities/exercises

Writing: Summary writing based on the reading passages.

Unit 2 - Persuasive Communication

Listening: listening to a product launch- sensitizing learners to the nuances of persuasive communication. Speaking: debates - Just-A Minute Activities. Reading: reading texts on advertisements (on products relevant to the subject areas) and answering inferential questions. Writing: dialogue writing- writing an argumentative /persuasive essay.

Unit 3- Digital Competence

Listening to interviews (subject related). Speaking: Interviews with subject specialists (using video conferencing skills). Creating Vlogs (How to become a vlogger and use vlogging to nurture interests - subject related). Reading: Selected sample of Web Page (subject area). Writing: Creating Web Pages. Reading Comprehension: Essay on Digital Competence for Academic and Professional Life.

The essay will address all aspects of digital competence in relation to MS Office and how they can be utilized in relation to work in the subject area.

Unit 4 - Creativity and Imagination

Listening to short (2 to 5 minutes) academic videos (prepared by EMRC/ other MOOC videos on Indian academic sites - E.g. <https://www.youtube.com/watch?v=tpvicScuDy0>). Speaking: Making oral presentations through short films - subject based. Reading : Essay on Creativity and Imagination (subject based). Writing - Basic Script Writing for short films (subject based). - Creating blogs, flyers and brochures (subject based). - Poster making - writing slogans/captions (subject based).

Unit 5- Workplace Communication & Basics of Academic Writing

Speaking: Short academic presentation using PowerPoint. Reading & Writing: Product Profiles, Circulars, Minutes of Meeting. Writing an introduction, paraphrasing. Punctuation (period, question mark, exclamation point, comma, semicolon, colon, dash, hyphen, parentheses, brackets, braces, apostrophe, quotation marks, and ellipsis). Capitalization (use of upper case)

SEMESTER- III

Course Code:20UBT3CC3

InstructionHours: 5

Credits:4

ExamHours:3

InternalMarks:25

ExternalMarks: 75

CORECOURSE-III MOLECULAR BIOLOGY

Course outcomes

- To understand the functional aspects of the cell at molecular level.
- This course is designed to give an understanding about the basics of molecular biology-classical genetics & molecular aspects.
- To understand the inheritance pattern at molecular level
- To explain the arrangement of Genes and their interaction.
- To describe the influence of environment on gene expression and regulation

UNIT-I Nucleus & Chromosomes

Cytoskeleton - Microtubules, microfilaments - associated proteins, actin, myosin and intermediate filaments - 3 dimensional organization of cytoskeleton -**Nucleus**, Nucleus, nuclear envelope, nucleoplasm - chromatin and chromosomes, allele, loci, gene, Nuclear division.

UNIT-II Classical genetics

Organization of Chromosomes - Specialized chromosomes - chromosomal abnormalities and qualitative inheritance - Population genetics and developmental genetics using *Drosophila melanogaster* as model system-**Somatic cell genetics analysis** - Mendelian inheritance, Law's of inheritance, single & dihybrid ratio, **Linkage analysis**.

UNIT-III Central dogma of Molecular Biology

Characteristics of genetic code - **Transcription**, Prokaryotic & Eukaryotic Transcription - Enzymes involved in Transcription-RNA polymerase - Post transcriptional processing in mRNA (5' cap), 3',end polyadenylation, splicing, **Translation**, Factors involved in translation-Mechanism of translation in Prokaryotes and Eukaryotes, initiation, elongation, termination -Translational inhibitors - Post, translational modification of Proteins - Importance of Glycosylation and Phosphorylation-**Overview of Glycosylation and Phosphorylation**.

UNIT-IV DNA Replication & repair

Prokaryotic and Eukaryotic DNA replication - Mechanism of DNA replication - Enzymes & proteins involved in DNA replication - Models of replication, Semi, conservative, unidirectional, bidirectional, rolling circle mechanism- Inhibitors of DNA replication - DNA repair, Types of DNA repair- DNA repair mechanism.

UNIT- V Regulation of gene expression

In prokaryotes, lac operon, ara operon and trp operon & attenuation - In eukaryotes, gene loss, gene amplification, gene rearrangement - Regulation of synthesis of primary transcripts - transcriptional control by hormones.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
37	1	1	3	32	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Ajoy Paul. 2011. Textbook of Cell and Molecular Biology. Books and Allied Ltd.
2. Benjamin Lewin. 2007. Gene IX, 9th Edition, Jones and Barlett Publishers.
3. J.D. Watson, N.H. Hopkins, J.W. Roberts, J. A. Seitz & A.M. Weiner. 2007. Molecular Biology of the Gene. 6th Edition. Benjamin Cummings Publishing Company Inc.
4. Watson JD, Gilman M, Witkowski J, Zoller M. 1992. Recombinant DNA. Scientific American Books.

References

1. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter. 2014. Molecular Biology of Cell. Garland Science

ublication.

2. Burton E. Tropp. 2012. Molecular Biology-Genes to Proteins. Jones and Bartlett Publishers.
3. George M. Malacinski. 2013. Freifelder's Essentials of Molecular Biology. Narosa Publishing House.
4. Stanely R. Maloy, Jhon E. Cornan Jr, David Freifelder. 1994. Microbial genetics. 2nd Edition. Jones and Bartlett publisher.
5. Uldis N. Streips and Ronald E. Yasbin. 2002. Modern Microbial Genetics. 2nd Edition. Wiley-Blackwell.
6. Sandy B. Primrose, Richard M. Twyman and Robert W. Old. 2008. Principles of Gene Manipulation. 6th Edition. Blackwell Science.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
III	20UBT3CC3	Molecular Biology					6	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓		✓	✓	✓	✓		✓		
CO3	✓		✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches (M) =		46									Relationship: High	

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- III

CourseCode:20UBT3CP3
InstructionHours:3
Credits:3

ExamHours:3
InternalMarks:25
ExternalMarks: 75

COREPRACTICAL-III MOLECULAR BIOLOGY(P)

Course outcomes

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

- Utilize laboratory skills to enhance understanding of genomic and plasmid DNA isolation
- Develop responsible conduct of laboratory skills appropriate to the field of molecular biology
- Apply the molecular biology techniques to biotechnological approaches
- In this course the students will get hands on experience in Molecular Biology techniques.
- To know about DNA isolation, separation and estimation technique.

1. Isolation and purification of genomic DNA from prokaryotes.
2. Isolation and purification of genomic DNA from eukaryotes.
3. Isolation and purification of plasmid DNA.
4. Observation of DNA - Agarose gel electrophoresis.
5. Quantification of nucleic acids-DNA &RNA-Chemical and UV method.
6. Separation of protein by SDS PAGE
7. Staining of proteins - Amidoblack,coomossie brilliant blue &AgNO₃.
8. Bacterial mutagenesis-physical & chemical.
9. Preparation of *E. coli* competent cells.
10. Transformation of bacteria-CaCl₂ method.
11. Bacterial conjugation.
12. Transduction.
13. Estimation of protein
14. lipid profile identification.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
14	7	2	3	2	Local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. M.Mooyoung.1985.ComprehensiveBiotechnology.Vol.2,3&4.Pergamonpress.
2. Dr.DavidAThompson. 2011. CellandMolecularBiologyLabManual.
3. GeorgeM.Malacinski.2013.Freifelder’sEssentialsofMolecularBiology.NorosaPublishingHouse.
4. StanelyR. Maloy,JhonECornanJr,DavidFreifelder.1994.Microbialgenetics. 2ndEdition. JonesandBartlettpublisher.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse	Hours	Credits						
III	20UBT3CP3	MolecularBiology- Lab	3	3						
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓		✓	✓	✓		✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NumberofMatches(ℓ)=45		Relationship:VeryHigh								

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER- III

Course Code:20UBI3AC3
InstructionHours: 4
Credits:3

ExamHours:3
InternalMarks:25
ExternalMarks: 75

ALLIEDCOURSE-III BIO INFORMATICS

Courseoutcomes

- Describe the importance of DNA and protein sequence alignments, methods of alignment and application
- Describe bioinformatics tools to understand protein structure.
- Describe how to find a best match for a given DNA or protein sequence from the target
- Demonstrate the knowledge of various Biological databases and tools
- This course provides the details of dry lab conditions and analysis of macromolecules and genetic material.

UNIT-I

Biological Databases - Sequence data bases, Nucleic Acid sequence Data bases, Gen bank - Protein Sequence Databases, Swiss Prot - Searching Sequence Databases- Non, redundant Databases -Low Annotation Databases -Specialized sequence Databases - Structural Databases, Motif Databases - Genome Databases, Proteome Databases-Applications of bioinformatics.

UNIT-II

Tools for Bioinformatics- Pairwise alignment - Dotplots , scoring matrices - Blosum Matrices, PAM Matrix - Gap Penalty, Alignment Algorithms - Needleman, Wunsch Global Alignment Algorithm - Smith, Waterman Local Alignment Algorithm.

UNIT-III

Pairwise Sequence Analysis Tools - BLAST, Steps involved in using BLAST -Interpreting BLAST results - FASTA, Alignment Scores -Multiple Alignment, Clustal W- Phylogenetic Tree, Sequence Analysis using EMBOSS.

UNIT-IV

Protein Structure Prediction - Secondary structure Prediction, PDB, FSSP, SCOP, CATH, Chou, Fasman- Jpred, Q3, Transmembrane protein prediction Tertiary structure prediction-Comparative Modeling- Fold recognition, Abinitio prediction -modeler, RASMOL

UNIT-V

Emerging areas of Bioinformatics - DNA microarrays-Structural genomics -Functional Genomics - Proteomics Comparative Genomics - Docking, Protein-Protein Interaction -HEX soft ware-Protein, ligand interaction - Next generation sequence and characterization.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
40	4	7	16	22	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Harshawardhan,P.(2005)Bioinformaticsprinciplesandapplication.TataMcGrawHillPublishers.New Delhi.
2. ManikandanVijayaraj,2002.Bioinformaticsforbeginners,Kalaikathir Achchagam,Coimbatore.
3. Mount,D.W.2005.BioinformaticsSequenceandgenomeanalysis(IIndedition)CBSPublishers.New Delhi.

References

1. Hagen. J.B. (2000).Theoriginofbioinformatics.Nat.Rev.Genetics1:231-6.
2. Tyers,M.,andMann,M.2003.Fromgenomicstoproteomics.Nature422:193-7.
3. Sundarajan.S.andR.Balaji.(2005),IntroductionofBioinformatics,HimalayaPublishinghouse,Mumbai.
4. Westhead,D.R,H.J.ParishandR.M.Twyman.(2003)BioinformaticsVivabooksPrivateLtd.New Delhi.
5. J.M.Keith.Bioinformatics.Vol.1:2008Data,sequenceanalysis&evolution.HumanaPress.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
III	20UBI3AC3	Bioinformatics					4	3				
CourseO utcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓		✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		✓	✓		✓	✓		
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓		
Number ofMatches(ℓ) =44Relationship:VeryHigh												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER- III

CourseCode:20UBI3AP2

Instruction Hours: 3

Credits: 2

ExamHours:3

InternalMarks:40

ExternalMarks: 60

ALLIEDPRACTICAL-II BIOINFORMATICS (P)

Course outcomes

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

- To provide practical experience in the analysis of protein sequence
- Perform DNA and protein sequence alignments, methods of alignment and apply scoring schemes
- Demonstrate knowledge of various biological databases and computational tools
- Perform alignment of multiple sequences and build phylogenetic trees.
- Perform search using variants against various publically available databases.

1. Study of Nucleic acid sequence data banks-GenBank, EMBL nucleotide sequence databank, sDDBJ, UniGene.
2. Study of protein data banks-PIR, Swiss - PROT, UniPROT.
3. Study of Protein Structure and Classification databases -PDB, SCOP, CATH, FSSP, PDBSUM.
4. Study of Domain/ Motif databases-BLOCKS, PRINTS,SBASE and PFAM.
5. Gene structure and function prediction (using Gen Scan, Gene Mark).
6. Sequence similarity searching(NCBI BLAST)
7. Protein sequence analysis (ExpASy proteomics tools).
8. Multiple alignments-CLUSTALW.
9. Building structure for a given sequence using Homology modeling.
10. Evaluation of protein structure by Swiss PDB viewer and by other molecular visualization tools.
11. Sequence docking
12. Enzyme docking

Total Number of Topics	Local	Regional	National	Global	Category Based on %
12	9	2	4	7	Local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. Droit, A., Poirier, G. G., and Hunter, J. M. 2005. Experimental and bioinformatic approaches for interrogating protein-protein interactions to determine protein function. *J. Mol. Endocrinol.* 34:263-80.
2. Stanton, L. W. 2001. Methods to profile gene expression. *Trends Cardiovasc. Med.* 11:49-54.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20UBI3AP2	Bioinformatics-Lab					3	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
Number of Matches (l)=42 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- III

Course Code:20UBT3NME1
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

NON MAJOR ELECTIVE-I **BIOTECHNOLOGY FOR HUMAN WELFARE**

Course outcomes

- This paper provides an in-depth scope and significance of various ecotechnological applications.
- The student will gain knowledge about the role of biotechnology in relation to Human welfare.
- The student will get an idea about the exploitation of readily available resources and issues associated with product development, which will be useful for developing entrepreneurship skills
- To know the basic concept and issues of environmental pollution biotechnological treatment to cleanup polluted environments and to create valuable resources for the human society
- Getting the knowledge for the diagnostics and prevention and treatment to diseases.

UNIT-I Agricultural Biotechnology

Organic farming-Integrated farming-Vermicompost-Crop Improvement.

UNIT-II Food&Dairy Biotechnology

Microbes as food-feed Prebiotics, Probiotics, Algae- SCP, Betacarotene, Fungi as food-Mushroom, Fermented food products.

UNIT- III Biotechnology for disease diagnosis

Clinical diagnosis-Lab diagnosis -Microscopy, Macroscopy, Biochemical, serological & Molecular diagnosis of diseases - PCR, RT, PCR, RAPD, RFLP, Karyotyping - DNA finger printing- Applications of DNA amplification.

UNIT- IV Biotechnology for treatment & prevention of diseases

Treatment - Symptomatic therapy, specific therapy, antimicrobials, Prevention -Active immunization, passive immunization, combined immunization,herd immunity-Chemotherapy.

UNIT- V Environmental Biotechnology

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

Total Number of Topics	Local	Regional	National	Global	Category Based on %
20	8	5	6	2	Local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. D.Balasubramanian,C.F.A.Bryce, K.Dharmalingham, J.Green andK.Jayaraman.1996.ConceptsinBiotechnology.UniversitiesPress.
2. AshokK.Chauhan.2009.ATextbookofMolecularBiotechnology.I.K.InternationalPublishinghousePvt.Ltd.
3. Chandrakant Kokate, SS Jalalpure, Pramod H.J. 2011.TextbookofPharmaceuticalBiotechnology.AdivisionofReedElsevierIndia Pvt.Ltd.

References

1. B.C.BhattacharyyaandRintuBanerjee.2007.EnvironmentalBiotechnology.OxfordHigherEducationPublication.
2. KrishnaBGhimire.2000.Socialchangeandconservation.LondonEarthscanPubl.
3. P.J.Delves,I,S.J.Artin,,I.D.R.BurtonandII.M.Roitt.2006.Essential Immunotechnology.12thEdition.Wiley&Blackwell.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
III	20UBT3NME1	Biotechnologyfor human Welfare					2	2			
CourseOutcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓		✓	✓	✓	

CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NumberofMatches(ℓ) =44		Relationship:High								

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-IV

Course Code:20UBT4CC4
InstructionHours:6
Credits:4

ExamHours:3
InternalMarks:25
ExternalMarks: 75

CORECOURSE-IV rDNA TECHNOLOGY

Course outcomes

- To understand the steps involved in recombinant DNA technology.
- Describe the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production.
- To explain the construction of DNA&cDNA library and their applications
- To get expertise in isolation of plasmids, cloning of gene and transformation in to suitable bacteria for selection of recombinant clones.
- To enable the students to grasp of the latest advances in genetic engineering techniques and the applications in various fields of biotechnology

UNIT- I Introduction or DNATechnology

Introduction to genetic engineering and recombinant DNA technology - Various steps involved in rDNA technology - Isolation of genes - Enzymes of rDNA technology, Restriction endonucleases, exonuclease - DNA modifying enzymes-Polymerase, Transferase, Kinase and Ligase- Enzyme applications in DNA modification.

UNIT-II Different types of Vectors

Plasmids -Types of plasmid- Phage vectors - Cosmids, Phagemids - Virus vectors, Shuttle vectors and expression vectors - YAC, BAC, *S.cerevisiae* system as a model.

UNIT-III Cloning Strategies

Cloning vectors for *E.coli* - Cloning vectors for Eukaryotes - Methods of transformation - Construction of

genomic libraries and cDNA Libraries - Probe construction, recombinant selection and screening - DNA amplification using polymerase chain reaction (PCR) - keyconcepts, Analysis of amplified products - Applications of PCR - Ligase chain reaction. RFLP, RAPD, DNA Finger printing - Principles of Southern, Northern and Western blotting techniques.

UNIT-IV Selection & Screening of rDNA products and Gene Sequencing

Analysis of recombinant DNA - Selection methods - antibiotics, expression basis, GUS expression - Sequencing, chemical degradation, chain termination and automated sequence - Altered expression and engineering genes, Site, directed mutagenesis

UNIT-V

Application of rDNA Technology in Plants & Animals and Gene therapy - Transgenic plants with reference to virus and pest resistances, herbicide tolerance and stress tolerance (cold, heat and salt) - cytoplasmic male sterility - delay of fruit ripening - resistance to fungi and bacteria - Biopharmaceuticals and secondary metabolite production - Transgenic animals, Pharmaceutical products-insulin, Farm animal production - Gene therapy, Haemopoietic cells - genetically engineered bone marrow cells - skin fibroblasts, hepatocytes, myoblast and genetically modified lymphocytes - Recombinant DNA Technology in the production of vaccines.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
40	4	5	20	16	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter. 2002. Molecular Biology of the Cell, 4th Edition. Garland Sciences.
2. Stanley Maloy 1994. Microbial genetics. 2nd Edition. Jones and Bartlett publisher.
3. Uldis N. Streips and Ronald E. Yasbin. 2002. Modern Microbial Genetics. 2nd Edition. Wiley-Blackwell.
4. Sandy B. Primrose, Richard M. Twyman, Robert W. Old. 2008.

Principles of Gene Manipulation. 6th Edition. Blackwell Science.

- Brown TA. 2008. Genomes. 3rd Edition. New York: Garland Publishing Co. New York: Garland Science.

References

- Old, R. Wand S. B. Primrose. 1996. Principles of Gene Manipulation: An Introduction to Genetic Engineering. 2nd Edition. Blackwell Scientific Publications, Oxford.
- Glover, DM. and BD. Hames. 1995. DNA Cloning: A Practical Approach. 2nd Edition. IRL Press, Oxford.
- Daniel L. Hartl. 2011. Analysis of Genes and Genomes. 8th edition. Maryellen Ruvolo. Laxmi Publications.
- Keya Chaudhuri. 2012. Recombinant DNA Technology. The Energy and Resources Institute, TERI.
- J.F. Sambrook and D. W. Russell. 2011. *Molecular Cloning: A Laboratory Manual*. 3rd Edition. Volume 1, 2 and 3. Cold Spring Harbor Laboratory Press.
- Tvan R.S. 1997. Recombinant Gene Expression Protocols. Humana Press Inc., Tokowa.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
IV	20UBT4CC4	rDNA Technology					6	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓	✓		✓	✓		✓	✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches (l) = 46 Relationship: Very High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

CourseCode:20UBT4CP4
InstructionHours: 3
Credits:3

ExamHours:3
InternalMarks:25
ExternalMarks: 75

COREPRACTICAL-IV **rDNA TECHNOLOGY(P)**

Course out comes

- Students will be exposed to the latest techniques employed in recombinant DNA technology related to DNA manipulation in prokaryotes and eukaryotes.
- The student will be able to understand and develop the concept to recombinant DNA technique.
- To gain hands on experience in gene isolation, cloning by PCR approach, DNA on and PCR-amplification for DNA finger printing analysis via RAPD and restriction digestion.
- This course is planned to give hands on training in recombinant DNA technology.
- The course helps the students to understand about the recombinants from the basics to advanced techniques, giving indetail about each factor during construction of recombinants.

1. Isolation of genomic DNA from plant, animal cells & from bacteria
2. Isolation of plasmid DNA- small & large scale
3. Size analysis of plasmids by agarose gel electrophoresis
4. Restriction digestion - single & double digestion.
5. Ligation.
6. Preparation of competent *E.coli* cells
7. Transformation of *E.coli* with recombinant DNA.
8. Selection & screening of rDNA products-Antibiotic resistance, Blue white colony.
9. PCR amplification
10. Southern blot and northern blot.
11. RAPD
12. RFLP
13. DNA estimation
14. DNA finger printing

Total Number of Topics	Local	Regional	National	Global	Category Based on %
14	8	7	6	3	Local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. J. Sambrook and D.W. Russel. 2001. Molecular Cloning: A Laboratory Manual, Vol. 1-3. CSHL.
2. T.A. Springer. 1985. Hybridoma Technology in the Biosciences and Medicine. Plenum Press New York.
3. Judith W. Zyskind and Sanford I. Bernstein. 1989. Recombinant DNA Laboratory Manual. Academic press.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	0UZO4AC4	Developmental Biology					5	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓		✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (l)=42		Relationship: High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER -IV

CourseCode: 20UZO4AP4
InstructionHours: 5
Credits: 4

ExamHours:3
InternalMarks:25
ExternalMarks: 75

ALLIED COURSE-IV DEVELOPMENTAL BIOLOGY

Course out comes

- This is helps to the students to understand about organization and function in animals.
- To know about processes of growth and development and fertilization in mammals
- Students will be able to give two examples of organogenesis, including genes and signal transduction pathways that lead to organ system formation.
- Students will be able to explain embryonic patterning, using examples that include genes known to actin patterning events.
- Students will be able to generally describe the concepts of cellular competence, induction, specification, commitment and differentiation in embryonic development.

UNIT-I Gametogenesis and Fertilization

Gametogenesis and Fertilization - Definition, scope & historical perspective of development Biology - Gametogenesis , Spermatogenesis, Oogenesis - Fertilization , Definition, mechanism - types of fertilization - Different types of eggs on the basis of yolk- Egg membrane types.

UNIT-II Early embryonic developments cleavage

Fertilization and its types- Early embryonic development cleavage -Definition, types, patterns & mechanism-Blastulation, Process,types & mechanism-Gastrulation: Morphogenetic movements, epiboly, emboly, extension, invagination,convergence delamination-Formation & differentiation of primary germ layers Fate Maps in early embryos.

UNIT-III Embryonic Differentiation

Embryonic Differentiation -Cell commitment and determination - the epigenetic land scape, a model of determination and differentiation - control of differentiation at the level of genome - transcription and post, translation level Concept of embryonic induction Primary, secondary & tertiary embryonic induction - neural induction and induction of vertebrate.

UNIT-IV Organogenesis

Organogenesis, Neurulation, notogenesis, development of vertebrate eye - Fate of different primary germ layers - Development of behavior - constancy & plasticity- Extra embryonic membranes - placenta in Mammals. Differentiation: Chemical basis, Genes and differentiation - Placentation in Mammals.

UNIT-V Organization of shoot and root

Recent trends in plant regeneration - Organization of shoot and root apical meristem, and development - Leaf

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

Total Number of Topics	Local	Regional	National	Global	Category Based on %
36	2	2	3	29	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

Gilbert, Scott's. 10th edition (2014). Developmental biology. Sinauer Association, Inc. Publishers.
 Chattopadhyay. S. 2016. An Introduction to Developmental Biology, Books and Allied (P) Ltd, Kolkata. First Edition.

References

1. Bruce M Carlson, Patten's Foundation of Embryology, Tata McGraw Hill Co.
2. Balinsky, B. I., 1981. 5 edition. An Introduction to Embryology, W. B. Saunders Co., Philadelphia
3. Verma, P. S., Agarwal, V. K., and Tyagi., 1995. Chordate embryology, S. Chand & Co., New Delhi

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
IV	0UZO4AC4	Developmental Biology					5	3				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO2	✓		✓	✓	✓	✓		✓	✓	✓		
CO3	✓	✓		✓	✓	✓	✓		✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓		✓		
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches (M) = 42		Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER -IV

Course Code:20UBT4NME2
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

NON MAJOR ELECTIVE-II PHARMACEUTICAL BIOTECHNOLOGY

Course out comes

- To create general understanding regarding basic principles involved in modern medicinal/ structural chemistry systems.
- The student will gain knowledge in utilization of the commonly available resources for clinical application.
- The student will get an idea about the exploitation of readily available resources and issues associated with product development, which will be useful for developing entrepreneurship skills.
- Getting the knowledge for the diagnosis and treatment of diseases.
- To know about chemotherapeutic drugs.

UNIT-I Introduction

Development of Biopharmaceutical Industry - Therapeutic agents, uses and Economics.

- Drug development- Drug marketing - Drug designing.

UNIT-II Biologic drug Metabolism and Pharmacokinetics

Biologic Drug metabolism - Physico Chemical principles - Pharma Kinetics -Action of drugs on human bodies.

UNIT- III Unit Operations in Biopharmaceutical Technology

Production of water for biopharmaceutical use- Filtration, mix-in - Drying, Freeze drying- Sterilisation.

UNIT-IV Biopharmaceuticals

Various categories of plant - animal and microbial derived therapeutics like vitamins -laxatives, analgesics,contraceptives,antibiotics, hormones and biologicals.

UNIT- V Quality Control and Quality Assurance of Dosage Forms

Analytical methods and tests for various drugs and Pharmaceuticals - Packing, Packing, Techniques, Quality control-Good manufacturing Practice.

al Number of Topics	Local	Regional	National	Global	Category Based on %
18	3	4	7	4	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Biotechnology and Biopharmaceutical Manufacturing, Processing, and Preservation (Drug Manufacturing Technology Series, Vol 2), by Kenneth E. Avis (Editor), Vincent L. Wu, CRC Press, 1996.
2. Remington's Pharmaceutical Sciences, Mack Publishing and Co, 1990.

References

1. A.C. Guyton. Textbook of medical physiology, W.B. Saunders, Hong Kong 1986.
2. S.S. Purohit, Kaknani, Saleja Pharmaceutical Biotechnology.
3. N. Murugesu, A concise Text Book of Pharmacology. Sixth edition. Sathya Publishers, Madurai.
4. R.C. Dubey, A Text Book of Biotechnology. S. Chand & Co Ltd, New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
IV	20UBT4NME2	Pharmaceutical Biotechnology					2	2				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓	✓	✓	✓	✓		✓		
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓			
CO3	✓	✓		✓	✓	✓		✓	✓	✓		
CO4	✓	✓	✓	✓		✓	✓	✓	✓	✓		
CO5	✓		✓	✓	✓	✓	✓	✓		✓		
Number of Matches (l) = 42 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
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Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER -IV

CourseCode:20UBT4SBE1:1
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

SKILL BASED ELECTIVE- MUSHROOM AND VERMITECHNOLOGY

Course out comes

- Acquired knowledge about mushroom cultivation and vermicompost production
- bio
- Describe and apply the uses and lore of many mushrooms and culture techniques to further explore their cultivation potential
- Acquired knowledge about applications of Mushroom and Vermicomposting
- To facilitate self- employment

UNIT-I Introduction of Mushroom

Edible and non edible mushroom (Historical account, most commonly cultivated mushrooms in the world, distribution and production in various countries) - Cultivation of button mushroom ,morphology raising a pure culture & spawn preparation - Cultivation of oyster and paddy straw mushroom- preparation of pure culture &spawn cultivation methods, harvest.

UNIT-II Cultivation

Preparation of compost & cultivation of *Agaricus bisporus*,*Pleurotus flabellus*, harvest - Pests and diseases of Edible mushrooms (Environmental, fungal, bacterial, viral, insect pests and Nematode diseases and competitor moulds).

UNIT-III Earthworms

Soil biota, Earth worms, Ecological classification of earth worms as Epigeics, Introduction to earth worm - biology, physical and chemical effects of earth worms on soils-Earthworm Culture-

Role of earthworms in soil, classification of earthworms based on ecological strategies, Burrowing activity of earthworms - Drilospheres - Microorganisms and their relationship with earth worms, Composting, anaerobic composting, aerobic - composting, types of composting, vermicompost, earth worm species used in vermicompost production - endemic species, exotic species - Poisonous earthworm species.

UNIT- IV Vermicomposting

Vermicompost, setting up vermicompost quality N, P, K, C, N, Microbial quality applications - vermiculture, vermivash, role of vermicompost in organic farming, its quality and advantages over chemical inputs - Earthworms in Bio-reclamation of soil, Problems in vermiculture units, remedial suggestions.

UNIT-V Applications of Mushroom and Vermicomposting

Antiviral value, antibacterial effect, antifungal effect, antitumor effect, haematological value cardiovascular & renal effect, in therapeutic diets, adolescence, for aged persons & diabetes mellitus - Delicious recipes of mushroom, Economic importance of mushrooms - Vermicomposting as a tool for solid waste management, a small scale industry and its economics, Vermic cultivation benefits, Marketing of vermiproduct.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
22	16	10	4	7	Local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. Brady, C.N,1974"TheNatureandPropertiesofsoils"MacmillanpublishingCo.NewYork,London.
2. Edwards, C.A.,andBohlen, P.J., 1996. BiologyandEcologyofEarthworms,ChapmanandHall,LondonIsmail,S.A.,1997,Vermicology: TheBiologyEarthwormOrientLongman.
3. Chang. T.W.A. Hayanes1978."BiologyandcultivationofMushrooms"AcadPress.N.Y.
4. Zadrazil.F&K.Grabbe1983"EdibleMushroom,Biotechnology"Vol.3,Weinheim:VerlagChemie,Berlin.
5. Kannaiyan.2001. HandbookofEdibleMushrooms"TNAUPublication.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
IV	20UBT4SBE1:1	MushroomandVermi Technology					2	2				
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓		✓	✓	✓		✓	✓	✓		
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		✓	✓		✓	✓		
CO5	✓	✓		✓	✓	✓	✓	✓	✓	✓		
NumberofMatches(ℓ)=43		Relationship:High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

CourseCode:20UBT4SBE1:2
InstructionHours:2
Credits: 2

ExamHours:3
InternalMarks: 40
ExternalMarks: 60

SKILL BASED ELECTIVE -I FOOD AND NUTRITION

Course out comes

- Acquired knowledge of Nutrition and Food Science
- Acquired comprehensive knowledge of role of Nutrition in human life
- This course comprehensive knowledge of Carbohydrates, Protein, Vitamins and Lipids
- Acquired comprehensive knowledge of Food pyramid
- Acquired comprehensive knowledge of nutritional deficiency disorder

UNIT-I

Definitions, Food Science, Food, Nutrients, Nutrition Status - Mal-nutrition, under, Nutrition, over Nutrition, Balanced diet, Hunger, Hollow Hunger, Hidden Hunger, Appetite, Health, Meal, Menu - Balanced Diet and Food Groups, Basic four and Basic five - Nutritional Classification of foods - Energy yielding, Body Building and protective foods - **Cooking Methods, Moist and Dry heat methods of cooking, merits and demerits** - Fire less cooking- Advantages of cooking method.

UNIT-II

Introduction to Nutrition and Food Science - Definition, history, RDA, factors affecting RDA- Methods used for deriving RDA - Basic five food groups and the functions of food - Food pyramid.

UNIT-III

Lipid classification, function, digestion and absorption, sources, excess and deficiency disorder- Carbohydrates classification, functions, digestion and absorption, Sources, deficiency diseases - Role of fibre in human Nutrition, Energy, units, Carbohydrate, protein, fat as a source of energy- **Uses of carbohydrates.**

UNIT-IV

Protein, classification, functions, sources digestion and absorption, sources and deficiency disorders.

UNIT-V

Vitamins , Fat soluble vitamins A, D, E & K, functions, sources, requirements deficiency diseases - Water soluble vitamins ,B like thiamine, Riboflavin, Niacin, Phridoscin, Folic acid, B2 and - Vitamin C

and their functions sources requirements and deficiency diseases - Minerals ,Calcium, phosphorus, Sodium, Potassium, Iron, Iodine, Flourine and their functions, sources requirements and deficiency diseases.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
23	1	2	11	12	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Aruna Thaker & Arlene Barton, Multicultural Handbook of Food, Nutrition and Dietetics (2012), Blackwell Publishing.
2. Michael Gibney, Hester. H. Voster & Frans. J. Kok, Introduction to Nutrition (2002), Blackwell Publishing

References

1. Guthrie H.A. - Introductory Nutrition C.V. Mosby Co. St. Louis.
2. Bogert, J.G.V. Briggs, D.H. Calloway Nutrition and physical fitness (1985), 11th edition - W.B. Saunders Co., Philadelphia, London, Toronto.
3. Wardlaw, G.M. Insel, P.H. - Perspectives in Nutrition (1990) Times Mirror/Mosby College Publishing Co. St. Louis, Toronto, Boston.
4. William, S.R. - Nutrition and Diet Therapy (1985) 5th edition, Mosbey Co. St. Louis.
5. M. Swaminathan "Principles of Nutrition and Dietetics", 1993, Bappa 88, Mysore Road, Bangalore-560018.
6. Maurice E. Shils, James A. Olson, Moshe Shike "Modern Nutrition in health and disease" (1994) eighth edition, Vol. I & II Lea & Febiger Philadelphia, A Waverly Company.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20UBT4SBE1:2	Food and Nutrition					2	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (l)=44		Relationship: High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

CourseCode:20UBT4SBE1:3
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

SKILL BASED ELECTIVE-I **PHYTOCHEMICALS AND HERBAL MEDICINE**

Course out comes

- Acquired knowledge of about herbal medicine, so that one can think of farming herbal plants for future.
- Acquired knowledge of tissue culture of medicinal Plants
- Acquired knowledge of various techniques used for analysis of phytochemicals
- Acquired knowledge about medicinal plants in health care
- To enable the students to become self-employed/ entrepreneur.

UNIT-I Crude Drugs

Crude Drugs, Scope & Importance - Classification (Taxonomical, Morphological Chemical, Pharmacological), Cultivation, Collection & processing of Crude Drugs - Indian System of medicine, Ayurveda, Siddha and Unani and its significance-Regulations of siddha medical system- Advantages of Ayurveda, Siddha and Unani.

UNIT- II Medicinal & Aromatic Plants

Cultivation and Utilization of Medicinal & Aromatic Plants in India - Genetics as applied to Medicinal herbs - Modern Biotechnological tools and its influence in Medical and Aromatic plant cultivation.

UNIT-III Tissue Culture of medicinal Plants

Plant Tissue Culture as source of medicines, Secondary metabolite production in plants - Plant Tissue Culture for enhancing secondary metabolite production (*Withaniasomnifera*, *Rauwolfia serpentina*, *Catheranthus roseus*, *Andrographis paniculata*, *Dioscorea sp.*) - Anticancer, Anti inflammatory, Antidiabetic, Analgesic drugs, Biogenesis of Phytopharmaceuticals.

UNIT-IV Analysis of Phytochemicals

Methods of Drug evaluation (Morphological, Microscopic, Physical & Chemical) - Preliminary screening, Assay of Drugs, Biological evaluation/ assays, microbiological methods, Characterization of drugs - Types of Phytochemicals, Carbohydrates & derived products, Glycosides, extraction methods (*Digitalis*, *Aloe*, *Mentha*) - Alkaloids, extraction methods (*Taxus*, *Papaver*, *Cinchona*)-Flavonoids extraction methods, Resins, extraction methods, Lectins.

UNIT-V Applications of Phytochemicals

Application of phytochemicals in industry and health care - Biocides, Bio-fungicides, Bio-pesticides, Nutraceuticals and their significance.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
19	3	8	7	5	Regional

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Pharmacognosy, C. K. Kokate, A. P. Purohit & S. B. Gokhale (1996), Nirali Prakashan, 4th Ed. School of Biotechnology and Health Sciences Department of Biotechnology (BT) Karunya University Page 626.
2. Natural Products in medicine: A Biosynthetic approach (1997), Wiley.

References

1. Hornok, L. (ed.) (1992). Cultivation & Processing of Medicinal Plants, Chichester, U.K.: J. Wiley & Sons.
2. Trease & Evans, Pharmacognosy - William Charles Evans, 14th ed. (1989), Harcourt Brace & Company.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits
IV	20UBT4SBE1:3	Phytochemicals and Herbal Medicine	2	2

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches (ℓ)=45 Relationship: Very High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

Course Code:20UBT5CC5
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks:25
ExternalMarks: 75

CORE COURSE-V PLANT BIOTECHNOLOGY

Course out comes

- This course is acquired basic knowledge about plant tissue culture, transgenesis and genetic modifications in agriculture.
- Design experiments for functional characterization of plant genes and to identify those suitable for creating agronomically important traits.
- Conceptualize plant transformation, selection of desirable genes for crop improvement, design binary vector and procedure for generating GM crops.
- Evaluate critically the safety issues of GM crops and products in the society.
- To understand the concepts of modern technology pertaining to large scale production of agricultural products.

UNIT-I

Plant tissue culture - Plant tissue culture techniques-Establishment of plant tissue culture: Culture media , types of media- Explant: selection and preparation- *in-vitro* pollination and fertilization - embryo culture and its applications - embryogenesis and organogenesis - micropropagation - haploids and their applications - somoclonal variations and applications - Endosperm culture- production of triploids.

UNIT-II

Genetic manipulation of plants - Introduction, protoplast isolation, culture and regeneration - methods of fusing protoplasts - somatic hybridization - Protoplast and tissue culture manipulation for genetic manipulation of plants.

UNIT-III

Applications of Plant Genetic Engineering - Genetic engineering & crop improvement - herbicide resistance - insect resistance - virus resistance - asbioreactors.

UNIT-IV

Genetic modification in Agriculture - Genetic modification in food industry -back ground, history, controversies over risks, application, future applications - Transgenic plants - genetically modified food,

application - future perspectives & ecological impact of transgenic plants.

UNIT-V

Organic food - Production of organic food - types of organic food - identification of organic food - organic food & preservatives.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
34	10	11	18	12	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Gamborg O.L and Philips, G.C. 1995. Plant Cell, Tissue and organ culture - Fundamental methods. Narosa Publishing House, New Delhi.
2. Slater A., Scott N.W. and Fowler, M.R. 2008. Plant Biotechnology - The genetic manipulation of plants. Oxford University press, USA.

References

1. Phundan Singh, 2013. Principles of Plant Biotechnology. Kalyani Publishers, India.
2. V. Kumaresan, 2015. Applied Plant Biotechnology. Saras Publication, India.
3. Singh, 2014. Plant Biotechnology, 2nd Revised Edition, Kalyani Publishers, India.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits
V	20UBT5CC5	Plant Biotechnology	5	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓		✓	✓	✓	✓		✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Number of Matches (I)=45 Relationship: Very High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

Course Code:20UBT5CC6
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks:25
ExternalMarks: 75

CORE COURSE-VI ANIMAL BIOTECHNOLOGY

Course out comes

- To understand the difference between stem cell types and methods for producing transgenic animals
- To improve artificial embryo transfer and nuclear transfer methods and applications.
- To learn the various type cell morphology, stages and fertilization and transformation techniques employed in animal systems.
- The course helps the students to know about the animal cell culture techniques and applications from basics to advanced level.
- Be able to describe techniques and problems both technical and ethical in animal cloning.

UNIT-I

Embryolog, Gametogenesis and fertilization in animals-Molecular events during fertilization- genetic regulations in embryonic development-Artificial Fertilization methods (IVF,IUF,ICSI) -*In vitro* fertilizations and embryo transfer- Superovulation - Polycystic ovarian syndrome (PVS)-Collection and preservation of embryo- culture of embryos, culture of embryonic stem cells and its applications

UNIT-II

Animal cell culture, Fundamentals. Facilities and Applications- Media for Animal cells- Media Composition ,Types ,Natural , Synthetic, Semisynthetic, Freezing Medi - Types of cell culture: Primary cell culture, secondary culture- cell transformation, cell lines,Insect cell lines, Stem cell cultures, cell viability and cytotoxicit- Biology of cultured cells, measurement of growth, cell synchronization, senescence and apoptosis- Organculture.Cryopreservation.

UNIT-III

Genetic engineering in animals - GMO (Genetically modified organism)-methods of

DNA transfer in to animal cells - calcium phosphate co precipitation, microinjection, electroporation, Liposome encapsulation- Biological vectors- Hybridoma technology- Bacteria, Virus - Hybridoma technology -DOLLY.

UNIT-IV

Gene therapy-mapping of human genome- Human Genome Project (HGP)-Gene silencing- RFLP and applications - DNA finger printing and Forensic Science- Molecular diagnosis of Genetic disorders.

UNIT-V

Transgenics, Transgenic animals- Production and recovery of products from animal tissue culture-cytokines, Plasminogen activators, Blood clotting factors, Growth hormones- Transgenic animals ,Merits and demerits- Ethical issues in animal biotechnology

Total Number of Topics	Local	Regional	National	Global	Category Based on %
37	9	8	7	19	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. B.Singh,SKGautam andMSChauhan. 2013. TextbookofAnimalbiotechnology.TheEnergyandResearchInstitute.
2. M.K.Sateesh.2010.Biotechnology:V:(IncludingAnimalCellBiotechnology,ImmunologyandPlantBiotechnology).2ndEdition.New AgeInternational.

References

1. Freshney, E.D. 2000. Animal Cell Culture: A Practical Approach. John Wiley Pub. New York.
2. Mather, J.P. and Barnes, D. (Eds.). 1998. Animal Cell Culture Methods (Methods in Cell Biology Vol. 57). Academic Press, London.
3. Butler, M. (Ed.). 1990. Mammalian Cell Biotechnology - A Practical Approach. Oxford Univ. Press, Oxford.
4. Singer, M. and P. Berg. (Ed.). 1997. Exploring Genetic Mechanisms. University Science Books, Sausalito, CA, USA.
5. E.J. Murray (Ed.). 1991. Gene Transfer and Expression Protocols - Methods in Molecular Biology Vol. 7. Humana Press, Totowa, NJ.
6. Watson, J.D., N.H. Hopkins, T.W. Roberts, J.A. Steitz and A.M. Weiner. 1987. Molecular Biology of Gene. Benjamin Cummings, San Francisco.
7. Watson, J.D., M. Gilman, J. Witkouski and M. Zoller. 1992. Recombinant DNA. Scientific American Books, New York.
8. Puller, A. (Ed.). 1993. Genetic Engineering of Animals. VCH Publishers, New York.
9. Balinsky, B.I. 1975. An Introduction to Embryology. Saunders, Philadelphia.
10. Beril, N.J. 1974. Developmental Biology. Tata McGraw-Hill Publishing Company Ltd. New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBT5CC6	Animal Biotechnology					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO3	✓	✓		✓	✓	✓	✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (I) = 46 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

Course Code:20UBT5CC7

InstructionHours: 5

Credits: 5

ExamHours:3

InternalMarks:25

ExternalMarks: 75

CORECOURSE-VII BIostatISTICS AND BIOSAFETY

Courseoutcomes

- ToKnowbasicconceptsofprobabilityandstatisticsandbeabletodescribestatisticalmethodsandprobabil
itydistributions relevantformolecularbiologydata
- Toknowtheapplicationsandlimitations ofdifferentbiostatisticalmethods.
- Knowbasic bioethicstobefollowedduringanyscientificwritingorexperimentation.
- Thispartofthesyllabushelpsthestudentstounderstandtheethical,social,legalaspectsinbiologyandbio
containment.
- Thiscourseisdesignedtogiveknowledgeon Biosafetyguidelinesandregulation

UNIT-I

Biostatistics , Concepts of statistics - basic principles - Variables, measurements, functions and limitation
- Data,types of data-biological measuremen- kind of biological dat- functions of statistics and limitation of
statistics- methods of collection of data - merits and demerits, tabulation and - representation of data by
frequency distribution diagram (Simple/ Multiple/ Sub divided bar diagram, Pie diagram) - Graphs
(Histogram, polygon, curve) - Stem and leaf diagram - Sampling design essentials of sampling, census
methods, sampling methods -statistical laws,statistical error-test of reliability of sample.

UNIT-II Measures of central tendency

Mean, median, mode and geometric mean - Measures of dispersion -range, mean deviations, standard
deviation,Variance,Skewness,Kurtosis,quartile deviation merits and demerits - coefficient of variations -
Correlation , types and methods of correlation - Regression, simple regression equation - fitting
prediction, similarities and dissimilarities of correlation and regression.

UNIT- III Inferential statistics

Hypothesis, definition, types (one tailed,two tailed) - Sampling distribution and errors - Statistical Tests
of significance, 't' test, Chi-square and goodness of fit-'F' test Analysis of variance - (ANOVA),One,way
&Two,way.

UNIT-IV Biosafety

Introduction, biosafety issues in biotechnology - historical background- Introduction to Biological Safety Cabinets - Primary Containment for Biohazards - Biosafety Levels - Biosafety Levels of Specific Microorganisms - Recommended Biosafety Levels for Infectious Agents and Infected Animals.

UNIT-V Biosafety Guidelines

Biosafety guidelines and regulations (National and International) -operation of biosafety guidelines and regulations of Government of India - **Definition** of GMOs & LMOs - Roles of Institutional Biosafety Committee - RCGM, GEAC etc,for GMO applications in food and agriculture - **Environmental release of GMOs, Risk Analysis, Risk Assessment, risk management and communication** - Overview of National Regulations - relevant InternationalAgreements including Cartagena Protocol.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
41	2	11	20	11	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Norman T. J. Bailey, 2009. Statistical methods in Biology. University press, CambridgeRastogi, V.B.2009.Fundamentals of Biostatistics, AnneBooks, India.
2. Sateesh, M.K., 2008. Bioethics and Biosafety, I.K. International Pvt. Ltd, New Delhi, India.
3. Senthil Kumar Sadhasivam and Mohammed, Jaabir. 2008. IPR, Biosafety and Biotechnology Management. Jansen Publications, Tiruchirapalli, India.

References

1. Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.K. Freeman. San Francisco.
2. Zar, J.H. 2003. Biostatistical Analysis. Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi.

3. <http://www.cbd.int/biosafety/background.shtml>
4. <http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3>.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBT5CC7	Biostatistics and Biosafety					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓		✓	✓		✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Number of Matches (I) = 44 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

CourseCode:20UBT5CP5
InstructionHours:4
Credits:4

ExamHours:3
InternalMarks:25
ExternalMarks: 75

COREPRACTICAL-V PLANT AND ANIMAL BIOTECHNOLOGY(P)

Objectives

This course is planned to give hands on training on plant & animal tissue culture and biotechnology

Course outcomes

- This course is to give hands on training on plant & animal tissue culture and biotechnology
- Explain the basis for formulation of plant tissue culture medium for growth and differentiation of plants
- Discuss the importance and applications of different techniques employed in tissue culture and storage of plant germplasm
- Illustrate the preparation of mesophyll protoplasts and analyze their fusing using PEG.
- To know Animal cell culture and different type of cell culture and application of cell culture.

Plant Biotechnology

1. Introduction to Safety Practices for plant cell culture laboratory (Theory & Demo) -
2. Aseptic culture techniques for establishment and maintenance of cultures (Handson) - .
3. Tissue culture media preparation: Preparation of stock solutions of Murashige Skoog basal medium and plant growth regulator stocks (Handson) -
4. Protoplast isolation-1. Mechanical 2. Enzymatic -
5. Protoplast culture (Hands on) -
6. Isolation of plant genomic DNA (Handson) -
7. Size analysis of DNA by Agarose Electrophoresis (Handson) -
8. Photoperiodism -
9. Transformation of leaf discs with *Agrobacterium* (Handson) -
10. Expression of foreign genes in to plant cells: use of *Agrobacterium tumefaciens* (Theory) -
11. Morphogenesis in tobacco leaf tissue (Handson) -
12. Regeneration of the Shoot Apical Meri stem (SAM) -
13. Preparation of chloroplast from pea (Handson) -

Animal Biotechnology

1. Isolation of DNA from Animal liver
2. Isolation of DNA from human cheek cells
3. Isolation of DNA from blood
4. Quantification of DNA by spectrophotometric method
5. Size analysis of DNA by Agarose gell electrophoresis
6. Animal cell culture-Preparation of media
7. Types of Animal cell culture- Primary, secondary & established.
8. Identification of stages during chick embryo development.
9. Establishment of Primary culture
10. Establishment of Secondary culture
11. Visit to Animal Cell Culture Lab.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
24	11	6	6	1	local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. M.S. Clark.1997.*PlantMolecularBiology:ALaboratoryManual*.Springer-Verlag.
2. Slater A., Scott N.W. and Fowler, M.R. 2008. Plant Biotechnology - the genetic manipulationofplants.2ndEdition.OxfordUniversitypress,USA.
3. H.S. Chawla,2002.IntroductiontoPlantBiotechnology.OxfordandIBHPPublishingCo.Pvt.Ltd.NewDehli.
4. Monica.A.Hughes.1999.Plant MolecularGenetics.PearsonEducationlimited,England.
5. Harrison, M.S. and Bal, I.R. 1997. General techniques of all culture Cambridge Universitypress.
6. PrasashM.andArora.C.K..1998.Planttissueculture, AmmolpublicationPvt.Ltd.

7. Darling D.C. and Morgan S.J. 1994. Animal cells, culture Media. Wiley, New York.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBT5CP5	Plant and Animal Biotechnology-Lab					4	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (l)=46		Relationship: Very High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

Course Code:20UBT5MBE1:1
InstructionHours: 5
Credits:3

ExamHours:3
InternalMarks:25
ExternalMarks: 75

MAJOR BASED ELECTIVE - I

IMMUNOLOGY

Courseoutcomes

- To understand the immune system, its components and their functions
- To comprehend the different types of cells, organs and mechanisms involved in immune system and their contributions in elucidating immune response.
- To impart knowledge of immune responses to various pathogens
- To understand the various components and the techniques associated with the specific immunological reactions.
- Gain knowledge about vaccine preparation

UNIT-I Fundamental Concepts and Anatomy of the Immune System

Terminology, Antigen, immunogen, hapten, allergen, tolerogen, super antigens, antibody, immunoglobulin, antigenicity, immunogenicity - Self & nonself, innate & acquired immunity - Haematopoiesis - Organs, tissues, cells and mediators of immune system - primary lymphoid organs, secondary lymphoid tissues, lymphocytes, mediators - Lymphatic system - lymphocyte circulation and lymphocyte homing - Principles of cell signaling.

UNIT- II Non specific Immunity

Natural built in barriers, skin, semen, saliva, tears, enzymes - Mediators of immune system-lymphokines, cytokines, interferon, tumor necrosis factor - Complement components - natural killer cells, macrophages - phagocytosis, pinocytosis - Inflammatory response - Mucosal and Gut associated lymphoid tissue (MALT&GALT) and mucosal immunity.

UNIT- III Specific Immunity

Antigen recognition and response - Major Histo compatibility Complex - MHC genes - MHC in immune responsiveness and disease susceptibility - HLA typing - Kinetics of immune response and memory - CMI response -T cell development, mutation activation and differentiation - T cell receptor and determinant - T cell subsets, TCR complex - Antigen processing and presentation - HI response , B cell, B cell development, maturation, activation and differentiation - B cell receptor and determinants - B cell subsets - Immuno globulins, basic structure, classes & subclasses of immunoglobulins - antigenic determinants - Generation of antibody diversity -Unresponsiveness, tolerance, suppression and potentiation.

UNIT-IV Vaccinology

Active, passive and combined immunization - Live, killed, attenuated, plasma derived, subunit, recombinant DNA, protein based, plant, based, peptide, anti, idio typic and conjugate vaccines, production & applications- Role and properties of adjuvants & ISCOMS.

UNIT- V Clinical Immunology

Immunity to infection, Bacteria, viral, fungal and parasitic Hypersensitivity -Ebola infection causative treatment - H1N1 viral infection causative treatment - Type I, II, III and IV. Autoimmunity Transplantation immunology - Tumor & Cancer immunology and immune therapy Immuno deficiency- Ebola infection causative treatment - H1N1 viral infection causative treatment.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
42	2	3	3	37	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. E.Riot.2011. Essential Immunology 12th Edition. Wiley & Blackwell.
2. Janeway et al. 1999. Immunobiology. 4th Edition. J Current Biology publications.
3. D.M. Weir, John Stewart. 1997. Immunology. 8th Edition. Churchill Livingstone.
4. P.J. Delves, IS.J. Artin, ID.R. Burton and II.M. Roitt. 2006. Essential Immunotechnology. 12th Edition. Wiley & Blackwell.
5. Richard M. Hyde. 2012. Microbiology and Immunology. 3rd Edition. Springer Science & Business Media.

References

1. Brostoff J, Seaddin JK, Male D, Roitt IM., 2002. Clinical Immunology. 6th Edition. Gower Medical Publishing.
2. Paul. 1999. Fundamental of Immunology. 4th Edition. Lippencott Raven.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBT5MBE1:1	Immunology					5	3			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓	✓		✓	
CO3	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO4	✓	✓	✓		✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (I)=45		Relationship: Very High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

Course Code:20UBT5MBE1:2
InstructionHours: 5
Credits:3

ExamHours:3
InternalMarks:25
ExternalMarks: 75

MAJOR BASED ELECTIVE - I BIOINSTRUMENTATION

Courseoutcomes

- To provide better understanding of various analytical techniques used in research area
- This course will give an understanding about the working principles, construction and applications of the instruments often used in the studies related to various disciplines of Biological Sciences
- Outline the principle, types and applications of Spectroscopy.
- Summarize the principle, types and applications of Centrifugation and chromatography.
- Demonstrate the various electrophoretic techniques and its applications

UNIT- I Basic Instruments

Principles, operation protocol & applications of the following instruments - Weighing balance - pH meter - Polarography - Radioactivity - ECG - FTIR.

UNIT- II Microscopy

Observation of different microbes, Light, Bright & Dark field; Phase contrast- Inverted Phase contrast; Fluorescent, Electron-TEM & SEM; Confocal- Application of Microscope.

UNIT- III Spectroscopy

Colorimeter - Spectrometer - UV visible spectrometer - X-ray spectrometer - ELISA reader - Atomic absorption spectrometer - Flame photometer - Fluorimeter & Spectrofluorimeter - Application of spectrophotometer

UNIT-IV Separation Techniques

Centrifugation, Principle, operation, types & application - Chromatography, Principle, operation & applications - Paper, ascending, descending & Circular, TLC, HPTLC, GC, HPLC- Column Chromatography, Ion Exchange & Affinity Chromatography, LC, MS.

UNIT- V Electrophoresis

Native & denatured, zone, iso-electro focusing & isotachopheresis - 1D & 2D. PCR, MoldiT.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
24	12	13	5	4	Regional

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. S.Sadasivam., A. Manickam. 1996. Biochemical Methods. 2nd Edition. New Age International(p)Ltd,Publishers.
2. Dr.G.Rajagobal.,Dr.B.D.Toora.2001.PracticalBiochemistry.1stEdition.AhujaBookCompany Pvt.Ltd.
3. J.Jayaraman.2000.LaboratoryManualinBiochemistry.NewAgeInternational(p).
4. PlummerMu,DavidT.Plummer.1988.IntroductiontoPracticalBiochemistry.TataMcGraw-HillEducation.
5. M.Mooyoung.1985.ComprehensiveBiotechnology.Vol.2,3&4.Pergamonpress.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
V	20UBT5MBE1:2	BioInstrumentation					5	3				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓		✓	✓	✓		✓	✓	✓		
CO3	✓		✓	✓	✓	✓	✓		✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓		
Number of Matches (ll)=44 Relationship:High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-V

Course Code:20UBT5MBE1:3
InstructionHours: 5
Credits:

ExamHours:3
InternalMarks:25
ExternalMarks:7

MAJOR BASED ELECTIVE - I

NANOTECHNOLOGY

Courseoutcomes

- To introduce the learner to the basic concepts and applications of nanotechnology.
- Students to understand the various nanomaterial, their construction and biological approach of in medical field.
- Gain an understanding of producing novel nanobiologics and Nanopharmaceuticals
- Expand their knowledge on Ethical, Safety and regulatory issues of Nanomedicine.
- Gain an understanding of producing novel environmental NanoRemediation Technology

UNIT-I

Basic Concepts of Nanoscience Scientific Revolution- Feynman's Vision , Nanoscience - Introduction, **Scope and Overview** - Length scales- Nanomaterials definitions - Classification of Nanomaterials - dimensions, confinement, Surface to **volume ratio**, **Energy at bulk and nano scale** - Nature Nanophenomena - Size dependent variation in Mechanical, Physical, Chemical, electronics, reaction, catalytic properties-Importance of Nanoscale and technology- History of Nanotechnology- Future of Nanotechnology- Nanotechnology Revolution-**Silicon based Technology**.

UNIT-II

Synthesis of semi conducting nano structured materials by co precipitation technique and to calculate the absorption coefficient-optical bandgap using UV Vis spectrometer- Nanoparticles, Introduction- Types of Nanoparticles, **Pure Metal, Gold, Silicon, Silver**, Cobalt, Metal Oxides, Silica, Zinc oxide, Iron oxide, Alumina, Titania- **Techniques to Synthesize Nanoparticle**-Characterization of Nanoparticle, Nanocomposite.

UNIT-III

Applications of nanotechnology- Nanosensors - types and its applications- Nanocarriers for Drug Delivery, Polymeric Nanoparticles as Drug Carrier-Micelles for Drug Deliver-**Nanomedicine**- Nanotechnology for Cancer Research and Therapy-

Nanocomposite materials for therapy and food packaging, Functional graphen, carbon nanotube and polymer composite applications in defence and aerospace.

UNIT-IV

Environmental Nano Remediation Technology, Thermal, Physico, Chemical, and Biological methods-Nano Filtration for the Treatment of Wastes, Removal of Organics, Inorganics and Pathogen, Nanotechnology for Water Purification- Green synthesis of silver & iron nanoparticles.

UNIT-V

Nature Nanophenomena Size dependent variation in Mechanical, Physical, Chemical, electronics reaction catalytic properties- Ethical issues in nanotechnology: Introduction, Socio-economic Challenges, with special Reference to Nanomedicine -Social and Ethical Issues- Economic Impacts.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
34	12	10	26	20	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Christef M. Niemeyer, C.A. Mirkin. 2004. Nanobiotechnology: Concepts, Application and Properties. Wiley-VCH Publishers, New York.
2. Tuan Vo-Dinh. 2007. Nanotechnology in Biology and Medicine: Methods, Devices and Applications.

References

1. Ratner M,
Ratner D, "Nanotechnology: A Gentle Introduction to the Next Big Idea" Prentice Hall, 2005.
2. H.S. Nalwa, "Encyclopedia of Nanoscience & Nanotechnology", McGraw Hill, 2004.

3. CNRRao,
“ThechemistryofNanomaterials:Synthesis,Properties&Application”,Springer2006.
4. ViolaVogel, “Nanomedicine&Nanotechnology”, JohnWilley&SonsLtd,2008.
5. Goodshell,“Nanobiotechnology”, JohnWilley&SonsLtd,3rdedition, 2004.
6. RalphS.Greco, “NanoscaleTechnologyinBiologicalsystems”, CRCPress,2005.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
V	20UBT5MBE1:3	Nanotechnology					5	3			
CourseO utcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓	✓	✓	✓		✓	✓	✓		✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
NumberofMatches(ℓ)=43		Relationship:High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-V

CourseCode:20UBT5SBE2:1
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

SKILL BASED ELECTIVE - II **MEDICAL LAB** **TECHNOLOGY**

Courseoutcomes

- Thecourseprovidesknowledgeaboutmedicallabmanagementandvarioustechniquesinmedicalfield.
- ThecourseprovidesknowledgeaboutHistopathologicaltechniquesandskillsrequiredtodiagnose various disorders
- Thecourseprovidesknowledgeaboutthematologicalspecimensandbloodbankmanagement
- Acquiredknowledgeabouttheroleofpathologyin applied orexperimentalmedicalresearch.
- Tofacilitateself-employment

UNIT-I

Medical lab management-Laboratory management and planning- reception and recording of specimen- knowledge of maintenance and use of the following: microscope, hot plates, refrigerators, cryostat, blood bank refrigerators,walking coolers,refrigerated centrifuge,incubator,oven, autoclave- Equipments for Hematology.

UNIT-II

Histopathology- Tissue processing, details of paraffin embedding, vacuum embedding, decalcification- section cutting and different types of microtomes- frozen section uses and techniques- Staining procedures in Histopathology, Museum methods, mounting of specimens,preparation of mounting medium- Parts of photometer, types of photometry, colorimetry, spectrophotometry.

UNIT-III

Hematology, Blood, Collection of haematological specimens, Equipments for Hematology- Parts of photometer, types of photometry colorimetry, spectrophotometry-Different methods of estimation of hemoglobin - Staining procedures in haematology, Peripheral blood smears- Salient features and investigations for iron deficiency anemia, megaloblastic anaemia and haemolytic anaemia,Leukaemias,Haemorrhagic disorders-Hemostasis: Definition, Basic concept and principle, Basic steps involved in Hemastosis.

UNIT-IV

Body fluids and excretory products- Examination of stool, Urine its formation- normal and abnormal constituents - Examination of sputum- Examination of body fluids pleural, pericardial, ascetic, cerebrospinal fluid and semen examination-Bone marrow: Techniques of aspiration, preparation and staining of films, Bone marrow biopsy.

UNIT-V

Hemostasis: Definition, Basic concept and principle, Basic steps involved in Hemastosis-Blood bank management: Blood bank management and planning the receiving and recording of blood samples, indexing- Inheritance and nomenclature of ABO and Rh blood group systems, other blood group systems- transfusion reactions, recognition and investigations- Criteria used while selecting a blood donor-Blood Components, Blood Transfusion Reactions.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
29	13	8	20	12	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. RajanS. MedicalMicrobiology.MJPPublishers, Chennai.2007.
2. RajanS.Parasitology.SRSPublications,Chennai.2007.

References

1. K.L. Mukherjee,
“MedicalLaboratoryTechnology”Vol.I,II&III,TataMcGrawHillPublishingcompany,N
ew Delhi,2008.
2. C.R.Maity,“MedicalLaboratoryTechnology”,NewCentralBookAgencyPvtLtd.Kolka
ta,2005.
3. AlanHGowenlock,“Varley’sPracticalClinicalBiochemistry”,CBSPublications&Distr

ibutors, New Delhi, 2009.

4. Monica Cheesbrough, "District Laboratory Practice" in Tropical Countries Part - 1 & 2 Cambridge Low-Price Edn. 2000.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
V	20UBT5SBE2:1	Medical lab technology					2	2				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓		✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓		✓	✓	✓	✓		✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches (l) = 46 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

CourseCode:20UBT5SBE2:2
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

SKILL BASED ELECTIVE-II BIOFERTILIZER

Courseoutcomes

- To give adequate knowledge on biofertilizer production and to train the students for self employment
- To ensure imparting the knowledge of biofertilizer based agriculture.
- The course provides knowledge about the application of biofertilizer and organic farming.
- The course provides knowledge about Biofertilizers Production and quality control
- Acquired knowledge about economic importance and reduce hazards in environment

UNIT-I Microbes and Agriculture

Importance of Carbon, Nitrogen and Phosphorus cycles - Benefits of Biofertilizers - strain selection, seed pelleting, Inoculant and inoculants carriers-Nitrogen fixing Bacteria (*Azotobacter*, *Beijerinckia*, *Clostridium*, *Cyanobacter*) - Media for *Azotobacter*, *Azospirillum* and phosphate solubilizer-New nitrogen fixers, 'Nif' genes (Hybrid *E.coli*).

UNIT-II Blue Green algae as Biofertilizers

Mass cultivation of Cyanobacteria (*Anabaena*, *Cylindrospermum*) -Mass cultivation of *Azolla*, *Azolla* - *Anabaena* complex, Algal inoculants -methods of production (Trough method, Pit method, Field scale) application.

UNIT- III Microbial Symbiotic association

Rhizobium, Taxonomy, physiology, Host, *Rhizobium* interaction, mass cultivation, carrier and base inoculants - Nod gene and factor - Vermiculture, Earthworms and microorganisms-Microbial enzymes, Bioprocessing.

UNIT- IV Mycorrhiza

Types of mycorrhizal associations - VAM mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield - collection of VAM-VAM life cycle-isolation, stock plants and inoculums production of VAM.

UNIT- V Production and quality control in Biofertilizers

Isolation and identification of different nitrogen fixing ability of different strains under controlled and field conditions - direct and indirect methods, culture production, fermenter, storage of culture,

carrier,packing,quality control - ISI Standards, inoculums requirements,packing, marketing and storage - inoculums requirements methods of application.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
24	4	12	3	9	Regional

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. S.G. Borkar, 2015. Microbes as Bio-fertilizers and their Production Technology, Woodhead Publishing India in Agriculture, India.
2. RShankaraReddy, 2012. Biofertilizer Technology, Adhyayan Publishers, India.

References

1. Moshrafuddin Ahmed and Basumatary, S.K. 2006. Applied Microbiology, M.J.P. Publishers, Chennai.
2. Dubey, R.C. 2003. A text book of Biotechnology. S. Chand & company, New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	20UBT5SBE2:2	Biofertilizer					2	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓		✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (ll)=44		Relationship: High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-V

CourseCode:20UBT5SBE2:3
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

SKILLBASEDELECTIVE-II DAIRY TECHNOLOGY

Courseoutcomes

- Tohavetheabilitytouseetheacquiredknowledgeduringmilkprocessinganddairyprocessingequipments
- The courseprovides knowledgeaboutdairyindustry&manufactureofDairyproducts
- ThecourseprovidesknowledgeaboutFermented dairyproducts
- ThecourseprovidestheIndustrialapproachofBiotechnology
- Toimprovethestudentsentrepreneurialskill

UNIT-I Dairy Chemistry and Microbiology

Introduction, Basic dairy terminology, milk as raw material, composition, food value, contaminants, milk reception in dairies and tests - Quality and Quantity tests at reception - Cell count and other tests - Milk transport and storage in dairy plants, Cholesterol, fatty acids and their relation to cardiovascular diseases ,Dietary recommendations-Applications of enzymes in dairy industry- Pasteurization concept.

UNIT-II Dairy Processing Equipments

Milk processing terminology, Processing flow sheet, Equipment employed, Pasteurisers (Heat Exchangers), Plant piping, Pumps, Cream separating Centrifuges, Homogenizers, Bottle and pouch fillers, Milk Chillers, Ice Cream Freezers - Vacuum Evaporators, Spray and Drum Dryers, Product in stantizing equipment.Packaging of milk in bottles and sachets.

UNIT-III Manufacture of Dairy Products

Cheese, Types of cheese- Defects in cheese- Manufacture of paneer-Toned Milk, Sweetened Condensed milk, Khoa, Milk powder,Quality aspects.

UNIT- IV Manufacture of Ice Cream and other Dairy Products

Manufacture of Ice cream, Chemistry and technology -Microbiology of ice cream -Quality, Aspects, Manufacture of Butter, Ghee and Grading of butter-Quality aspects, Extraction of case in from milk, properties, composition and industrial uses - Production of lactose and whey.

UNIT- V Fermented dairy products

Fermented products, Yoghurt, Curd, acidophilus milk etc - Energy use in Dairy plant, sources of energy, cost of energy - Control of energy losses and Energy conservation - Dairy marketing, Milk industries in india.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
23	5	3	15	4	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Textbooks

1. National Institute of Industrial Research, Modern Technology of Milk Processing and Dairy Products, II Edition, NIIR Publications, India, 2004.
2. Tufail Ahmad: *Dairy Plant Systems Engineering* Kitab Mahal, Allahabad, India (1985)
3. Edger Spreer & Axel Mixa: *Milk and Dairy Product Technology* Marcel Dekker Inc. N.Y. (1998)

References

1. Arthur W. Farral: *Engineering of Dairy and Food Products* (II Edition 1970) Robert E. Krieger Publishing Co. NY.
2. Garret Smit: *Dairy Processing (Improved Quality)* Woodhead Publishing Ltd. CRC Press (2003).
3. W.M. Clunie Harvey and Harry Hill: *Milk Products* Bio Tech Books, New Delhi (1999).
4. Prof. H.G. Kessler: *Food Engineering and Dairy Technology* Verlag Kessler Publishing House, Germany (1981).
5. W. James Harper and Carl W. Hall: *Dairy Technology and Engineering* AVI Publishing, Westport, USA (1976).

A (1976). Edger Spreer: *Milk and Dairy Product Technology* Marcel Dekker Inc. New York, USA

Semester	Code	Title of the Course					Hours	Credits				
V	20UBT5SBE2:3	Dairy technology					2	2				
(2005) Relationship Matrix for COs, POs and PSOs												
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO2	✓		✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO4	✓	✓		✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches (I) = 45 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29 *	** 30-34	35-44	45-50
Relationship	VeryPoor	Poor ⁸	Moderate	High	VeryHigh

SEMESTER-V

Course Code:20UBT5SBE3:1
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

SKILLBASEDELECTIVE- III AQUA CULTURE

Courseoutcomes

- The students acquired knowledge about Preparation and Management of Ponds
- The students acquired knowledge about Concept of different systems of aquaculture.
- The students acquired knowledge about Disease management & Product export
- To have the ability to manufacture of aquaculture feeds
- To facilitate self-employment

UNIT-I Introduction

History, definition, scope and significance of aquaculture - comparison of aquaculture with agriculture - and commercial fisheries - Different aquaculture systems - Aquaculture, Global and Indian Scenario - General characters of fishes, and shell fishes - Criteria for the selection of species - Fresh water and marine cultivable fishes and their biology.

UNIT-II Aquaculture ponds

Preparation and Management of Ponds - Types of ponds, Nursery ponds, Rearing ponds, grow out ponds - Prestocking management - Liming of ponds, Fertilization of ponds - Control of algal blooms, weed control - Water quality management.

UNIT- III Systems of aquaculture

Concept of different systems of aquaculture - Monoculture, Polyculture, Composite culture - Mono sex culture, Mixed culture, Pen, Cage and raft culture - Extensive, Semi-intensive, Intensive aquaculture - Integrated fish farming, Shellfish, culture of prawns and molluscs.

Unit IV

Fish feed and its importance - Prawn culture and hosting - Prawn feed production - Factors affecting feed design - production and feeding - Manufacture of aquaculture feeds - Feed types, selection of ingredients and additives, Formulation of feeds and storage - Feed techniques, Manual and Mechanical.

UNIT-V Disease management & Product export

Introduction to fish diseases - Diseases in aquaculture - bacterial, viral and fungal pathogens of fish - Methods for disease control and management - Environment management, chemotherapeutic agents, vaccines and probiotics - Export of fishery products from India - major countries, important

products.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
33	7	6	17	8	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. S.Ayyappan,J.K.Jena,A.Gopalakrishnan,Dr.A.K.Pandey.2010.Handbook of FisheriesandAquaculture.IndianCouncilofAgriculturalResearch.New Delhi.
2. K.K.Balachandran.2001.PostharvestTechnologyinFishandFisheryProducts.DayaPublishingHouse.New Delhi.
3. JhingranV.G.1985.FishandFisheriesofIndia.3rdEdition.HindustanPubl.Crop.India.Ltd.NewDelhi.
4. T.V.R.PillayandM.N.Kutty.2005.AquaculturePrinciplesandPractices.WielyBlack-Well

References

1. AlineW.1980.Fishdiseases.SpringerVerlag.
2. MidlenA.BandReddingT.A.1998.EnvironmentalManagementforAquaculture.6thEdition.London:Chapman&Hall.
3. WedmeyerG.MeyerF.P.andSmithL.1999.EnvironmentalStress andFishDiseases.NarendraPubl.House.
4. WooP.T.KandBrunoD.W.1999.FishDiseasesandDisorders.Vol.3Viral,BacterialandFungalInfection.CenterforAgricultureandBiosciencesInternational.
- 5.FelixS.RijiJohnK,PrinceJeyaseelanM.J.andSundararajV.2001.FishDiseaseDiagnosis andHealthManagement.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
V	20UBT5SBE3:1	Aquaculture					2	2			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓		✓		✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓	✓		✓	
CO4	✓	✓	✓		✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
NumberofMatches(l)=43		Relationship:High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-V

CourseCode:20UBT5SBE3:2
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

SKILL BASED ELECTIVE-III API CULTURE

Courseoutcomes

- The students acquired knowledge about honey bees, its lifestyle, the social behavior and colonization.
- The students acquired knowledge about Concept Apiary Management.
- To know about nutritional value and economic importance of honey
- The students acquired knowledge about Honey extraction & Product export
- To facilitate self-employment

UNIT-I

History and scope of Bee keeping - Present status of Apiculture in India - Honey bee, Systematic position, Species of Honey bees - Morphology and Life history, Stinging apparatus and bee poisoning.

UNIT-II

Bee colony, Castes- natural colonies and their yield - Bee foraging, Pollen and nectar yielding plants, Honey bee, behaviour, swarming, Pheromones.

UNIT-III

Apiary Management- Artificial bee hives, types, construction of space frames, Selection of sites, Handling, Maintenance- Recent trends in apiculture- Instruments employed in Apiary and International markets for Honey and Wax - Natural enemies and diseases of honey bees and their control measure

UNIT-IV

Honey Composition Honey extraction, seasonal maintenance, uses. Bee wax and its uses, National control measures.

UNIT-V

Apiculture as Self, employment venture- Apiculture marketing- financial assistance and funding agencies - Economics of Apiculture and Management.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
19	2	10	5	6	Regional

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Abrol,D.P.1997.BeesandBeekeepinginIndia.KalyaniPublishers,Ludhiana.
2. Rare,S.1998,IntroductiontoBeekeeping, VikasPublishinghouse.

References

1. Cherian,R.&K.R.Ramanathan,1992-BeekeepinginIndia
2. Singh, S.1982-BeeKeeping -ICAR
3. Mishra,R.C. 1995.HoneyBeesandTheirManagementinIndia.ICAR,NewDelhi.
4. Sharma,P.andSinghL. 1987-Handbookofbeekeeping, ControllerPrintingandStationery,
5. Shukla,G.S andUpadhyay,V.B.1997.Economic Zoology.RastogiPublications,Meerut.
6. Arumugam,N.,Murugan,T.,JohnsonRajeshwar,J.andRamPrabhu,R.2009.AppliedZoology.SarasPublication,Nagercoil.
7. Amsath,A.andMarimuthuGovindarajan,2013.Apiculture.LambertAcademicPublishing.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
V	20UBT5SBE3:2	Apiculture					2	2			
CourseOutcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓	✓	✓	
CO2	✓		✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓		✓	✓	
CO4	✓		✓	✓	✓	✓	✓	✓		✓	

CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NumberofMatches(l)=43		Relationship:High								

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-V

CourseCode:20UBT5SBE3:3
InstructionHours: 2
Credits:2

ExamHours:3
InternalMarks:25
ExternalMarks: 75

SKILLBASEDELECTIVE-III SERICULTURE

Courseoutcomes

- The students acquired knowledge about the technique of silkworm rearing, cocoon production and silk reeling from sericulture.
- The students acquired knowledge about types of silkworms, distribution of races.
- The students acquired knowledge about mulberry cultivation
- Describes silkworm rearing house and appliances
- To kindle the young mind to become self-employers.

UNIT-I

Introduction, Sericulture, Definition, history and present status, silk route. - Prospects of Sericulture in India, Sericulture industry in different states of India-Employment potential in mulberry and non-mulberry sericulture - Mulberry, Classification, distribution and common varieties of mulberry used in India-Mulberry import and export-Mulberry cultivation skills

UNIT-II

Types of silkworms, distribution of races, exotic and indigenous races - Commercial races, Multivoltine, bivoltine and hybrid races used in India - Morphology and Life cycle of Bombyx mori - Structure of silk gland and secretion of silk- Chemical composition of silk-Silk marketing.

UNIT-III

Silkworm rearing house and appliances - Rearing house, Early age rearing and Late age rearing - Appliances, Rearing trays, ant, wells, rearing stands and racks, paraffin papers, rubber foam pads, net, chopsticks, feathers-Types of mountages, Spinning, harvesting and storage of cocoons.

UNIT-IV

Pests of silkworm, uzifly, dermistid beetle, control and preventive measures - Silkworm diseases, protozoan viral fungal and bacterial diseases and their control and preventive methods.

UNIT-V

Sericulture organizations in India, Silk Industry - commercial classification of silk and silk thread wastes and their marketing-By-products of sericulture used as compost, animal feed, in Biogas plants and in pharmaceutical products.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
21	4	1	16	1	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Ganga,G.andSulochanaChetty,J.2003. AnIntroductiontoSericulture(2ndEdition). OxfordandIBHPublishingco.Pvt-Ltd.,NewDelhi.
2. Taxima,Y. 1972.Hand BookofSilkwormRearing.FujiPublication,Tokyo.

References

2. Ullal,
S.R.andNarasimhanna,M.N.1979.HandbookofPracticalSericulture.CentralSilkBoard,Bombay.1.Jo
lly,M.S.(Ed)AppropriatesericulturalTechniques,CSR&TI,Mysore.
3. Narasimhanna,M.N.1988. Manualofsilkwormeggproduction. CSB, Bangalore
4. Wupang-chunandda-chung. 1988.Silkwormrearing, pub.ByFAO, Rome
5. SenguptaK.1989.Aguideforbivoltinesericulture:, Director, CSR&TI,Mysore
6. Krishnaswamy,1986.Improvedmethodofrearingyoungagesilkworm:S.reprintedCSB,Bangalore.
7. Shukla,G.S.andUpadhyay,V.B. 1997.EconomicZoology. RastogiPublications, Meerut.
8. Tomar,B.SandN.Singh. ATextBookofAppliedZoology. 2007. Emkaypublications. Delhi.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse	Hours	Credits
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V	20UBT5SBE3:3	Sericulture				2	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓		✓	✓	✓
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓		✓		✓	✓	✓
CO5	✓	✓		✓	✓	✓	✓	✓	✓	✓
Number of Matches (l)=43		Relationship: High								

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High
		*	**		

SEMESTER-VI

Course Code:20UBT6CC8

Instruction Hours: 6

Credits:6

ExamHours:3

InternalMarks:25

ExternalMarks: 75

CORECOURSE -VIII MICROBIAL BIOTECHNOLOGY

Courseoutcomes

- The students will be able to demonstrate a familiarity with the wide diversity of microbes, and their potential for use in microbial biotechnology
- The students will be able to understand screening methods for industrial microbes
- Have acquired a detailed knowledge of number of products which are produced by industrial fermentation processes
- The students will be able to understand Biology of Industrial Microorganisms
- The students will be able to know the Industrial production of various products

UNIT-I

Basic principle of Biochemical engineering - Isolation, screening and maintenance of industrially important microbes - Microbial growth and death kinetics with reference to industrially useful microorganisms - Strain improvement for increased yield and other desirable characteristics.

UNIT- II Concepts of basic mode of fermentation processes

Bioreactor designs and types of fermentation and fermentors - Concepts & basic modes of fermentation- Batch, fed batch and continuous fermentation - Conventional fermentation versus biotransformation - Solid substrate, surface and submerged fermentation - Fermentation economics and fermentation media - Fermenter design - mechanically agitated, pneumatic and hydrodynamic fermenters. - Large scale animal and plant cell cultivation and air sterilization.

UNIT- III Up stream processing

Media formulation - sterilization, aeration and agitation - Measurement and control of bioprocess parameters - scale up and scale down process.

UNIT-IV Downstream processing

Bio-separation, filtration, centrifugation, sedimentation, flocculation, microfiltration, sonication - Cell disruption, enzymatic lysis and liquid, liquid extraction - Purification by precipitation (ammonium sulfate, solvent electrophoresis and crystallization - Extraction (solvent, aqueous two phase, super critical) and chromatographic techniques - Reverse osmosis and ultra filtration - Drying, crystallization - storage and packaging - Treatment of effluent and its disposal.

UNIT-VApplications of Microbes in food processing and production

Fermented foods and beverages - Commercial products of fermentation, Application of fermentation-food ingredients and additives used in fermentation and their purification - Fermentation in preparing and preserving foods- Microbes and their use in pickling - producing colours and flavours, alcoholic beverages and other products - Process wastes, whey, molasses, starch substrates and other food wastes for bioconversion to useful products - Bacteriocins from lactic acid bacteria- Ethanol production- Importance of biodiesel-production and applications in food preservation.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
39	5	9	21	4	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Jackson AT. 1991. Bioprocess Engineering in Biotechnology. Prentice Hall, Englewood Cliffs.
2. Shuler ML and Kargi F. 2002. Bioprocess Engineering: Basic concepts, 2nd Edition. Prentice Hall, Englewood Cliffs.

References

1. Young M.M., Reed. 2004. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine. Vol 1, 2, 3 and 4. Elsevier India Private Ltd, India.
2. Mansi EMTEL, Bryle CFA. 2007. Fermentation Microbiology and Biotechnology. 2nd Edition. Taylor & Francis Ltd,

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
VI	20UBT6CC8	Microbial Biotechnology					6	6				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		

CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO4	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓
NumberofMatches(l)=46 Relationship:VeryHigh										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-VI

Course Code:20UBT6CC9
InstructionHours:6
Credits:6

ExamHours:3
InternalMarks:25
ExternalMarks: 75

CORECOURSE-IX **IPR AND** **BIOETHICS**

Courseoutcomes

- Exposure to legal and socioeconomic impacts of biotechnology. To understand the ethical implications in Biotechnological applications.
- Exposure to ethical concerns of biotechnology research
- To understand the ethical, social, legal aspects in biology and biocontainment.
- To understand the ethical implications in Biotechnological applications.
- To understand the intellectual property rights, biosafety of genetically engineered products and guidelines in India.

UNIT-I

Introduction to Intellectual Property - Types of IP: Patents, Trade marks, Copyright & Related Rights - Design, Draft design-Agmark and its uses-Traditional Knowledge- Geographical Indications- importance of IPR-Applications of IPR-patentable and non patentables -patenting life, legal protection of biotechnological inventions - world intellectual property rights organization (WIPO)- IP rights in India-IPs of relevance to Biotechnology few Case Studies.

UNIT- II

Patent Filing Procedures - National & PCT filing procedure - Time frame and cost - Status of the patent applications filed - Precautions while patenting - disclosure/nondisclosure-Legal rights for products-Financial assistance for patenting- introduction to existing schemes Patent licensing, agreement Patent infringement-meaning, scope, litigation, case studies.

UNIT-III

IPR Agreements and Treaties - History of GATT - TRIPS Agreement - Madrid Agreement; Hague Agreement -WIPO Treaties; Budapest Treaty -PCT; Indian Patent Act 1970 & recent amendments - Patent and copyright Infringement - Patent and copyright misappropriation, and enforcement - Trade secret.

UNIT-IV

Bioethics -Introduction to ethics/bioethics -framework for ethical decision making - purpose and principles of bioethics - Bioethics in medical - drug testing, non maleficence ,Informed consent and human cloning - Bioethics on religious rules and guidelines.

UNIT-V

Biotechnology and ethics -Benefits and risks of genetic engineering -ethical aspects of genetic testing -ethical aspects relating to use of genetic information-genetic engineering and biowarfare -Ethical implications of cloning -Reproductive cloning- therapeutic cloning - Ethical, legal and socio economic aspects of gene therapy -germ line, somatic, embryonic and adult stem cell research -GM crops and GMO's -biotechnology and biopiracy -Ethical implications of human genome project.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
53	4	1	33	20	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Bioethics- byEllenFrankelPaul, FredD.Miller, JeffreyPaul, FredDycusMillerCambridgeUniversityPress,2002.
2. Bioethics&Science,JohnA.Bryant,LindaBaggottlaVelle,JohnF.Searle.a2002.

References

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2. Hoosetti,B.B.2002. GlimpsesofBiodiversity.Daya,NewDelhi.
3. Martin.M.W.andSchinzinger.R. 2003.Ethics inengineering. 3rdEdition, TataMcGraw-Hill,New Delhi.
4. BAREACT. 2007.IndianPatentAct1970Acts&Rules.UniversalLawPublishingCo.Pvt.Ltd.
5. Kankanala,K.C. 2007.GeneticPatentLaw&Strategy.1stEdition. ManupatraInformationSolutionPvt.Ltd.Noida,India.
6. SenthilKumarSadhasivamandMohammed, Jaabir.2008.IPR,BiosafetyandBiotechnologyManagement.JasenPublications,Tiruchirapalli,India.
7. <http://www.cbd.int/biosafety/backgrounds.html>
8. <http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.html>.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
VI	20UBT6CC9	IPRandBioethics					6	6			
CourseO utcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓	
NumberofMatches(l)=44		Relationship:High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-VI

CourseCode:20UBT6CP6
InstructionHours: 5
Credits:4

ExamHours:3
InternalMarks:25
ExternalMarks: 75

COREPRACTICAL-VI MICROBIAL BIOTECHNOLOGY(P)

Courseoutcomes

- This course the students will get hands on exposure on strain selection, fermentation, upstream & downstream the product.
 - Acquired knowledge about isolation of industrial important microorganism and various industrial production
 - To understand the various downstream processing methods and production of industrially significant products in fermentation.
 - Acquired knowledge about immobilization methods
 - Acquired knowledge about various techniques
1. Isolation of industrially important microorganisms.
 2. Selective isolation of actinomycetes -study their growth characteristics.
 3. Isolation and enumeration of lactic acid bacteria.
 4. Ethanol production by yeast.
 5. Estimation of alcohol content by colorimetric method and GLC.
 6. Wine production by yeast-setting up a lab experiment.
 7. Wine production by various methods.
 8. Enzyme production-amylase production.
 9. Enzyme production-Protease production.
 10. Production of organic acids-Citric acid production by solid state fermentation.
 11. Antibiotic production by different strains of microbes(Theory).
 12. Test for sensitivity of microorganisms.
 13. Down stream processes of enzymes-dialysis.
 14. Immobilization of yeast cell by alginate beads
 15. Isolation & identification microbes from spoiled food.
 16. Production of yogurt, butter.
 17. Visit to Distillery unit; alcohol production and pharmaceutical industries. Pasteur Institute(Field Visit)

Total Number of Topics	Local	Regional	National	Global	Category Based on %
17	3	3	8	3	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. E.Mans,E.M.T.andC.F.A.Bryce,Taylorand Francis,UK.2002.FermentationtechnologyandBiotechnology.
2. Ghose,T.KandP.Ghose. 2003.Biotechnologyin India.SpringerPublishers,India.
3. Glazer,A.NandH.Nikaido.1995.MicrobialBiotechnology. W.H.FreemanandCo.,NewYork.
4. Stanbury,P.F.,A.WhitakerandS.J.Hall. 1995.PrinciplesoffermentationTechnology, Pergamon,UK.
5. Wolf.Cruzer andAnnaliseCruzer.2000.BiotechnologyTextBookofIndustrialMicrobiology.Panima PublishingHouse,NewDelhi.
7. Patel,A.H.2001.IndustrialMicrobiology.MacmillanIndiaLtd.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
VI	20UBT6CP6	MicrobialBiotechnology-Lab					5	4				
CourseO utcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓		✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
NumberofMatches(ℓ)=46Relationship:VeryHigh												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-VI

Course Code:20UBT6MBE2:1
InstructionHours: 6
Credits:5

ExamHours:3
InternalMarks:25
ExternalMarks: 75

MAJORBASEDELECTIVE- II FOOD TECHNOLOGY

Courseoutcomes

- To gain knowledge on the basic principles of food processing and the various methods used to process foods
- To be aware of the processed food products available in the market.
- To know about Foodborne diseases.
- To help the students to understand about the industrial food process and consumer safety
- To understand the basic principles of processing and the unit operation employed in a food processing plant.

UNIT-I

Introduction to Food Biotechnology-Microorganisms associated with food, bacteria, fungi and yeast- Principle of Fermentation process-Enzymes in food preparation -Food contaminations- Food preservation-Food carcinogens & mutagen-N nitrosamines, Acrylamide- their mode of action- Application in Food Industries, Pharmaceuticals, Agriculture, and Waste Utilisation.

UNIT-II

Food processing and preservation-Food borne diseases-Food Allergens-Antioxidants-Food colors (natural & artificial food colourants)- Food flavoring agents- Properties & function of Emulsifiers & Stabilizers in food- Food Sweeteners, Saccharine, Acesulfane, Aspartame & Sucrose.

UNIT-III

Production of food products , Bread, Dairy, Confectionery and Beverages -General principle, plant design, construction, functionality of building, Plant layout- Pestproofing/ fumigation methods- Water supply to food processing unit.

UNIT- IV

Food engineering operations - Characteristics of food raw materials, preparative operations in

food industry, cleaning of food raw materials, sorting of foods, grading of foods- Sensory evaluation of food quality- quality factors for consumer safety.FSSA, HACCPFD- Food waste management-

UNIT-V

Cleaning and sanitation of process plants- Classification & Characterization of waste from food industry- Treatment methods for solid & liquid waste- Genetically Modified Food ,Bovine somatotropin, alpha lactalbumin& lactoferrin in milk- Edible vaccine (Cholera vaccine ,potatoes & Hepatitis B vaccine & maize).

Total Number of Topics	Local	Regional	National	Global	Category Based on %
31	11	6	23	12	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. B.Siva2011.FoodProcessing&Preservation-PHILearningPvtLtd.

References

1. D.G. Rao,2010.FundamentalsofFoodEngineering -PHI LearningPvtLtd.
2. Narang,FoodMicrobiology.
3. MichaelP.Doyle,Larry.R.FoodMicrobiology -Fundamentals&Frontiers
4. Frazier,FoodMicrobiology.
5. YiuHui&G.Khachatourians,FoodBiotechnology.
6. Ibek,Laramie&Bhunia, FundamentalsofFoodMicrobiology,CRCPress.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse	Hours	Credits
VI	20UBT6MBE2:1	Foodtechnology	6	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓		✓	✓	✓
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓		✓	✓	✓	✓	✓
Number of Matches (l)=45 Relationship: Very High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-VI

Course Code:20UBT6MBE2:2
InstructionHours: 6
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

MAJOR BASED ELECTIVE- II

ENZYME TECHNOLOGY

Courseoutcomes

- Acquiretheknowledgeabouthistory,classification,purificationandseparationofenzymes
- Describethemechanismofenzymeactionandconstructtheknowledgeonenzymeregulation.
- To enable the learner to realize the importance of enzymes in daily life, the properties ofenzymes, the use of enzymes in industry, research and human health, and methods for thediscoveryofnovelenzymes willbethoroughlyexplored
- Tocreateabasicunderstandingoftheimportanceofenzymesascellularcatalysts.
- Appraiseaboutthetechniquesofimmobilizationandapplicationinenzymes inindustries.

UNIT- I Enzyme Introduction

Enzyme Introduction-Classification, nomenclature & general properties-factors, affecting enzyme action pH, Temp, ions, substrate concentration, enzyme concentration-inhibitors, extraction, assay and purification of enzymes-units of activity and kinetics of enzyme catalysed reactions-The transition state.

UNIT-II Steady state kinetics

Steady state kinetics-Bi substrate and multi substrate reaction -enzyme catalyzed Reaction-different types of inhibitors and activators-Michaelis Menton (MM equations)Lineweaver and burke equations- k_m , k_{cat} and k_i value, enzyme specificity-absolute and rigid Specificity-nucleophilic and electrophilic attack.

UNIT-III Role of coenzyme in enzyme catalysis

Role of coenzyme in enzyme catalysis - Coenzyme regeneration, mechanism of enzyme action, e.g. Lysozyme, chymotrypsin, DNA polymerase, ribonuclease, LDH and Zymogen - Enzyme activation - allosteric enzymes and metabolic regulations - Clinical and industrial uses of enzymes.

UNIT-IV Techniques of enzyme immobilization and their applications

Techniques of enzyme immobilization and their applications-Medical, food, leather, Textile and paper industries -Enzyme Engineering-Biosensors,types and its application.

UNIT- V Industrial utilization of enzymes

Industrial utilization of enzymes -Applications of industrial enzymes- Enzyme production mechanism-Use of soluble enzymes-enzyme reactors, membrane reactors, continuous flow - packed bed reactors-large scale application of microbial enzymes in food and allied industries-Enzyme therapy.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
29	9	6	11	16	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. RenugaHarekrishnanBiomoleculesandEnzymes,
2. ThomasMDevlin.TextbookofBiochemistrywithClinicalCorrelations,7thedition,Wileypublis her.2010.
3. AlbertLLehninger, DavidLNelsonandMichaelMCox.
LehningerPrinciplesofBiochemistry,2ndedition,Wileypublisher.2010.
4. SathyanarayanaUandChakrapaniU.Biochemistry,4thedition,Elsevierpublishers. 2013.

References

1. Blazej,a.&Zemek.j.1987.InterBiotech,87,Enzymetechnologies,Elsevier.
2. Murraymoo-
Young.1988.Bioreactorimmobilizedenzymeandcells.Fundamentalsandapplications,elseyl er,appliedscience.

3. Rehm, h. j. and Yeed, g. 1988. Biotechnology, Vol. 7a, Enzyme technology, Elsevier.
4. William, b. Jakoby, 1984. Methods in Enzymology, vol. 104, enzyme purification and related techniques.
5. Charlotte W Pratt and Kathleen Comely. Essential Biochemistry, 3rd edition Wiley publisher. 2013.
6. DeBAC. Fundamentals of Biochemistry, 10th edition, New Central Book Agency (p) ltd, London. 2011.
7. Rajagopal G. Concise text book of Biochemistry, 2nd edition, Ahuja Publishing House. 2010.
8. Reginald H Garrett and Charles M Grisham, 5th edition. Biochemistry, Brooks Cole publishers. 2012.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	20UBT6MBE2:2	Enzyme technology					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓	✓	
CO3	✓		✓	✓	✓	✓	✓	✓		✓	
CO4	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches (I)=44		Relationship: High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-VI

Course Code:20UBT6MBE2:3
InstructionHours: 6
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

MAJOR BASED ELECTIVE - II **BIODIVERSITY AND CONSERVATION**

Courseoutcomes

- Toacquireknowledgewithrespecttobiodiversity,its threatsanditsconservationandappreciatethe conceptofinterdependence.
- Tobeawareofthenationalandinternationalconcernforprotectingtheenvironment.
- Toobservetheorganization,functionalmorphologyanddiversityofrepresentativePlant andanimal.
- Tostudythefundamentalknowledgeaboutendangeredplantand animals
- Improvethenewdiscoveryandcommercializationofnewproductsbasedonbiologicalresources.

UNIT-I Biodiversity

Biodiversity, Definition, Types - Diversity of Genes (genetic diversity)species (species diversity) and ecosystems (ecosystem diversity) - Genetic diversity, Nature and origin of genetic variation - The need for preservation of wild relatives of domestic animals - Centres of origin of domesticated animals - Species diversity- Measurement, concepts, richness and turnover -Species-area relationships -Global distribution of richness -Centres of species diversity - Mega diversity centres - Hot spot analysis.

UNIT-II Loss of biodiversity

Loss of biodiversity-Species extinction-Fundamental causes-Deterministic and stochastic processes - Current and future extinction rates -Methods of estimating loss of biodiversity -Threatened species -The IUCN threat categories (Extinct, Endangered, Vulnerable,Rare, Intermediate, and Insufficiently known), The threat factors (Habitat loss, Over exploitation for uses, introduction of exotics, Diseases Habitat fragmentation etc.), Common threat animal taxa of India-Red data books.

UNIT-III Uses and values of Biodiversity

Uses and values of Biodiversity-Uses of bio resources- animal uses; food animals (terrestrial and aquatic)-non food uses of animals, domestic livestock, Values of Biodiversity- Instrumental (Goods,Services, Information and Psycho spiritual values), inherent or intrinsic values, ethical and aesthetic values-An outline account on methods of valuing biodiversity.

UNIT-IV Conservation and sustainable management

Conservation and sustainable management of Biodiversity and Bioresources-National policies and instrument relating the production of the wild / domesticated fauna as well as habitats-International policies and Instruments - A general account on multilateral treaties-the role of CBD, IUCN, IBPGR,NBPGR, WWF, FAO, UNESCO AND CITES- Bioresources-Biotechnology and intellectual Property Rights - An elementary accounton WTO,GATT and TRIPs, Bioprospecting and IKS-Bio privacy rights of farmers, breeders and indigenous people -An elementary account on biodiversity/ bio resources data.

UNIT-V Conservation of biodiversity

Conservation of biodiversity, Current practices in conservation-Habitat orecosystem approaches- Biodiversity research- Species protection areas in india and global-Species based approaches, Social approaches, Chipko movement- *In situ* (Afforestation, Social forestry, Agro forestry, Zoos, Biosphere reserves, National parks, Sanctuaries), *exsitu* (Cryopreservation, Gene banks, Sperm banks, DNA banks,Tissue culture and Biotechnological strategies) -Eco restoration, environmental and biodiversity laws, environmental education.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
54	9	12	22	11	National

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1.Gaston,K.J.1996.Biodiversity:Biologynumbersand Difference.Blackwell

References

1. Primack,R. B.1993.EssentialsofConservationBiology, SinauerAssociates,USA

2. Meffe,G.K.andC.R.Carroll.1994.PrinciplesofConservationBiology,SinauerAssociates,USA.

3. Groombridge,B.1992.GlobalBiodiversity.StatusoftheEarth'sLivingResources.Chapman andHall,London.

4. Mittermeier, R.A., Meyers, P.R., Giland C. G. Mittermeier 2000. Hotspots: Earth
5. Biologically richest and most endangered Terrestrial Ecoregions. Cemex/Conservation International, USA.
6. Soule, M.E. 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
7. Reaka-Kudla, M.L., D. E. Wilson and E.O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
8. Clark, T.W., R.P. Reading and A.L. Clarke 1994. Endangered Species Recovery: Finding the Lessons, Improving the process. Island Press, Washington, DC.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
VI	20UBT6MBE2:3	Biodiversity and conservation					6	5				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓			
CO4	✓		✓	✓	✓	✓	✓	✓	✓	✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches (I) = 46		Relationship: Very High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER- VI

Course Code:20UBT6MBE3:1
InstructionHours: 6
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

MAJOR BASED ELECTIVE - II ENVIRONMENTAL BIOTECHNOLOGY

Course outcomes

- To understand the treatment of wastewater and solid waste management.
- To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.
- To know the basic concept and issues of environmental pollution biotechnological treatment to clean up polluted environments and to create valuable resources for the human society.
- To gain knowledge on the importance of environmental education and ecosystem.
- To be aware of the national and international concern for protecting the environment.

UNIT-I

Basic components of environment, Definition, concept and scope of ecosystem, abiotic and biotic components- Basic Concepts, Interactions between environment and biota- Concept of habitat and ecological niches- Limiting factor; Ecosystem dynamics and management: Stability and complexity of ecosystem- Energy flow, food chain, food web and trophic level- Ecological pyramids, Population ecology- recycling, biotic community- concept, structure, dominance, fluctuation and succession; N.P.C and S cycles in nature.- Population ecology - community structure- Principles of conservation; Speciation and extinctions Conservation strategies; sustainable development. - Environmental impact assessment

UNIT-II

Environmental Pollution - Effects and control of Water pollution- Water Pollution: Sources of pollution. Industrial effluents, Domestic wastes, Agrochemical, Heavy metals - Bhopal disaster, Chernobyl tragedy- Water pollution analysis and monitoring - prevention and control of water pollution- Soil pollution, sources, effects and its control- Air pollution, sources, air pollutants, effects and control measures- Ozone depletion and global warming- Air pollution analysis and monitoring- Noise pollution, Radioactive pollution- Thermal pollution and their Sources, effects, prevention and control measures.

UNIT-III

Bioremediation and Bio leaching, Environmental impact of pollution and measurement methods- Microbial bioremediation of oil spills and toxic metalions- Phytoremediatio- Microbial leaching of ores, direct and indirect mechanisms- Genetic Engineering in Environmental Biotechnology- Role of Genetically engineered microorganisms in environment. Waste water treatment-sewage treatment and common industrial effluent treatment; Concepts of bioremediation (in situ and ex situ), Bioremediation of toxic metal ions - biosorption and bioaccumulation principles, Concepts of phytoremediation. Microbial biotransformation of pesticides and xenobiotics; Microbial leaching of ores - direct and indirect mechanisms.

UNIT-IV

Biomass energy , Biomass waste as renewable source of energy- Conversion of Solid Waste to Methane (Biogas production)- solid waste management and Industrial waste watermanagement-Management of Sludge and Solid waste treatment -Land filling, Composting and VermiComposting.

UNIT-V

Biodiversity Definition, Types- Diversity of Genes (genetic diversity) species (species diversity) and ecosystems (ecosystem diversity)- Conservation of biodiversity, Current practicesin conservation.- Biodiversity reserve - *In situ* (Afforestation, Social forestry, Agro forestry, Zoos, Biosphere reserves, National parks, Sanctuaries)-*ex situ* (Cryopreservation, Gene banks, Sperm banks, DNA banks, Tissue culture and Biotechnological strategies) - Ecorestoration, environmental and biodiversity laws, environmental education.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
45	16	28	13	25	Regional

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. JogdandSN.EnvironmentalBiotechnology.2010.HimalayaPublishingHouse.NewDelhi.
2. Gaston, K.J.1996.Biodiversity:BiologynumbersandDifference. Blackwell.
3. Prescott,Harley,Klein.2003.Microbiology.5thEdition.McGrawHillPublication.

References

1. AlanScragg.1999.EnvironmentalBiotechnology.PearsonEducationLimited,England.
2. Jogdand,S.N.1995.EnvironmentalBiotechnology.HimalayaPublishingHouse,Bombay.
3. Chatterji AK. Introduction to Environmental Biotechnology. Prentice-Hall of IndiaPrivate Limited.2005.
4. Primack,R. B.1993.EssentialsofConservationBiology, SinauerAssociates,USA
5. Reaka-Kudla,M.L.,D.E.WilsonandE.O.Wilson1997.BiodiversityII:Understandingand

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
VI	20UBT6MBE3:1	EnvironmentalBiotechnology					6	5				
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO2	✓	✓		✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		✓	✓	✓		✓		
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

NumberofMatches(ℓ)=46	Relationship:VeryHigh
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Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-VI

Course Code:20UBT6MBE3:2
InstructionHours: 6
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

MAJORBASEDELECTIVE-III CANCER BIOLOGY

Courseoutcomes

- To explore the cellular and molecular mechanisms underlying cancer development with the aim of understanding how changes in the normal growth and division processes lead to the formation of tumours.
- To acquire knowledge about Carcinogens
- To know about Cell Cycle regulation
- To know the knowledge of molecular and genetic basis of cancer.
- To understand the current concepts of cancer, including cancer diagnosis, cancer treatment and prevention

UNIT-I

Introduction, Growth characteristics of cancer cells -Historical Aspects of Cancer- Morphological and ultra structural properties of cancer cells -Types of growth, hyperplasia, dysplasia, anaplasia and neoplasia- Nomenclature of neoplasm - Differences between benign and malignant tumor-Types of cancer-Epidemiology of cancer.

UNIT-II

Biology, Genetic Factor, Viruses, Hormones. Life style and Dietary factors Tobacco, Alcohol and Cigarette - Cancer biology and biochemistry- Aberrant metabolism during cancer development - Paraneoplastic syndromes - Tumormarkers; cellular proto oncogenes oncogene activation -Growth factors EGF, TNF α and TGF β , growth factor receptors, Signal transduction in cancer-Role of transcription factors.

UNIT-III

Carcinogenesis, radiation and chemical carcinogenesis-Cell Cycle Regulation in Cancer Cell, Cyclin Dependent Protein Kinase-stages in chemical carcinogenesis, Initiation, promotion and progression - Free radicals, antioxidants in cancer;Viral carcinogenesis - DNA and RNA Viruses and human cancer - Cancer endocrinology.

UNIT-IV

Cell Cycle Regulation - Tumor suppressor genes p53, p21, Rb, BRCA1 and

BRACA2, Telomeres, Telomerase, and Immortality - Cell to cell interactions, cell adhesion, invasion and metastasis, VEGF signaling, angiogenesis- Epigenetics, Role of DNA methylation in gene silencing, epigenetic silencing of tumor-suppressor gene- Apoptosis in cancer, Cell death by apoptosis, role of caspases - Death signaling pathway, mitochondrial and death receptor pathways.

UNIT-V

Strategies of anticancer drug therapy- Chemotherapy gene therapy. Immunotherapy and Radiotherapy -Tumor therapy-Stem Cells and Cancer- Clinical Examination, Biopsy, Blood Test, Bone marrow Aspiration, Pap Test. Imaging X ray, CT Scan, MRI Scan, Endoscopy and Mammography - Dietary Supplement, Retinoid, Carotenoids, Vitamin D, Soy Products, Life style Practice, Yoga and Exercise.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
35	12	4	14	16	Global

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. The Biological Basis of Cancer: R.G. McKinnell, R.E. Parchment, A.O. Perantoni, G. Barry Pierce, I. Damjanov. 2nd Edition, Cambridge University Press, 2006.
2. The Biology of Cancer: R.A. Weinberg. Garland Science. 2006.

References

1. The Molecular Biology of Cancer: S. Pelengaris, M. Khan. Blackwell Publication. 2002.
2. The Cancer Handbook: Malcolm R. Alison. Nature Publishing Group.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits
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VI	20UBT6MBE3:2	CancerBiology				6	5			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓		✓	✓	✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓	✓	✓	✓		✓	✓
CO4	✓	✓	✓		✓	✓	✓		✓	✓
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓
NumberofMatches(ℓ) =44Relationship:High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29 *	30-34 **	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-VI

Course Code:20UBT6MBE3:3
InstructionHours: 6
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

MAJORBASEDELECTIVE-III STEM CELLBIOLOGY

Courseoutcomes

- To strengthen the knowledge of students on Stem cell basics and their applications for the benefit of mankind
- To acquire knowledge about Embryonic Stem Cells and Adult stem cell
- To impart knowledge about stem cell culturing and stem cell signaling
- To know about Stem cell policy, ethics and stem cell research.
- To acquire knowledge about Gene therapy

UNIT-I Stem Cells

Introduction, Tissue organization, Stem cells Sources - Unique properties of stem cells classification-Embryonic stem cells adult stem cells - similarities and differences between adult and embryonic stem cells - Functional characterization-Stem cell preservation methods.

UNIT- II Embryonic Stem Cells

Stem cells and their developmental potential-In vitro fertilization-culturing of embryos-Recent trends in stem cell development-Blastocyst inner cell mass- isolation and growing ES cells in lab- Identification, characterization of human ES cells- Cloning and controlled differentiation of human embryonic stem cells, Applications of Embryonic stem cells- Gene knock in, Gene knock out, Ethical issues.

UNIT-III Adult Stem Cells

Somatic stem cells - test for identification of adult stem cells -adult stem cell differentiation-transdifferentiation plasticity- different types of adult stem cells-liver stem cells, skeletal muscle stem cells, bone marrow derived stem cells-Stem cell specific transcription factors- Induced pluripotent cells.

UNIT-IV Cancer Stem Cell Signaling

Introduction, Tumor stem cells - Breast Cancer Stem Cells - Identification, Signaling pathways-Notch signaling- Wnt signaling in stem cells, cancer cells.

UNIT-V Stem Cells InTissueEngineering

Introduction, Biomaterials – Cell and biomaterial interactions-Haematopoietic Stem Cells- Mesenchymal stem cells-Bone tissue engineering-Cartilage tissue engineering-Cardiovascular tissue engineering-Neuraltissue engineering-Therapeutic applications.

S

Total Number of Topics	Local	Regional	National	Global	Category Based on %
46	20	10	9	6	local

*Colour indicates -Green-Local, Pink-Regional, Blue-National, Brown-Global

2021

M.ScBIOTECHNOLOGY
CourseStructureandSyllabus

(Forthecandidatesadmittedfromtheacademicyear2021-2022onwards)

CHOICEBASEDCREDITSYSTEM(CBCS)

THANTHAIHANSROEVERCOLLEGE(AUTONOMOUS)

(ApprovedbyNAAC,AffiliatedtoBharathidasanUniversity)

ELAMBALUR,PERAMBALUR –621220



ThanthaiHansRoeverCollege(Autonomous),Elambalur,Perambalur-621220



M.Sc.,BIOTECHNOLOGY–CourseStructureUnderCBCS



(For the candidates admitted from the academic year 2021-2022 onwards)

Semester	Course Code	Title of the Course	Ins.Hours/Weeks	Credits	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
1	Core Course I(20PBT1CC1)	Cell Biology	6	4	3	25	75	100
1	Core Course II(20PBT1CC2)	General Microbiology	6	4	3	25	75	100
1	Core Course III(20PBT1CC3)	General Biochemistry	5	4	3	25	75	100
1	Core Course IV(20PBT1CC4)	Molecular Biology	5	4	3	25	75	100
1	Core Practical I(20PBT1CP1)	Cell Biology, Microbiology, Biochemistry & Molecular Biology(P)	8	4	3	40	60	100
Total			30	20	-	-	-	500
2	Core Course V(20PBT2CC5)	rDNA Technology	6	5	3	25	75	100
2	Core Course VI(20PBT2CC6)	Immunotechnology	6	5	3	25	75	100
2	Core Practical II(20PBT2CP2)	rDNA Technology & Immunotechnology(P)	8	4	3	40	60	100
2	Elective Course I 20PBT2EC1:1 20PBT2EC1:2 20PBT2EC1:3	1. Human Anatomy and Physiology 2. Biophysics 3. BioInstrumentation	5	5	3	25	75	100
2	Elective Course II 20PBT2EC2:1 20PBT2EC2:2 20PBT2EC2:3	1. Pharmaceutical Biotechnology 2. Cancer Biology 3. Bioinformatics	5	5	3	25	75	100

		Total	30	24	-	-	-	500
3	CoreCourseVII	PlantBiotechnology	6	5	3	25	75	100

	(20PBT3CC7)							
3	Core Course VIII (20PBT3CC8)	Animal Biotechnology	6	5	3	25	75	100
3	Core Practical III (20PBT3CP3)	Plant and Animal Biotechnology (P)	8	5	3	40	60	100
3	Elective Course III 20PBT3EC3:1 20PBT3EC3:2 20PBT3EC3:3	1. Biostatistics, Bioethics and IPR. 2. Marine Biotechnology 3. Genomics and Proteomics	5	5	3	25	75	100
3	Elective Course IV 20PBT3EC4:1 20PBT3EC4:2 20PBT3EC4:3	1. Biotechnology for Entrepreneurs 2. Dairy Technology 3. Stem Cell Basics and Application	5	4	3	25	75	100
Total			30	24	-	-	-	500
4	Core Course IX (20PBT4CC9)	Bioprocess Technology	5	5	3	25	75	100
4	Core Course X (20PBT4CC10)	Food Technology	5	5	3	25	75	100
4	Core Practical IV (20PBT4CP4)	Bioprocess and Food Technology (P)	8	4	3	40	60	100
4	Elective Course V 20PBT4EC5:1 20PBT4EC5:2 20PBT4EC5:3	1. Environment Biotechnology and Nanotechnology 2. Enzyme Technology 3. Quality Control and Hygienic Practices	5	4	3	25	75	100
4	Project Work* (20PBT4PW)	Project	7	4	-	-	-	100
Total			30	22	-	-	-	500
Grand Total			120	90	-	-	-	2000

List of Elective Courses

Elective	Course Code	Title of the Course
Elective-1	20PBT2EC1:1 20PBT2EC1:2 20PBT2EC1:3	1. Human anatomy and Physiology 2. Biophysics 3. BioInstrumentation
Elective-2	20PBT2EC2:1 20PBT2EC2:2 20PBT2EC2:3	1. Pharmaceutical Biotechnology 2. Cancer Biology 3. BioInformatics
Elective-3	20PBT3EC3:1 20PBT3EC3:2 20PBT3EC3:3	1. Biostatistics, Bioethics and IPR. 2. Marine Biotechnology 3. Genomics and Proteomics
Elective-4	20PBT3EC4:1 20PBT3EC4:2 20PBT3EC4:3	1. Biotechnology for Entrepreneurs 2. Dairy technology 3. Stem Cell Basics and Application
Elective-5	20PBT4EC5:1 20PBT4EC5:2 20PBT4EC5:3	1. Environment Biotechnology and Nanotechnology 2. Enzyme technology 3. Quality Control and Hygienic Practices

Note:

Project: 100
 Marks Dissertation: 80
 Marks Viva Voce: 20
 Marks

Core Papers -10
 Core Practical -4
 Elective Papers -5
 Project -1

1. Theory Internal 25marks External 75marks
 2. Practical " 40marks " 60marks

3. Separate passing minimum is prescribed for Internal and External

a) The passing minimum for CIA shall be 40% out of 25 marks (i.e. 10 marks)

b) The passing minimum for University Examinations shall be 40% out of 75 marks (i.e. 50 marks)

c) The passing minimum not less than 50% in the aggregate.

PROJECTWORK

Objectives

The student can get the knowledge to prepare the document, to implement tools for the specific problem and learn the industrial need programs for their placement.

S.No.	Work Description	Maximum Marks
1	Dissertation	80
2	Vivavoce	20
Total		100

Note:

PASSING MINIMUM –50 MARKS

I Review – December last week

- Confirmation letter from the company
- Project type & title
- Company profile
- Synopsis
- Contact number & mail of the external guide
- S/w selection

II Review – January 3rd week

- Data or System flow diagram
- Documentation of first three chapters
- Database design
- Input design – Forms
- Output design – Reports

III Review – February 3rd week

- Complete coding
- Test plan with demo
- Rough documentation of the entire project

IV Review – March 1st week

- Corrected rough draft
 - Explanation of the entire project
 - Execution of Implementation Work
-
- Attending all the review is compulsory
 - PPT and necessary Documentations should be brought for each Review
 - Font size in documentation has to be 12, Times New Roman, Space 1.5
 - Document should be neatly aligned and justified
 - No change can be made in the review marks later
 - Internal mark will be submitted at the same day of review to controller section.
-

THANTHAIHANSROEVERCOLLEGE(Autonomous)

Programme Outcomes(POs)

Postgraduate Programmes

Upon completion of the programme, the postgraduate will be able to

1. Gain advanced knowledge resulting in entrepreneurship; innovation and newer opportunities for being employable in public and private sectors, research and development organizations
2. Apply enhanced new techniques and adopt new technologies needed in the respective disciplines
3. Appreciate the diversity of behaviour in professional practice and act in accordance with the core values of chosen profession.
4. Demonstrate the knowledge, values and skills to be critical consumer of research practice and possess investigative skills to evaluate the practice
5. Engage in lifelong learning process, have the ability to communicate the findings of Languages Commerce Management Studies Social Work/Computing Sciences/Physical Sciences/Biological Sciences/Life Sciences with the current knowledge

M.Sc., Biotechnology- Programme Specific Outcomes(PSO's)

1. Basics and current updates in the areas of Biochemistry, Molecular biology, Plant tissue culture, Genetic Engineering, Bioinformatics rDNA, Industrial Biotechnology, Fermentation Technology, Agriculture & Environmental Biotechnology are included to train the students and also sensitize them to scope for research.
2. The Masters in Biotechnology Programme will address the increasing need for skilled scientific manpower with a understanding of research ethics involving animals and humans to contribute to application, advancement, and improvement of knowledge in the field of biotechnology globally.
3. An ability to conduct experiments, as well as to analyze data, understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
4. An ability to acquire the skills in handling scientific instruments, planning and performing in laboratory experiments to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability in biotechnology.
5. Graduates will exhibit contemporary knowledge in Biotechnology and will be eligible for doing jobs in pharmaceutical and biotechnological Industry and also graduates who attain professional leadership role.

SEMESTER-I

CourseCode:20PBT1CC1
InstructionHours:6
Credits:4

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

CORE COURSE – I

CELL BIOLOGY

Course outcomes

- To know fundamental knowledge about Prokaryotic and eukaryotic cell
- Understand the cell organelles and its functions
- Acquire knowledge about the structural and a functional aspect of the cell provide the student with a strong foundation in the molecular mechanisms underlying cellular function.
- To get knowledge about structure and function of cells, cellular signalling, protein trafficking, biomolecules and cellular development.
- Students after completion of this paper will be exceptionally well prepared to pursue careers in cellular and subcellular biological research, biomedical research, or medicine or allied health fields

UNIT- I Cell structure

Introduction to cell: Prokaryotic, and eukaryotic cell. Bion, viroid, mycoplasmas and cyanobacteria (gene organization only)-Difference between plant and animal cell at different level - **Plasma Membrane:** The lipid layer, membrane proteins, membrane carbohydrate, membrane transport of small molecules, cell adhesion, cell junction and extra cellular matrix-**Cell Wall:** Chemical composition, crosslinkage, porosity, tensile strength, turgor modifications in special types of cells. Plasmids and fluid transport between cells.

UNIT-II Cell Organelles

Endoplasmic Reticulum: Types, rough & smooth. Ultra structure. Role in compartmentalization, intracellular transport & lipid biosynthesis -**Ribosomes:** Ultra structure, general chemistry, assembly and function -**Golgi Apparatus:** Structure and functions-**Mitochondria:** Ultrastructure and membrane organization. Role of mitochondria in cellular energies & biogenesis - **Chloroplast:** Structure and function. Photosynthesis. Photosynthetic units and reaction centers. Photophosphorylation. CO₂ fixation and synthesis of carbohydrates. Importing proteins in chloroplast and biogenesis -**Lysosomes:** General organization, polymorphism, enzyme systems and their functions. Vacuoles and gastic substances -**Peroxisomes:** Formation, enzyme content and role.

UNIT-III Nuclear Material

Cytoskeleton: Microtubules, microfilaments & associated proteins- actin, myosin and intermediate filaments. 3 dimensional organization of cytoskeleton -**Nucleus:** Nucleus, nuclear envelope, nucleoplasm, chromatin and chromosomes. Nuclear division.

UNIT-IV Organization of Chromosomes, Cell Division & Cell Cycle

Specialized chromosomes, chromosomal abnormalities and qualitative inheritance - Population genetics and developmental genetics using *Drosophila melanogaster* as model system - Somatic cellgenetics. **Cell Division:** Mitosis, meiosis and binary fission - **Cell cycle, cell cycle clock & checkpoints-Cell Cycle and Cell Growth Control:** Overview of cell cycle - molecular mechanisms forregulating mitotic events, check points in cell cycle regulation - meiosis cell birth, lineage and death;Cancer -genetic basis of cancer; Oncogenes and tumour suppressor genes.

UNIT-VMicrobialCellBiology

Structural organization of prokaryotic cell. Cell appendages, cilia, pili, fimbriae & flagella-Role of cell appendages-Cell wall structure and bacterial surface layers-Nan a enzymes in bacteria-Toxin producing bacteria-Cytoplasm. Bacteria as example for prokaryote-Eukaryotic cell organization – filamentous fungus and yeast as example.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
30	14	5	18	6	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1. FreifelderD.1985.MolecularBiology,NarosaPublishingHouse.NewDelhi.
2. LewinB. 2007. GenesIX. OxfordUniversityPress,London.
3. AjoyPaul.2011.TextbookofCelland Molecular Biology.Booksand AlliedLtd.
4. BruceAlberts,AlexanderJohnson,JulianLewis,MartinRaff,KeithRoberts,andPeterWalter.2008.Molecul ar BiologyofCell.6thEdition.Garland Science,Taylor&FrancisgroupPublishers.
5. HarveyLodish,ArnoldBerk,SLawrenceZipursky,PaulMatsudaira,DavidBaltimore,andJamesDarnel l.1995.MolecularCellBiology.3rdEdition.W.H. FreemanPublishers.

References

1. WatsonJD,GilmanM,WitkowskiJandZollerM.1992.RecombinantDNA.ScientificAmericanBook s.2ndEdition.NewYork.
2. BlackburnGMandGaitMJ.1996.NucleicAcidsinChemistryandBiology.OxfordUniversityPress.

3. Lodish H, Baltimore D, Beck A, Zipursky SL, Matsudaira P and Darnell J. 1995. Molecular Cell Biology. Scientific American Books.
4. Cooper M 1995. The Cell Molecular Approach. 2nd Edition. ASM Press.
5. Lewis J, Kleinsmith and Valerie M Kish. 1980. Principles of Cell and Molecular Biology 2nd Edition. Benjamin-Cummings Publishing Company.
6. DeRobertis, E D and E. M. F Robertis. 1980. Cell and Molecular Biology. 7th Edition. Saunders Company.
7. T. A. Brown. 2011. Introduction to genetics: A molecular approach. 1st Edition. Garland Science.
8. J. D. Watson, Tania A. Baker, Stephen P. Bell, Michael Levine and Richard Losick. 2013. Molecular Biology of the Gene. 7th Edition. Benjamin/Cummings Publ. Co., Inc., California.
9. Benjamin Lewin. 2008. Genes XI. 9th Edition. Jones & Bartlett Learning.
10. R. A. Meyers. 1995. Molecular Biology and Biotechnology. A comprehensive desk reference. (Ed) Wiley-Blackwell Publishers.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
I	20PBT1CC1	Cell Biology					6	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO5	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Number of Matches (✓) = 44 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

CourseCode:20PBT1CC2
InstructionHours:6
Credits:4

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

CORECOURSE-II GENERAL MICROBIOLOGY

Courseoutcomes

- ToenablethestudentstounderstandthebasicknowledgeinMicrobiology
- Receiveafundamentalknowledgeonmorphologyandfunctionsofmicrobes
- Toimparttheknowledgeonmicrobialclassificationandtaxonomy
- Impartingideasoncultivationmethodsofmicrobes
- Obtainingknowledgeaboutpreservationmethodsofmicrobes

UNIT-I Ultrastructure and function

Bacteria: Morphological types, cell wall-cell walls of Gram negative, Gram positive, halophiles Lforms- Bacterial virulent enzymes-Archaeobacteria, Cell wall synthesis, cell membrane, capsule type's composition and function - Structureand function of flagella, fimbriae and pili, gas vesicles - chlorosomes, carboxysomes, magnetosomes and phycobilisomes - Reserve food materials polyhydroxybutyrate, polyphosphates, cyanophycin and sulphur inclusions .Nuclear material – bacterial chromosomes and bacterial plasmids.

UNIT-II Microbial Classification

Microbial Taxonomy-Definition and systematic – Nomenclature and identification. Haeckel's three kingdom classification - Whittaker's five kingdom approach - Three domain classification; Taxon, species, strain, type culture - Major characteristics used in taxonomy - morphological, physiological, metabolic, serological and molecular - Phylogenetic relationships - Cladogram, Dendrogram; Classification and salient features of bacteria according to Bergey's Manual of Determinative Bacteriology(9thedition).

UNIT- III Fungi and Viruses: Fungi: Classification of fungi based on Alexopoulos system.

Characteristics of Fungi - Filamentous, non filamentous and dimorphic fungi - Morphology, structure and life cycle of *Aspergillus niger* and *Saccharomyces cerevisiae* - Parasitism, mutualism and symbiosis with plants and animals - Industrial uses of yeast and moulds - Viruses: ICTV system of classification, General properties, Morphology and ultra-structure of virus -capsid and their arrangements-viral culture method-Antiviral treatment-types of envelopes and their composition - viral genome(RNA,DNA);Viroids, Prions - structure and importance.

UNIT- IV Algae and Protozoans

Classification of Algae based on Fritsch system -General characters of Bluegreen Algae (Cyanobacteria) Macroalgae – Biological and Economic importance of algae. Protozoa - structural characteristics, classification and reproduction.

UNIT-V Cultivation methods of microbes

Isolation of different types of bacteria - Fungi , Actinomycetes ,Cyanobacteria, Protozoa - Physical and Chemical requirements for growth - Pure culture methods - Anaerobic culture techniques -Preservation methods of microbes - Type of culture collections - Physical and chemical methods of controlling microorganisms.

S

Total Number of Topics	Local	Regional	National	Global	Category Based on %
42	11	18	22	10	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Alcamo E. Fundamentals of Microbiology. 6th Ed., Jones and Bartlett Publishers, New Delhi. 2001.
2. Dubey RC and Maheswari DK. A Text Book of Microbiology. S Chand, New Delhi. 2010.
3. Dube HC. Introduction to Fungi. Vikas publishing pvt. Ltd. New Delhi 2009.
4. Johri RM, Snehlatha, Sandhya Shrama. A Textbook of Algae. Wisdom Press, New Delhi. 2010.
5. Kanika Sharma. Textbook of Microbiology – Tools and Techniques. 1st edition, Ane Books Pvt. Ltd., New Delhi. 2011.
6. Pelczar TR, Chan ECS and Kreig NR. Microbiology. 5th Edition, Tata McGraw–Hill, New Delhi. 2006.
7. Salle AJ. Fundamental principles of Bacteriology. 7th edition, Tata McGraw-

HillpublishingcompanyLtd,NewDelhi.2001.

References

1. AlexopoulosCJ,MimsCWandBlackwellM.IntroductoryMycology.FiftheditionJohnWileyandSons. Chichester.2000.
2. HoltJS,KreigNR,SneathPHAandWilliamsST.Bergey'sManualofDeterminativeBacteriology(9thEdition),WilliamsandWilkins,Baltimore.1994.
3. MadiganMT,MartinkoJM,DunlapPVandClarkDP.BrockBiologyofMicroorganisms.12thEd.Pearson/PrenticeHall.2008.
4. PrescottLM, HarleyJPandKleinDA. Microbiology. 7thedition, McGrawHill, Newyork. 2008.
5. SchlegelHG.GeneralMicrobiology,CambridgeUniversityPress, UK.2008.

RelationshipMatrixfor COs,POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
I	20PBT1CC2	GeneralMicrobiology					6	4				
Course Outcomes (COs)	ProgrammeOutcomes(Pos)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
CO3	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
NumberofMatches(✓) =45Relationship:VeryHigh												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-I

CourseCode:20PBT1CC3
InstructionHours: 5
Credits:4

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

CORECOURSE –III

GENERALBIOCHEMISTRY

CourseOutcomes

- To provide the knowledge on structure and functions of the cell
- Attaining the fundamental concepts of enzymes and its inhibition
- To learn about the chemical nature of biological macromolecules
- Understanding the types and biosynthesis of macromolecules
- Acquire knowledge about bioenergetics and metabolism

UNIT-I Cell and its function

Cell and its function - Composition of living matter - Cell types and chemistry - Biochemistry of bacterial, animal and plant cell - Metabolism of microbes - Specialized components of microorganisms and their structure and function.

UNIT-II Enzymes

Enzymes: Enzymes as biocatalysts, enzyme classification, specificity, active site, unit activity, isozymes - Enzyme kinetics: Michaelis-Menten equation for simple enzymes - Enzyme inhibition-Enzyme synthesis concept

UNIT-III Types of macromolecules and their biosynthesis

Types of macromolecules and their biosynthesis - Structural features and chemistry of macromolecules. Nucleic acid - properties, biosynthesis of purines and pyrimidines - Structure of DNA and RNA - Proteins, classification – amino acids - primary, secondary, tertiary - quaternary and three dimensional structure of proteins - Carbohydrates, mono, di, oligo and polysaccharides - Lipid metabolism - Lipids and biomolecules: Fatty acids, properties - oxidation-biosynthesis of cholesterol.

UNIT-IV Bioenergetics

Bioenergetics: Bioenergetics and strategy of metabolism-flow of energy through biosphere, strategy of energy production in the cell. Oxidation-reduction reactions, coupled reactions and group transfer -ATP production, structural features of biomembranes-transport, free energy and spontaneity of reaction, G , G° , G' and equilibrium -Basic concepts of acids, base, pH and buffers.

UNIT- V Metabolism- basic Concepts

Metabolism - basic Concepts - Cell metabolism- catabolic principles and breakdown of carbohydrates- lipids, proteins and nucleic acids - vitamins and their role as coenzymes-Types of vitamins.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
38	11	7	20	18	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Donald Voet and Judith G. Voet. Biochemistry – Second Edition. John Wiley and Sons, Inc. 1995.
2. Freifelder D. Molecular Biology, II Edition, Narosa Publishing House, New Delhi. 1996.
3. Christopher K Mathews and Van Holde KE. Biochemistry. 2nd edition. The Benjamin/Cummings publishing company, Inc. 1996.
4. Geoffrey L and Zubay. Biochemistry. Fourth Edition. Wm. C. Brown Publishers. 1998.
5. Reginald H Garret and Charles M Grisham. Biochemistry (Second Edition) Saunders College Publishing. 1998.
6. Thomas M Devlin. Textbook of Biochemistry with clinical correlations. 5th edition. A John Wiley and Sons, Inc., publication, New York. 2002.
7. Rafi M D. Textbook of Biochemistry for medical students, 2nd edition, Universities Press, (India) Pvt. Ltd, Hyderabad, India. 2014.

References

1. David E Metzler and Carol M Metzler. Biochemistry - The chemical reactions of living cells - Vol. 1 and 2. 2nd edition. Harcourt/Academic press, New York. 2001.
2. Lehninger, Albert L, David L Nelson and Michael M Cox. Lehninger Principles of Biochemistry. New York: Worth Publishers. 2000.
3. Jeremy M Berg, John L Tymoczko and Lubert Stryer. Biochemistry. 5th edition. W. H. Freeman and company, New York. 2002.
4. Stryer L, Berg J M and Tymoczko J L. Biochemistry. 5th edition. New York: W. H. Freeman. 2002.
5. Trudy M Kee and James R M Kee. Biochemistry - An Introduction. 2nd edition. WCB McGraw-Hill, U.S.A. 1999.

RelationshipMatrixfor COs,POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
I	20PBT1CC3	GeneralBiochemistry					5	4			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
NumberofMatches(✓)=44 Relationship:High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-I

CourseCode:20PBT1CC4
InstructionHours: 5
Credits:4

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

CORECOURSE-V

MOLECULAR BIOLOGY.

Courseoutcomes

- To understand the basic structure and functioning of the genetic materials - DNA, RNA and to understand the changes in the genetic material and the consequences.
- Developed a fairly good knowledge about the three well known mechanisms by which genetic material is transferred among the microorganisms namely transformation, transduction and conjugation.
- Are able to describe different types of the extra chromosomal elements or the plasmids; the nature of the transposable elements in the prokaryotic and the eukaryotic cells.
- Acquired knowledge of gene, their expression and regulation of expression.
- Acquired a fairly good understanding mechanism of genetic exchange, mutations and their implications.

UNIT-I Introduction

Nucleic Acid, Bases, Nucleoside, Nucleotide Types-Millstones of Nucleic acid discovery-Overview of Molecular biology - discovery of DNA as genetic material and structure of DNA - Watson and Crick model-Chargaff concept-DNA & its types. RNA & its types -structure and function - **Chromosomes, chromatin and their function** - **Prokaryotic replication of DNA/RNA and enzymes involved** - **DNA repair mechanisms and recombination** - **DNA Replication** - Prokaryotic and Eukaryotic DNA replication - Mechanism of DNA replication. Enzymes & proteins involved in DNA replication-Models of replication Semi conservative, unidirectional, bidirectional, rolling circle mechanism -Inhibitors of DNA replication.

UNIT- II Central Dogma- Transcription & Translation.

Transcription -Prokaryotic transcription, transcription unit, promoters - constitutive and inducible, operators and regulatory elements - **Initiation, elongation, termination** -Rho dependent and independent and anti termination **Post transcriptional modifications** - Processing of hnRNA, tRNA, rRNA - 5' cap formation, 3' end processing and poly adenylation - Splicing, RNA editing - nuclear export of mRNA - mRNA stability and catalytic RNA -**Translation: Translation machinery, ribosomes, composition and assembly** - Universal genetic code, degeneracy of codons and termination codons - iso accepting tRNA and Wobble hypothesis - **Mechanism of initiation, elongation and termination** - Co and post translational modifications - Transport of proteins and molecular chaperones - Protein stability, protein turn over and degradation.

UNIT-III Mutation

Mutation - Types - Non sense mutation, missense mutation and point mutations - intragenic and intergenic suppression and frame shift mutations - Physical, chemical and biological mutagens - Transposition, mechanisms of transposition and role of transposons in mutation - Gene as unit of mutation and recombination - Molecular nature of mutation - mutagen and origin of spontaneous mutations - Gene transfer mechanisms - transformation, transduction, conjugation, transfection and their applications -Regulation in eukaryotes - gene loss, gene amplification, gene rearrangement - Regulation of synthesis of primary transcripts, transcriptional control by hormones.

UNIT-IV Extra-chromosomal hereditary materials & transposable genetic elements **Extra-chromosomal hereditary material Plasmids** - Biology of plasmids, discovery, types and structure of R, Rif, Col factors & Ti plasmids -Replication, incompatibility and copy number. Natural & artificial plasmids -Plasmid curing, plasmid transfer and their applications - **Transposable genetic elements:** Discovery, early experiments of Mc Clintock in maize. Insertion sequence in prokaryotes - Complex transposons (Tn10, Tn3 & Tn9 as examples) - Mechanisms, control - consequences and applications of transposition by simple & complex elements - transposable genetic elements in prokaryotes and eukaryotes and their uses in genetic analysis.

UNIT-V Genetic analysis of microbes

Genetic analysis of microbes –bacteria and yeast. Bacteriophages, Lyticphages -T7andT4. Lysogenic phages -I and P1, M13 and f X174 -Life cycle and their uses of microbial genetics - Microbial genetics and design of vaccines for BCG, TB and leprosy -DNA vaccine, designing and advantages.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
66	24	15	32	14	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1. AjoyPaul.2011.TextbookofCelland MolecularBiology.BooksandAlliedLtd.
2. BenjaminLewin.2007. GeneIX.9thEdition,JonesandBarlettPublishers.
3. J.D.Watson,N.H.Hopkins,J.WRoberts, J. A.Seitz&A.M.Weiner. 2007. MolecularBiologyofthe

4. Watson JD, Gilman M, Witkowski J, Zoller M. 1992. Recombinant DNA. Scientific American Books.

References

1. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter. 2014. Molecular Biology of Cell. Garland Science publication.
2. Burton E. Tropp. 2012. Molecular Biology – Genes to Proteins. Jones and Bartlett Publishers.
3. George M. Malacinski. 2013. Freifelder's Essentials of Molecular Biology. Norosa Publishing House.
4. Stanely R. Maloy, Jhon E Cornan Jr, David Freifelder. 1994. Microbial genetics. 2nd Edition. Jones and Bartlett publisher.
5. Sandy B. Primrose, Richard M. Twyman and Robert W. Old. 2008. Principles of Gene Manipulation. 6th Edition. Blackwell Science

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	20PBT1CC4	Molecular Biology					5	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓) = 46 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-I

CourseCode:20PBT1CP1
InstructionHours: 8
Credits: 4

ExamHours:3
InternalMarks: 40
ExternalMarks: 60

COREPRACTICAL-I

CELL BIOLOGY, MICROBIOLOGY, BIOCHEMISTRY & MOLECULAR BIOLOGY (P)

Course outcomes

- Students will get hands on experience in Cell Biology, Microbiology and Biochemistry & Molecular Biology Techniques.
- To learn about characteristics of cells, cell organelles and cell division and total & differential count of human blood cells
- Are able to perform basic experiments to grow and study microorganisms in the laboratory.
- Has acquired a fairly good knowledge of the tools and the laboratory skill for estimation of biomolecules.
- Students can perform isolation of DNA, amplification of any gene by PCR and its analysis by gel electrophoresis.

Cell Biology

1. Microtomy – (Demo).
2. Prokaryotic & eukaryotic cell-structure observation.
3. Cell count- prokaryotic & eukaryotic.
4. Types of cells - parenchyma, collenchyma, sclerenchyma, columnar epithelium, squamous epithelium.
5. Leishman staining
6. Giemsa staining
7. Total (WBC, RBC) & differential count of human blood cells.
8. Separation of Peripheral Blood Mononuclear Cells from blood.
9. Osmosis and Tonicity.
10. Cell Division- Cytological preparations of tissues (onion) for mitosis.
11. Cell Division- Cytological preparations of tissues (Tradescantia) for meiosis.
12. Cell Division- Binary fission of yeast
13. Polytene and diplotene chromosomes.
14. Temporary and permanent slide preparation.
15. Sub-cellular fractionation.

Microbiology

16. Microscopy- Observation of different microbes.
17. Sterilization techniques – physical, chemical, filtration and irradiation techniques.
18. Preparation of media – simple media and complex media.
19. Isolation of microorganisms from air, soil & water- spread plate, pour plate, streak plate techniques

20. Staining methods—simple, differential, acid- fast & negative
21. Identification—Macroscopic, microscopic, biochemical, serological & generic level.
22. Bacterial growth curve—colony counting, cell counting, spectrophotometric method.
23. Preservation & maintenance.
24. Viral culture method
25. Plating—different methods
26. Antibiotic sensitivity test—Kirby- Bauer method.

Biochemistry

27. Preparation of solutions—Molar, Normal, Percentage, Stock, Working etc.
28. Preparation of buffers— PBS, Tris and Acetate buffer.
29. Identification of sugars - reducing & non-reducing sugars.
30. Estimation of monosaccharine (glucose) by Nelson, Somogi method & polysaccharide (starch) by iodine method.
31. Estimation of amino acid by Ninhydrin method.
32. Estimation of protein by Lowry's method and Barford Method
33. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect.
34. Enzyme assay: Estimation of salivary amylase from saliva & phosphatase from potato
35. Estimation of DNA by diphenylamine and RNA by orcinol method.
36. Estimation of lipids- cholesterol, PUFA & steroid.
37. Estimation of vitamins—ascorbic acid, α -tocopherol & β -carotenoids.

Molecular Biology

38. Isolation and purification of genomic DNA from prokaryotes.
39. Isolation and purification of genomic DNA from eukaryotes.
40. Isolation and purification of plasmid DNA.
41. Observation of DNA -Agarose gel electrophoresis.
42. Quantification of nucleic acids—DNA & RNA—Chemical and UV method.
43. Separation of protein by SDS PAGE
44. Protein staining techniques. Amido black, coomassie brilliant blue & AgNO₃.
45. Transfer of protein—Western blot.
46. Observation of transferred protein—staining (Indian ink), immune blot.
47. Bacterial mutagenesis—physical & chemical.
48. Preparation of *E. coli* competent cells.
49. Transformation of bacteria—CaCl₂ method.
50. Bacterial conjugation.
51. Transduction.
52. Yeast Binary fission

Total Number of Topics	Local	Regional	National	Global	Category Based on %
52	24	19	6	3	Local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. S.Sadasivam.A.Manickam.1996.BiochemicalMethods.2ndEdition.NewAgeInternational (p)Ltd,Publishers.
2. Dr.G.Rajagobal.,Dr.B.D.Toora.2001.PracticalBiochemistry.1stEdition.AhujaBookCompany Pvt.Ltd.
3. J.Jayaraman.2000. LaboratoryManualinBiochemistry.NewAgeInternationalPublishers.
4. PlummerMu,DavidT.Plummer. 1988.IntroductiontoPracticalBiochemistry.TataMcGraw-HillEducation.
5. Gunasekaran,P.2009. Laboratory Manual in Microbiology.1st Edition.New AgeInternationalPublishers.Reprint2009.
6. Dr.T.Sundararaj.MicrobiologyLaboratory Manual.Dr.A.L.MPGIBMS,UniversityofMadras,Taramani,Chennai–600113.
7. ArnoldL.Demain&JulianE.Davies.1999.ManualofIndustrialMicrobiologyandBiotechnology. 2ndEdition.ASMpress.
8. M.Mooyoung.1985.ComprehensiveBiotechnology.Vol.2,3&4.Pergamonpress.
9. Dr.DavidAThompson. 2011.CellandMolecularBiologyLabManual.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
I	20PBT1CP1	CellBiology,Microbiology, Biochemistry&Molecular Biology(P)					8	4				
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CO4	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NumberofMatches(✓)=45 Relationship:VeryHigh										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-II

CourseCode: 20PBT2CC5

InstructionHours:6

Credits:5

ExamHours:3

InternalMarks: 25

ExternalMarks: 75

CORECOURSE-V

rDNA TECHNOLOGY

Courseoutcomes

- To understand the steps involved in recombinant DNA technology.
- Describe the mechanism of action and the use of restriction enzymes in biotechnology research.
- To get expertise in isolation of plasmids, cloning of gene and transformation into suitable bacteria for selection of recombinant clones.
- To conduct gene amplification experiments by PCR analysis and sequencing methods.
- To get insight in applications of recombinant DNA technology in agriculture, production of therapeutic proteins.

UNIT-I Basics Concepts

DNA structure and properties - Restriction enzymes - DNA ligase, Klenow enzyme - T4 DNA polymerase, polynucleotide kinase - alkaline phosphatase, cohesive and blunt end ligation - linkers, adaptors and homopolymeric tailing - Labeling of DNA - nick translation, random priming, radioactive and non radioactive probes - hybridization techniques - northern, southern and colony hybridization, fluorescence *in situ* hybridization - chromatin immuno-precipitation - DNA-protein interactions, electromobility shift assay - DNeI foot printing and methyl interference assay.

UNIT-II Cloning Vectors

Plasmids, bacteriophages, M13 mp vectors, PUC19 and blue script vectors - Phagemids, lambda phage vectors, insertion and replacement vectors - EMBL, cosmids, artificial chromosome vectors (YAC, BAC) - animal virus derived vectors - SV40 - vaccinia/ baculo & retroviral vectors - Expression vectors - pMal, GST and pET based vectors - Protein purification. His tag, GST tag, MBP tag etc. .intein based vectors, inclusion bodies - methodologies to reduce formation of inclusion bodies - baculovirus and pichia vectors system - plant based vectors - Ti and Ri as vectors, yeast vectors and shuttle vectors.

UNIT-III Cloning Methodologies

Insertion of foreign DNA into host cells - transformation, construction of libraries - isolation of mRNA and total RNA - cDNA and genomic libraries - cDNA and genomic cloning - expression cloning and protein-protein interactive cloning - Yeast two hybrid system - phage display and principles in maximizing gene expression.

UNIT-IV PCR and its Applications

Primer design, fidelity of thermo stable enzymes – DNA polymerases –types of PCR -multiplex - Nested reverse transcriptase, real time, touch down, hot start, and colony –Cloning of PCR products - T vectors, proof reading enzymes -PCR in gene recombination, deletion, addition, overlap extension, and site specific mutagenesis -PCR in molecular diagnostics, viral and bacterial detection -PCR based mutagenesis, mutation detection - SSCP, DGGE, RFLP, oligonucleotide assay(OLA) -Mismatch Chemical Cleavage(MCC) -Allele-Specific Amplification(ASA) and Protein Truncation Test(PTT).

UNIT -V Sequencing Methods

DNA sequencing - Enzymatic, chemical & automated DNA sequencing and RNA sequencing - Chemical synthesis of oligo nucleotides - introduction of DNA in to mammalian cells, and transfection techniques - Gene silencing techniques-Antisense RNA technology-Recent trends in RNA vaccine production-Recombinant vaccine production-Vaccine marketing-introduction to siRNA, siRNA technology,micro RNA - construction of siRNA vectors - principle and application of gene silencing - Gene knockouts and gene therapy - creation of knockout mice, disease model, somatic and germ line therapy - *in vivo* and *ex vivo*,suicide gene therapy - gene replacement and gene targeting -Transgenics,cDNA and intragenic arrays - differential gene expression and protein array.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
69	16	23	34	45	Global

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

- 1.S.B.Primrose,R.M.TwymanandR.W.Old.2001.PrinciplesofGeneManipulation.6thEdition.S.B.University Press.
- 2.J.D.Watson,N.H.Hopkins,J.W.Roberts,J.A.Seitz&A.M.Weiner.2007.MolecularBiologyofthe Gene.6thEdition.BenjaminCummings PublishingCompanyInc.

3. Watson, J.D., Gilman, M., Witkowski, J., Zoller, M. 1992. Recombinant DNA. Scientific American Books.

References

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. 2002. Molecular Biology of the Cell, 4th Edition. Garland Sciences.

2. Stanley Maloy 1994. Microbial genetics. 2nd Edition. Jones and Bartlett publisher.

3. Udis N. Streips and Ronald E. Yasbin. 2002. Modern Microbial Genetics. 2nd Edition. Wiley-Blackwell.

4. Sandy B. Primrose, Richard M. Twyman, Robert W. Old. 2008. Principles of Gene Manipulation. 6th Edition. Blackwell Science.

5. Brown, T.A. 2008. Genomes. 3rd Edition.

New York: Garland Publishing Co. New York: Garland Science.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PBT2CC5	rDNA Technology					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓) = 46 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

CourseCode:20PBT2CC6
InstructionHours: 6
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

CORE COURSE – VI

IMMUNOTECHNOLOGY

Courseoutcomes

- To understand the basic concepts of immune system, elucidate the immune response of human to foreign substances
- To study the modern techniques of immunology that help determine human protection.
- To know about the clear and concise idea about Vaccines
- Obtain Knowledge in transplantation and tumor immunology.
- Obtain Knowledge about treatment of infection

UNIT-I Fundamental Concepts and Anatomy of the Immune System

Terminology-Antigen, immunogen, hapten, allergen, tolerogen, superantigens - antibody, immunoglobulin, antigenicity, immunogenicity - Self & nonself, innate & acquired immunity - Haematopoiesis. Organs, tissues, cells and mediators of immune system - primary lymphoid organs, secondary lymphoid tissues - lymphocytes, cytokines and lymphokines - Lymphatic system, lymphocyte circulation and lymphocyte homing - Mucosal and Gut associated lymphoid tissue (MALT & GALT) and mucosal immunity - Principles of cell signaling.

UNIT- II Immune Responses Generated by B and T lymphocytes

B cell: B cell development, maturation, activation and differentiation - B cell receptor and determinants - B cell subsets - Immunoglobulins-basic structure, classes & subclasses of immune globulins - antigenic determinants - multigene organization of immune globulin genes and immune globulin super gene family - Generation of antibody diversity - T cell: T cell development, maturation, activation and differentiation - T cell receptor and determinant - T cell subsets. TCR complex - Antigen processing and presentation - endogenous antigens, exogenous antigens - non peptide bacterial antigens Cell to cell cooperation and hapten – carrier system.

UNIT- III Immune Response

Recognition & response – Non specific and Specific - Non specific: Natural built in barrier - phagocytosis. Complements, natural killing-Types of inflammation-Inflammation immediate treatment- Allergic reactions of vaccine-inflammatory response - Specific: HI & CMI - Antigen recognition and response-Major Histocompatibility Complex-MHC genes, MHC in immune responsiveness and

disease susceptibility - HLA typing - Kinetics of immune response and memory - Unresponsiveness: tolerance, suppression and potentiation.

UNIT-IV Vaccinology

Active, passive and combined immunization - Live, killed, attenuated, plasma derived, subunit, recombinant DNA - protein based, plant based, peptide - anti idio typic and conjugate vaccines - production & applications - Role and properties of adjuvants & ISCOMS - Antibody genes and antibody engineering -chimeric and hybrid monoclonal antibodies - catalytic antibodies and generation of immunoglobulin gene libraries.

UNIT-V Clinical Immunology

Immunity to infection, bacteria - viral, fungal and parasitic infections (with examples from each group) -Hypersensitivity-TypeI, II, III and IV - Autoimmunity and types of auto immune diseases - Mechanism and role of CD4⁺ T cells - MHC and TCR in autoimmunity - Treatment of auto immune diseases - Transplantation – immunological basis of graft rejection - clinical transplantation and immunosuppressive therapy -Tumor immunology, tumor antigens, immune response to tumors and tumor evasion of the immune system -Cancer immunology and immune therapy - Immuno deficiency –primary immune deficiencies –acquired or secondary immuno-deficiencies.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
66	10	10	12	47	global

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. PeterJ.Delves,SeamusJ.Martin,DennisR.BurtonandIvanM.Roitt.2011.EssentialImmunology12thEdition.Wiley -Blackwell.
2. CharlesAJaneway,Jr.PaulTravers,MarkWalport,andMarkJShlomchik.1999.Immunobiology.4thEdition.JournalofCurrentBiologypublications.
3. D.M.Weir andJohnStewart.1997.Immunology. 8thEdition.ChurchillLivingstone.
4. P.J.Delves,IS.J.Artin,ID.R.BurtonandI.M.Roitt.2006.EssentialImmunology.11thEdition.

Wiley-Blackwell.

- Richard M. Hyde. 2012. Microbiology and Immunology. 3rd Edition. Springer Science & Business Media.

References

- Brostoff J, Seaddin JK, Male D and Roitt IM., 2002. Clinical Immunology. 6th Edition. Gower Medical Publishing.
- Paul William E. 1999. Fundamental of Immunology. 4th Edition. Lippencott Raven.
- E Roitt. 2011. Essential Immunology. 12th Edition. Blackwell Publication.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PBT2CC6	Immunotechnology					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓) = 45		Relationship: Very High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

CourseCode:20PBT2CP2
InstructionHours: 8
Credits: 4

ExamHours:3
InternalMarks:40
ExternalMarks: 60

COREPRACTICAL-II

rDNA TECHNOLOGY & IMMUNOTECHNOLOGY(P)

Courseoutcomes

- Students will be exposed to the latest techniques employed in recombinant DNA technology related to DNA manipulation in prokaryotes and eukaryotes.
- The student will be able to understand and develop the concept of recombinant DNA technique.
- To gain hands-on experience in gene isolation, cloning by PCR approach.
- To learn identification of gene copies as well as integration of transgenes by Southern blot.
- To gain hands-on experience in Precipitation techniques and Agglutination techniques

rDNA Technology

1. Isolation of plasmids –small & large scale.
2. Size analysis of plasmids by agarose gel electrophoresis.
3. Restriction digestion, ligation.
4. Preparation of competent *E.coli* cells & transformation of *E.coli* with recombinant DNA.
5. Selection methods (Blue white selection, insertional inactivation).
6. Primer design and PCR amplification of β (beta)-galactosidase.
7. Cloning of PCR product into pBR322.
8. Introduction of cloned genes and analysis by SDS-PAGE.
9. Southern blotting.
10. RFLP Analysis of 18s rRNA of the genome.
11. AFLP analysis
12. DNA finger print pattern analysis
13. Genetic diversity of *Pseudomonas* by RAPD.
14. Reporter gene assay (GUS/ β (beta)-galactosidase).
15. Northern blotting.

Immunology

16. Basics-Bleeding, separation of serum, plasma. (Handson).
17. Precipitation techniques –Agar gel diffusion, counter immuno-electrophoresis, single radial immuno-diffusion, rocket immuno-electrophoresis (Hands on).

18. Agglutination techniques

19. Blood grouping and Rh factor; Latex agglutination–RF,ASLO,HBs Ag and CRP(Handson); Hemeagglutination -RPHA/ IHA(Handson)

20. Labeled Assays

21. Enzyme Linked Immunosorbent Assay (ELISA) (Handson).

22. Immuno fluorescence (IF)(Hands on).

23. Immuno histochemistry(IH)(Demonstration).

24. Immunoperoxidase(PAP)staining.

25. Radio immune assays(RIA)(Theory).\

Total Number of Topics	Local	Regional	National	Global	Category Based on %
25	9	8	7	1	local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Richard A. Goldsby, Thomas J. Kindt, Barbara, A. Osborne, Janis Kuby. 2003. Immunology. 5th Edition, W.H. Freeman & Company.
2. J. Sambrook and D. W. Russel, CSHL. 2001. Molecular Cloning: A Laboratory Manual, Vols 1-3. Cold Spring Harbor Laboratory press.

References

1. J.W. Goding, Academic Press, 1983. Monoclonal Antibodies: Principles and Practice
2. T.A. Springer. 1985. Hybridoma Technology in the Biosciences and Medicine. Plenum Press New York.
3. F. Brown, R.M. Chanock, K.A. Lerner. 1986. Vaccines New Approaches to immunization, Cold Spring Harbor Lab.
4. Topley and Wilson. G. Wilson, A. Miles, M.T. Parker. Arnold, Heineman, 1984. Principles of Bacteriology, Virology and immunology. Willy –Blackwell.
5. J.H. Miller. 1999. A short core course in bacterial genetics. Cold Spring Harbor Laboratory.
6. Brenda D. Spangler. 2002. Methods in Molecular Biology and protein chemistry. John Wiley & S

ons,Ltd.

7. BruceRirren/Eric.D.Green.1997.GenomeAnalysis–Alaboratorymanual–volIIAnalyzingDNA.ColdspringHarborLaboratorypress.
8. Sambrooketal.,1989.Molecularcloning:ALaboratorymanual.Vol.I–IIIColdSpringHarborLaboratory.
9. StanleyR.Maloy,Valley.J.Stewart.1996.Genetic analysisofBacteria.ColdspringHarborLaboratorypress.
10. JohnM.S.Barlett,DavidStirling.2003.PCRprotocols.HumanapressInc.
11. RobertE.FarrelJr.1996.RNAMethodologies.2ndEdition.AcademicpressInc.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
II	20PBT2CP2	DNA Technology&Immunotechnology(P)					8	4			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
NumberofMatches(✓)=45 Relationship:VeryHigh											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-II

CourseCode:20PBT2EC1:1
InstructionHours: 5
Credits: 5

ExamHours:3
InternalMarks: 40
ExternalMarks: 60

ELECTIVECOURSE-I

HUMANANATOMY AND PHYSIOLOGY

Courseoutcomes

- Acquirecomprehensiveknowledgeofstructureandfunctionsofhumanbody.
- Acquiredcomprehensiveknowledgeofrespiratoryorganandits functions
- This coursefocusesonanatomicalterminology,anatomicalidentificationandphysiologicalprocesses ofhumanbody
- Acquiredcomprehensiveknowledgeofexcretion
- Acquiredcomprehensiveknowledgeofendocrineglands-structure,secretionsandfunctions.

UNIT-I

Human organs Anatomical view-Sensory organs: eye, Ear, Nose –Circulatory organ Heart, Lungs, Kidney, liver- Digestive system Small and large intestine.

UNIT-II

Respiration Respiratory organ and its functions - Transport of gases [CO₂+O₂]Respiratory quotient-Circulation:Types, Composition, Properties and Functions of blood.

UNIT-III

Excretion kinds of excretory products-Kidney disease-mechanism of urine formation in mammals – Hormonal regulation of excretion- Kidney failure and Transplantation.

UNIT-IV

Nervous tissue Neuron Structure, types of neurons-Nervous disorder-Nerve Impulse Synapse Synaptic transmission of impulses- Neuro transmitters- Receptors Photoreceptor, eye, structure of retina, visual pigments-Physiology of vision.

UNIT-V

Endocrine glands, structure, secretions and functions-Endocrine disorders pituitary-Hypothalamus-thyroids,Adrenal-Thymus,Isletsof Langerhans-Gonad, Testis-Ovary.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
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26	10	6	4	3	Local
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*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1.S.C.Rastogi.EssentialsofAnimalPhysiology.NewAgeInternationalPublishers.2001.

References

1. Parameswaran, Anantakrishnan and Ananta Subramanian. Outlines of Animal Physiology, S. Viswanathan [Printers and Publishers] Pvt. Ltd., (1975)
2. Prosser, C.L. Brown. Comparative Animal Physiology, Satish Book Enterprise, Agra-282003. (1985)
3. Sambasivaiah, Kamalakar Rao and Augustine Chellappa. A Textbook of Animal Physiology and Ecology, S. Chand and Co., Ltd., New Delhi-110055. (1990)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PBT2EC1:1	Human Anatomy and Physiology					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓) = 43 Relationship: Very High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-II

CourseCode:20PBT2EC1:2
InstructionHours: 5
Credits:5

ExamHours: 3
InternalMarks: 40
ExternalMarks: 60

ELECTIVE COURSE – I

BIOPHYSICS

Courseoutcomes

Uponcompletionofthis course,the students willbe able to

- To knowthe fundamentalconcepts ofbiophysicsandtheStructuralanalysisofmacromolecules
- Explaintheintegrationofphysicaltheoryinto biologicalprocesses.
- ExplaintheStructuralAnalysisofMacromolecules
- ExplainthetechniquesandunderlyingtheoryofUV-Visible,IR,NMRandRaman,AAS,XRDandmass spectroscopy.
- Identify/Justifythebiophysicstoolsforbiologicalstudy/research.

UNIT-I

Introduction Levels of structures in Biological macromolecules- Basic strategies in biophysics- Importance of biophysics -Scope of biophysics-History of biophysics.

UNIT-II

Conformational Analysis - Forces that determine protein and nucleic acid structure – basic problems, polypeptide chains geometrics –potential energy calculations- observed values for rotation angles – hydrogen bonding – hydrophobic interactions-water structures ionic interactions, disulphide bonds.

UNIT-III

Structural Analysis of Macromolecules-Prediction of proteins structure, nucleic acids-Ramachandran blot-general characteristics of nucleic acid structure- geometrics, glycosidic bond rotational isomers-those puckering backbone rotational isomers-ribose puckering forces stabilising ordered forms-base pairing, base stacking tertiary structure of nucleic acids.

UNIT-IV

Kinetics of Ligand Interaction - Biochemical Kinetics studies, unimolecular reactions - simple biomolecular multiple intermediates- steady state kinetics, catalytic efficiency, relaxation spectrometry-ribonucleaseas an example.

UNIT-V

Techniques for the Study of Biological Structure & Function - Size and shape of macromolecules- methods of direct visualization- macromolecules as hydrodynamic particles –

macromolecular diffusion ultracentrifugation -Viscometry X ray crystallography-X ray diffraction-NMR - determination of molecular structures - electron microscopy neutron scattering light scattering.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
36	12	2	12	10	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Cantor R., Schimmel P. R., Biophysical Chemistry, Vol. I, II, W. H. Freeman & Co. 1985.

References

1. Daniel. M, Basic Biophysics for Biologists, 1998.
2. Kensal E. Van Holde, W. Curtis Johnson and P. Shing Ho, Principles of Physical Biochemistry, 2nd Edition, Prentice Hall, New York 2004.
3. Jones, D. W., Introduction to Spectroscopy of Biological Polymers, Academic Press, New York, 2003.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
II	0PBT2EC1:2	Biophysics					5	5				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
CO4	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		
Number of Matches (✓) = 40 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
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Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-II

CourseCode:20PBT2EC1:3
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE-I BIOINSTRUMENTATION

Courseoutcomes

Uponcompletionofthis course,the studentswillbe able to

- Identifyanddifferentiateworkingprinciple,instrumentationandapplicationsofvariousbio-analyticalinstruments.
- Acquire knowledge about instrumentation of spectroscopy and applications of various spectrophotometer.
- AcquireknowledgeaboutMicroscopyanditsuses
- TolearnaboutseparationTechniques
- Tolearnaboutelectrophoresistechniques

UNIT- I Basic Instrumentation

Principles,operation protocol & applications of the following instruments: Weighing balance, pHmeter, Polarography, Radioactivity, ECG, FTIR.

UNIT- II Microscopy

Observation of different microbes. Light-Bright & Darkfield; Phase contrast, Inverted Phase contrast; Fluorescent, Electron-TEM & SEM; Confocal.

UNIT-III Spectroscopy

Colorimeter, Spectrometer-UV visible spectrometer-X-ray spectrometer-ELISA reader, Atomic absorption spectrometer, Flame photometer, Fluorimeter & Spectrofluorimeter.

UNIT-IV Separation Techniques

Centrifugation - Principle, operation, types & applications. **Chromatography** - Principle, operation & applications – Paper ascending, descending & Circular-TLC, HPTLC, GC, HPLC, Column Chromatography, Ion Exchange & Affinity Chromatography, LC-MS.

UNIT- V Electrophoresis

Native & denatured-zone, iso electrofocusing & isotachopheresis, 1D & 2D. PCR, MoldiToF-Principles, operation protocol & applications CT scan-Principles, operation protocol & applications of MRI scan.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
18	6	7	8	7	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1.S.SadasivamA.Manickam.2004.BiochemicalMethods.2ndEdition.NewAgeInternationalPvt.Ltd,Publishers.

References

1.Dr.G.Rajagopal, Dr.B.D.Toora. 2005.PracticalBiochemistry. 2nd Edition. Ahuja Book

Company.Pvt.Ltd.2.J.Jayaraman.2000.LaboratoryManualinBiochemistry.New

AgeInternationalPublishers.

3.Plummer,Mu,DavidT.Plummer.1988.IntroductiontoPracticalBiochemistry.TataMcGraw-HillEducation.

4.M.Mooyoung.1985.ComprehensiveBiotechnology.Vol.2,3&4.2ndEdition.Pergamonpress.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
II	20PBT2EC1:3	BioInstrumentation					5	5				
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

C02	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C03	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
C04	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C05	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NumberofMatches(✓)=42Relationship:High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-II

CourseCode:20PBT2E2:1
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE-II

PHARMACEUTICAL BIOTECHNOLOGY

Courseoutcomes

- To create general understanding regarding basic principles involved in modern medicinal / structural chemistry systems.
- Acquire knowledge of History & principle of pharmacology
- Acquire comprehensive knowledge of Chemotherapeutic drugs
- Acquire comprehensive knowledge of Tissue Engineering
- Acquire knowledge of Production of biological protein

UNIT-I

History & principle of pharmacology- Drug names & classification systems- **Application of drugs**- General principle of drug action - Pharmacokinetics, Pharmacodynamics- Measurement of drug action.

UNIT-II

Chemotherapeutic drugs - Mechanism of chemotherapy- Protein Synthesis Inhibitors- Anti Inflammatory- Antibacterial, Antifungal- Antiviral, Anthelmintic- Anticancer Drugs.

UNIT-III

Production of biological hormones- insulin- HGH-Erythropoietins, IFN, TNF, IL, Clotting factor VIII – Synthetic therapy: Synthetic DNA- therapeutic ribozymes- synthetic drugs.

UNIT-IV

Prenatal diagnosis- Invasive Techniques- Amniocentesis, Fetoscopy, Chronic Villus sampling (CVS)- Non Invasive Techniques- Ultra Sonography- Diagnosis using protein & enzymes markers- DNA/ RNA based diagnostics.

UNIT-V

Tissue Engineering Skin, Liver, Pancreas- **Hair implantation** - Hair Therapy- Recombinant vaccines- Cell adhesion based therapy: Integrins, Inflammation.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
32	15	11	6	3	local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBook

1. S.S.Purohit,Kaknani,SalejaPharmaceuticalBiotechnology.

References

1. MaryJ.Myuk,RichardA.Hoarey,PamalaLippinwitt WilliamsPharmacologyedition.
2. H.P.Rang,M.M.Pale,J.M.Moore,ChurchillLivingston.Pharmacology.
3. Page,Curtis,Sulter,Walker,HalfmanIntegratedpharmacology.MosbyPublishingCo.
4. N.Murugesh,AconciseTextBookofPharmacology.Sixthedition.SathyaPublishers,Madurai.
5. R.C.Dubey,ATextBookofBiotechnology. S.Chand&CoLtd,NewDelhi.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
II	20PBT2EC2:1	PharmaceuticalBiotechnology					5	5			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	

CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NumberofMatches(✓)=42 Relationship:High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-II

CourseCode:20PBT2EC2:2
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE-II

CANCER BIOLOGY

Courseoutcomes

- Acquired knowledgeofCharacteristicsofhumancancer
- Acquired knowledgeofBiochemistryandcell biologyofcancer
- AcquiredknowledgeofoncogenesandTumorsuppressorgenes
- AcquiredknowledgeofMoleculargeneticsofcancer
- Acquired knowledgeofCancerdiagnosisand anticancerdrugs

UNIT-I

Characteristics of human cancer - Classification of human cancer- features of cancer- causes of cancer-Terminology of cancer disease -Type of cancer genes-carcinogens,genetic susceptibility-multiple mutation-DNA repair mechanism- Epidemiology of human cancer-Types of DNA repair

UNIT-II

Biochemistry and cell biology of cancer -Growth characteristics of malignant cells – modification of extracellular matrix component cells-Extracellular matrix and cell- cell adhesion-cell cycle regulation-Apoptosis-Growth factor, signal transduction mechanism-angiogenesis-biology of human metastasis.

UNIT-III

Molecular genetics of cancer - Chromatin structure and function, Split genes and RNA processing- genetic recombination, gene amplification- DNA methylation, Genomic imprinting, oncogenes-Tumor suppress orgenes- mechanism of gene silencing- Gene therapy of cancer.

UNIT-IV

Cancer diagnosis - Tumor markers- Gene expression- microarray - proteomic method- Molecular imaging- Nanotechnology- Pharmacogenomics.

UNIT-V

Tumor prevention-Diet and cancer prevention- Chemo prevention-Molecular targets of chemoprevention- Immunotherapy- Immunoassay-Radiationtherapy-Advantagesand limitation.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
44	8	11	16	9	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Maly B.W.J. Virology: A Practical approach IRL Press, Oxford, 1987.

References

1. Margaret A. Knowles, Peter J Selby, An Introduction to Cellular and Molecular Biology of Cancer, 4th Edition, Oxford Medical Publication, 1991.
2. Dunmock N.J and Primrose S.B; Introduction to Modern Virology, Blackwell Scientific publication, Oxford, 1988.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	20PBT2EC2:2	Cancer Biology					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓) = 44 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
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Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-II

CourseCode:20PBT2EC2:3

InstructionHours: 5

Credits: 5

ExamHours:3

InternalMarks: 25

ExternalMarks: 75

ELECTIVECOURSE-II

BIOINFORMATICS

Courseoutcomes

- By study this course the students will get an idea about the basic understanding about Bioinformatics, tools, sequences, algorithms and the analysis of phylogenetic tree.
- To provide an integrative approach to the understanding of bioinformatics
- Application of the gene and protein sequence analysis
- Perform a complete analysis of the genes and protein
- Compare and identify the differences in sequences

UNIT-I

Bioinformatics data nucleic acid sequence- protein sequence, protein structure-genomic, proteomic and metabolomic information,-Bioinformatics databases . types, design, file formats, access tools with examples-Bioinformatics tools and Resources-free online tools, downloadable free tools, software packages, internet -Bioinformatics books and Journal -Bioinformatics web portals.

UNIT-II

Sequence alignment basics match and mismatch similarity scoring alignment-gap penalty protein vs DNA alignments-Dot matrix alignment, Pair wise alignment.global and local alignment algorithms-Multiple sequence alignment-progressive alignment and Iterative alignment algorithms-consensus sequence,patterns and profile-Data base searching: Pairwise alignment based rigorous algorithm (Smith and Water man)and Heuristic algorithms (FASTA and Blast)-Multiple sequence alignment based database searching-PSI Blast, PAM and Blosummatrices

UNIT-III

Bioinformatics genome sequencing-EST clustering and analyses finding genes in prokaryotic and eukaryotic genomes-Regulatory sequence analysis -Bioinformatics for Genome maps and markers-Bioinformatics for understanding Genome variation-Protein structure prediction and classification-Bioinformatics in support of Proteomic research.

UNIT-VI

Molecular visualization tools-Rasmol chime and sdbp viewer-structure analysis tools-VAST and DALI-Structural biology-Homology modeling, Bioinformatics for microarray designing and transcriptional profiling- Bioinformatics for metabolic reconstruction- **Bioinformatics for phylogenetic analysis.**

UNIT-V

Medical application of bioinformatics diseases, genes-Drug discovery history.steps in drug discovery-Target Identification- Target Validation. QSAR-Lead Identification Preclinical pharmacology and toxicology-ADME. Drug designing-Rational drug design-Docking methods-Hex software-Docking software-Computer aided drug design. Ligand based approach-Target based approach.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
44	17	1	12	12	local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1. J.M.Keith.2008.Bioinformatics.Vol.1:Data,sequenceanalysis&evolution.HumanaPress.
2. R.Durbin.1998. Biologicalsequenceanalysis.CambridgeUniversityPress.

References

1. TeresaK.Attwood,DavidJ.ParrySmith.1999. Introduction to

bioinformatics.4th Edition.PearsonEducation.

2. M.Holmes.2007.ACellBiologists’guidetomodelingandBioinformatics.WileyInterscience.
3. R.C. Elston, W.D. Johnson. 2008. Basic biostatistics for geneticists & epidemiologists - Apracticalapproach.JhonWiley&Sons Pvt.Ltd.
4. P.R.Bevington.1969. Data reduction and error analysis for the physical sciences. McGrawHill.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
II	20PBT2EC2:3	BioInformatics					5	5			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
NumberofMatches(✓)=43		Relationship:High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-III

Course Code: 20PBT3CC7
Instruction Hours: 6
Credits: 5

Exam Hours: 3
Internal Marks: 25
External Marks: 75

CORE COURSE-VII PLANT BIOTECHNOLOGY

Course Outcomes

- Acquired knowledge about the basic principles and techniques involved in plant cell culture and to understand the concepts of transformation and achievements of biotechnology in plant systems.
- Design experiments for functional characterization of plant genes and to identify those suitable for creating agronomically important traits.
- Conceptualize plant transformation, selection of desirable genes for crop improvement, design binary vector and procedure for generating GM crops.
- Evaluate critically the safety issues of GM crops and products in the society.
- To understand the concepts of modern technology pertaining to large scale production of agricultural products.

UNIT-I

Basics of Plant Tissue culture-Plant tissue culture techniques-*In vitro* pollination and fertilization- Embryo culture and its applications-Embryo genesis and organogenesis- Micropropagation- haploids and their applications-Somaclonal variations and applications- Endosperm culture and production of triploids- Establishment of plant tissue culture- Culture media (types of media)- Explant: selection and preparation.

UNIT-II

Protoplast Culture-Genetic Manipulation-Genome Organization (*Arabidopsis thaliana*)- Introduction to protoplast isolation, culture and regeneration- methods of fusing protoplasts- somatic hybridization- Protoplast and tissue culture manipulation for genetic manipulation of plants- Cytoplasmic Male Sterility (CMS)- Thermo sensitive genic Male sterility (TGMS).

UNIT-III

Plant Transgenesis – Agrobacterium mediated gene transfer – Agrobacterium based vectors (Ti plasmids and Ri plasmids)- viral vectors and their applications - Direct gene transfer methods electroporation, microinjection and particle bombardment- Characterization of transgenics- screenable and selectable markers - Marker free methodologies and gene targeting.

UNIT-IV

Transgenic plants – Transgenic rice with Vitamin A –transgenic plants with stress tolerance for drought and salinity-crop improvement, herbicide resistance – insect resistance,-virus resistance-plants as bioreactors-Primary metabolite production-Secondary metabolite production-Organic foods and GMO – **Genetically modified foods application** – future applications-ecological impact of transgenic plants-Crop Improvement (Flavr savr tamato, Golden Rice)-Advantages and disadvantages of transgenic crops-Biosafety concerns and regulations of transgenic plants-Production of Organic food-Organic food, types of organic food, identifying organic food-organic food & preservatives- Genetic modification in food industry -**background, history, controversies over risks, application, future applications.**

UNIT-V

Plant Molecular Biology Techniques-Quantitative Real time PCR- Southern blotting, Northern blotting, Western blotting- **DNA sequencing methods and their applications**- DNA finger printing inplants – Marker assisted selection(MAS)for crop improvement- Production of biofertilizers (Azolla): Criteria for strain selection-steps for preparing biofertilizers (Seed pelleting, inoculant carriers, quality standards for inoculants)- Green manuring.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
59	20	18	33	11	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Gamborg O.L and Philips, G.C. 1995. Plant Cell, Tissue and Organ Culture - Fundamental methods. Narosa Publishing House, New Delhi.
2. Slater A., Scott N.W. and Fowler, M.R. 2008. Plant Biotechnology - the genetic manipulation of plants. 2nd Edition. Oxford University Press, USA.
3. H.S. Chawla, 2002. Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
4. Monica. A. Hughes. 1999. Plant Molecular Genetics. Pearson Education Limited, England.

References

1. PhundanSingh.2013.PrinciplesofPlantBiotechnology.KalyaniPublishers,India.
2. V.Kumaresan.2015.AppliedPlantBiotechnology.SarasPublication,India.
3. Singh.2014.PlantBiotechnology,2ndRevisedEdition,KalyaniPublishers,India.
4. HarveyLodish,ArnoldBerk,SLawrenceZipursky,PaulMatsudaira,DavidBaltimore,andJames Darnell. 2000. MolecularcellBiology.4thEdition,W.H.Freeman&Company.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
IV	20PBT3CC7	PlantBiotechnology					6	5				
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO3	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
NumberofMatches(✓)=45Relationship:VeryHigh												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-III

CourseCode:20PBT3CC8
InstructionHours: 6
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

CORECOURSE –VIII

ANIMAL BIOTECHNOLOGY

CourseOutcomes

- To have an understanding about the basics of Animal cell culture, transgenic animals, pest & animal management, Molecular markers and regulations about the use of Biotechnology.
- To improve artificial embryo transfer and nuclear transfer methods and applications.
- To learn the various types of cell morphology, stages, and fertilization and transformation techniques employed in animal systems.
- Be able to describe gene transfer technologies for animals and animal cell lines.
- Be able to describe techniques and problems both technical and ethical in animal cloning.

UNIT-I

Animal Cell, Tissue and Organ Culture-History, Definitions, steps for preparation of cell culture room, culture Environment (Substrate and Media) - Techniques for establishing of cell lines - insect cell culture , organ and embryo culture - cryo preservation ,valuable products- Artificial insemination (IUI, ICSI) - Embryo transfer - cloning (DOLLY, MOLLY and POLLY)-Nuclear transplantation-*in vitro* fertilization technology- Genetic Engineering in animals – Transformation of animal cells- Cloning vectors-RT PCR-animal viral vectors.

UNIT-II

Transgenic Animal-Development and uses - mice, cattle, goat, fish and sheep and transgenic pets- Tendered meat production-Featherless chicken production-Recent trends in transgenic animal production-Transgenic breeding strategies -Molecular farming(products with strategic importance)- Insulin production using GMO.

UNIT-III

Pest and Animal Management- Juvenile hormone analogues - pheromones and genetic manipulation- Biotechnology of silkworms- Transgenic silk production - Baculo viruses vector and foreign gene expression- Biotechnological approach to the production of live feed.

UNIT-IV

Molecular Markers - Use of nucleic acid probes and antibodies in clinical diagnosis and tissue typing- Mapping of human genome - HGP (Human genome project), RFLP, RAPD and its applications- Genetic engineering approaches for the correction of genetic disorders- Human cloning, Gene silencing- Animal right activities Blue cross in India - Society for prevention of cruelty against animals- Ethical limits of Animal use- Human Rights and Responsibilities-

Proteomics in disease biomarkers identification.

UNIT-V

Regulating the use of Biotechnology - Regulating DNA technology - DNA barcoding- Regulating food and food ingredients- **Human gene therapy- Initial public concerns – accumulation of defective genes in future generation-** Future of gene therapy- Patenting Biotechnology inventions - patenting multicellular organisms.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
52	12	9	23	15	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. BSingh, SKGautam and MS Chauhan. 2015. Textbook of Animal biotechnology. Teri Publication.
2. M.K. Sateesh. 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology). 2nd Edition. New Age International Pvt. Ltd. Publishers.

References

1. Harrison, M.S. and Bal, I.R. 1997. General techniques of cell culture Cambridge University press.
2. Darling D.C. and Morgan S.J. 1994. Animal cells, culture Media. Wiley, New York.
3. *In-vitro* cultivation of animal cells. 1994. I.ed., Butterworth–Heinemann Ltd.
4. R. Ian Freshney. 2010. Culture of Animal cells & Manual of basic technique. 6th Edition. Wiley–Blakwell publication.
5. Bernard B. Glick, Jack J. Pastunak. 2009. Molecular Biotechnology principles and application of Recombinant–DNA

6. R.Sasidhara.2006.AnimalBiotechnology.MJPublishers
7. DuheyR.C.2007.Textbookofbiotechnology.S.Chand &CompanyLtd.
8. RobertMatheson. 1994.Entomology- anintroductorycourse.2ndEdition. Comstock.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
III	20PBT3CC8	AnimalBiotechnology					6	5			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
NumberofMatches(✓)=45 Relationship:VeryHigh											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-III

CourseCode:20PBT3CP3
InstructionHours:8
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

COREPRACTICAL-III

PLANT AND ANIMAL BIOTECHNOLOGY(P)

Courseoutcomes

- Acquiredknowledgeabouthandsontrainingonplant&animaltissuecultureandbiotechnology.
- Explainthebasis forformulationofplanttissueculturemediumforgrowthanddifferentiationofplants
- Discusstheimportanceandapplicationsofdifferentechniquesemployedintissuecultureandstorageofplantgermplasm
- IllustratethepreparationofmesophyllprotoplastsandanalyzetheirfusingusingPEG.
- To knowAnimalcellcultureanddifferent type ofcellculture andapplicationofcellculture.

PLANTBIOTECHNOLOGY

1. Introduction to the laboratory and general Safety Practices for plant cell, Plant growth and development. Laboratory Report Guidelines (Theory & Demo).
2. Aseptic culture techniques for establishment and maintenance of cultures (Handson).
3. Tissue culture media preparation: Preparation of stock solutions of Murashige Skoog basal medium and plant growth regulator stocks (Hands on).
4. Mechanical isolation of protoplast. Enzymatic isolation of protoplast and culture (Handson).
5. Isolation of plant genomic DNA by modified CTAB method (Handson).
6. Isolation of plasmid DNA
7. Micropropagation method
8. Transformation of leaf discs with Agrobacterium (Hands on).
9. Expression of foreign genes in to plant cells: use of Agrobacterium tumefaciens(Theory).
10. Morphogenesis in tobacco leaf tissue (Handson).
11. Regeneration abilities of the Shoot Apical Meristem (SAM).
12. Preparation of chloroplast from leaves(Handson).
13. Effect of different light wavelengths on germinating corn embryos (Handson).
14. Measurement to photosynthesis (Handson).
15. Separation of thylakoid and stromal proteins by SDS-Gelelectrophoresis.
16. Protoplast Isolation
17. Isolation of DNA & RNA from light and dark-grown seedlings.
18. Photoperiodism in plants

ANIMAL BIOTECHNOLOGY

1. Isolation of DNA from Animal liver.

2. Isolation of DNA from human cheek cells.
3. Isolation of DNA from blood.
4. Quantification of DNA by spectro photometric method.
5. Size analysis of DNA by Agarose gelelectrophoresis.
6. Isolation & identification of stem cells
7. Visit to animal cell culture research lab

Total Number of Topics	Local	Regional	National	Global	Category Based on %
25	12	3	8	2	local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. M.S. Clark.1997.*PlantMolecularBiology:ALaboratoryManual*.Springer-Verlag.
2. SlaterA.,ScottN.W.andFowler,M.R. 2008.PlantBiotechnology-the geneticmanipulationofplants.2ndEdition.OxfordUniversitypress,USA.
3. H.S.Chawla,2002.IntroductiontoPlantBiotechnology.OxfordandIBHPPublishingCo.Pvt.Ltd.NewDelhi.
4. Monica.A.Hughes.1999.PlantMolecularGenetics.PearsonEducationlimited,England.
5. Harrison,
M.S.andBal,I.R.1997.GeneraltechniquesofallcultureCambridgeUniversitypress
6. PrasashM.andArora.C.K.1998.Planttissueculture,AmmolpublicationPvt.Ltd.
7. DarlingD.C. andMorganS.J.1994.Animalcells,cultureMedia. Wiley,NewYork.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse	Hours	Credits
III	20PBT3CP3	PlantandAnimalBiotechnology(P)	8	5

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of Matches (✓)=46 Relationship: Very High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

CourseCode:20PBT3EC3:1

InstructionHours: 5

Credits:5

ExamHours:3

InternalMarks: 25

ExternalMarks: 75

ELECTIVECOURSE-III BIostatistics, Bioethics AND IPR

CourseOutcomes

- The students will be able to know Biostatistics
- The students will be able to understand data collection for research
- Have acquired a detailed knowledge of bioethics and biosafety
- The students will be able to understand IPR & Legal Protection
- The students will be able to know patent

UNIT –I Biostatistics

Introduction to Biostatistics - History of biostatistics - sample, population and statistical inference.- **Interval data:** construction of histogram-interpretation of histogram, the normal distribution -mean, median, mode and standard deviation. -Representing normal curve, uncertainties in estimation of mean-comparison of mean and variance –**Proportion data:** examples of proportion data (MPN, sterility testing of medicines, animal toxicity, therapeutic trial of drugs and vaccines, infection and immunization studies)-statistical treatment to proportion data.- Chi square data and goodness of fit -**Count data:** examples of count data (bacterial cell count, radio activity count, colony and plaque counts) statistical treatment to count data -Poisson distribution, standard error-confidence limits of count.

UNIT –II Bioethics

Concept, philosophical considerations - Case study of bioethics-epistemology of science, ethical terms-principles and theories and relevance to biotechnology.- Ethics and the law issues -genetic engineering, stem cells, cloning, medical techniques,-trans humanism and bio weapons –Research concerns-animal-rights,ethics of human cloning-reproduction and stem cell research-Emerging issues-biotechnology's impact on society-DNA on the witness stand and use of genetic evidence in civil and criminal court cases. Challenges to public policy, regulations - improving public understanding of biotechnology products to correct misconceptions.

UNIT-III Introduction to IPR & Legal Protection

Basics of patents-History of patent and rights-types of patents-Indian Patent Act 1970, recent amendments-filing patent application,-precautions before patenting-disclosure and non-disclosure-WIPO treaties, Budapest treaty,-PCT and implications-role of a country patent office and procedure for filing a PCT application-Types of IP - patents, trademarks, copyright & related rights, industrial design-traditional knowledge-geographical indications and international framework for the protection of IP -Introduction to history of GATT, WTO, WIPO and TRIPS-Global scenario of patents and Indian position-patenting of biological materials-IP as a factor in R&D and IP relevance to Biotechnology.

UNIT-IV Patent Filing and Infringement

Patent application, forms and guidelines-fee structure and time frames-Types of patent applications-provisional and complete specifications-PCT and convention patent applications-International patenting - requirement, procedures and costs. -Financial assistance for patenting and introduction to existing schemes.-Publication of patents -gazette of India, status in Europe and US. Patenting by research students-lecturers and scientists - University/organizational rules in India and abroad, credit sharing by workers and financial incentives-Patent infringement, meaning, scope, litigation, case studies and examples.

UNIT-V Biosafety

Introduction and historical background – Introduction to biological safety cabinets-primary containment for biohazards-biosafety levels, biosafety levels of specific microorganisms-recommended biosafety levels for infectious agents and infected animals-Biosafety guidelines by Government of India-Definition of GMOs and LMOs-Roles of Institutional Biosafety Committee-RCGM, GEAC etc. for GMO's applications in food and agriculture-Environmental release of GMOs-GMO case studies-risk assessment; risk management and communication -Overview of national regulations and relevant international agreements including Cartagena protocol.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
74	13	17	43	16	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Important Links

1. Bioethics-byEllenFrankelPaul,FredD. Miller, JeffreyPaul,FredDycusMillerCambridge UniversityPress,2002.
2. Bioethics&Science, JohnA.Bryant,LindaBaggottlaVelle, JohnF.Searle–2002.
3. <http://www.w3.org/IPR/>

4. <http://www.wipo.int/portal/index.html.en>
5. http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
6. www.patentoffice.nic.in
7. www.iprlawindia.org/-31k-Cached- Similarpage
8. <http://www.cbd.int/biosafety/background.shtml>
9. <http://www.cdc.gov/OD/ohs/symp5/jyrtext.htm>
10. <http://web.princeton.edu/sites/ehs/biosafety/biosafetypage/section3.htm>
11. <http://www.accessexcellence.org/RC/AB/IE/#Anchor-Bioethics-6296>www.bioethics.net
12. http://www.americanprogress.org/issues/domestic/science?_kk=bioethics
13. <http://www.billmuehlenberg.com/2005/09/02/the-stem-cell-debate/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
III	20PBT3EC3:1	Biostatistics, Bioethics and IPR.					5	5				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Number of Matches (✓)=42		Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

CourseCode:20PBT3EC3:2
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE-III MARINE BIOTECHNOLOGY

CourseOutcomes

- The students will be able to know marine microbes and their applications
- The students will be able to understand Aquaculture for research
- Have acquired a detailed knowledge of pharmaceutical products from marine organism
- The students will be able to understand Environmental impacts of aquatic biotechnology
- The students will be able to know biomaterials and bioprocessing

UNIT-I

Marine biodiversity: Diversity & adaptation-Recent trends in marine biotechnology-Scope of marine biotechnology-Importance of marine diversity -Euphotic, mesopelagic, bathopelagic, benthos, deepsea- Marine microbial diversity: Marine microbial habitats - Microbial distribution in the oceans- Macro ecological theory and ocean microbes – Factors that impact marine microbial diversity-Interactions between marine microbes and marine macro organisms- Symbiosis with invertebrates – Microbial effects on the ecology and life history of marine invertebrates-Marine viruses-Application of marine science- Coral reefs-Marine animal and habits- Jelly fish life cycle

UNIT-II

Aquaculture and biotechnology -Importance of aquaculture, Criteria of selection of species for aquaculture- Culture practices of milkfish, mullets and seabass-Monoculture, polyculture and integrated fish farming. Culture practices of tiger shrimp, *Macrobrachium rosenbergi*- crabs and lobsters- Culture practices of edible oyster, pearl oyster and mussel-Poisonous sea snakes-Culture practices of Seaweeds-Fish genetics: gynogenesis, and rogenesis, polyploidy, control of sex, artificial insemination, eye stalk ablation-Transgenesis and DNA Vaccine development for aquacultured fish, cryopreservation.

UNIT-III

Biomedical importance of marine organisms-Screening for new metabolites from marine microorganisms - Production of useful chemicals by marine microalgae –Bioenergy production, Marine enzymes- Fatty acids from lipids of marine organisms.-Marine pharmacology: Potentialities in the treatment of infectious diseases- Osteoporosis , Alzheimer’s disease- New antibiotics and medicines from marine organisms-The secondary metabolites and biosynthetic gene clusters of marine cyanobacteria. Secondary metabolites from marine actinomycetes and fungi, Probiotics.

UNIT-IV

Biomaterials and bioprocessing -Byproducts: processing of low cost fish, minced meat-fish oil-fish meal, fish sausages-isinglass, glue, fish silage, fin rays-chitosan, chitin pearlescence, agar, alginates, carrageenan and heparin.

UNIT-V

Environmental impacts of aquatic biotechnology-Human impacts on marine microbial diversity – Critical microbially mediated equilibria that impact environmental and human health - Using marine microbes to ameliorate environmental deterioration- Control of oil spills and bioremediation. Environmental issues- Effects of biofouling and biodeterioration on marine structure-Protection methods against corrosion and fouling-Application of biotechnology in controlling the biodeterioration of wood and synthetic substances in the sea-Application of marine science- Coral reefs- Redtides: Causative factors and effects on the organisms of marine environment.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
52	19	16	18	12	local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBook

1. Proksch and Werner E.G. Muller, Frontiers in Marine Biotechnology, Horizon Bioscience, 2006.

References

1. Le Gal, Y., Ulber, R, Marine Biotechnology I. Advances in Biochemical Engineering/Biotechnology (Series editor: T. Scheper) Springer-Verlag Berlin Heidelberg. Vol. 96. pp. 287, 2005

2. Le Gal, Y., Ulber, R, Marine Biotechnology II: Advances in Biochemical Engineering/Biotechnology (Series editor: T. Scheper) Springer-Verlag Berlin Heidelberg. Vol. 97. pp. 261, 2005.

3. Jennie Hunter-Cevera, David Karl and Merry Buckley, Marine microbial diversity: The key to earth's habitability: A Report from the American academy of microbiology, Published by American Academy of Microbiology, held (April 8-10, 2005) in San Francisco, California. pp. 28, 2005.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	20PBT3EC3:2	Marine Biotechnology					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓) = 43 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

CourseCode:20PBT3EC3:3
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE-II **GENOMICS AND PROTEOMICS**

Courseoutcomes

- The students would have gained a better understanding of the organization of genomes in multiple levels of taxa and the methodologies and approaches used for the study of structural and functional genomics.
- The students would have also acquired knowledge on various genome mapping and sequencing methods, genomic markers, microarray technology and methods for proteomics.
- Acquire knowledge about human genome project
- To learn about pharmacogenetic studies
- To learn about genome physical mapping and sequencing

UNIT-I Genome Structure

Genome sizes - History of genomics - microbial and organelle genomes - Centromeres and telomeres, tandem repeats-dispersed repeats (transposons) - Basic Sanger sequencing - automated sequencing - sequencing simple genomes - Sequencing large genomes-finalizing sequences-resequencing and Next generation sequencing (NGS).

UNIT-II Microarray

Microarray and its types-DNA Micro array, Protein Micro array Transcriptomics-Applications and advantages of Micro arrays -DNA chips and SAGE technology-Organization of genome projects-human, plant, animal and microbial genome-Microarray-design-analysis visualization of data-Tools for microarray analysis-MADAM-Gene-Applications of Microarrays.

UNIT-III Human Genome

Characteristics of human-genome sequence important genes associated with each chromosome- Mendelian and sex-linked traits in human inheritance -Genetic diseases due to defects in auto somal and sex linked genes.-Whole genome sequencing-Human Genome Project.

UNIT-IV Proteomics

Identifying proteins in complex mixtures-Protein profiling, quantitative 2D GE-multidimensional chromatography - quantitative mass spectrometry-MALDI-TOF, TOF analysis and analytical protein chips-Protein structure data banks- protein data bank.

UNIT-V Pharmacogenomics and New Drug Design

Introduction to drug design and developing new drugs-Procedure followed in drug design-Molecular modification of lead compounds – Pro drug and soft drugs-Physico-chemical parameters in drug design-QSAR. Protein-protein interaction.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
46	14	11	9	20	global

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1. Necia Grant Cooper; (Ed.). The Human Genome Project; Deciphering the blueprint of heredity University Science Books, CA, USA. 1994.
2. Gary Zweiger. Transducing the Genome; Information, Anarchy and Revolution in Biomedical Sciences. Tata McGraw-Hill Publishers, New Delhi. 2003.
3. C. Branden, and J. Troze. Introduction to Protein Structure. Second Edition. Garland Publishing, New Delhi. 1999.
4. W.E. Evans and M.V. Relling. Pharmacogenomics: translating functional genomics into rational therapeutics. *Science* 286:487. 1999.

References

1. A.D. Baxevanis, and B.F.F. Ouellette. Eds. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley Interscience. New York. 2001.
2. D. Higgins, and W. Taylor (Eds). Bioinformatics: Sequence, Structure and Databases. Oxford University

Press,Oxford.2000.

3. Higgins,D and Taylor,W (Eds).2000. Bioinformatics: Sequence, Structure and Databank. OxfordUniversitypress.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
III	20PBT3EC3:3	GenomicsandProteomics					5	5			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
NumberofMatches(✓)=40		Relationship:High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-III

CourseCode:20PBT3EC4:1
InstructionHours:5
Credits:4

ExamHours:3
InternalMarks:25
ExternalMarks: 75

ELECTIVECOURSE-IV BIOTECHNOLOGY FOR ENTREPRENEURS

Courseoutcomes

- Topromotingbio-entrepreneurship
- AcquiredknowledgeaboutProjectmanagement
- AcquiredknowledgeaboutGenerationofFund
- Acquiredknowledgeaboutimmobilizationmethods
- AcquiredknowledgeaboutBiotechenterprises

UNIT- I Introduction to Entrepreneurship

Entrepreneurship definition, factors necessary for entrepreneurship-desirables in a start up-mistakes to be avoided-pillars of bio-entrepreneurship-promoting bio entrepreneurship-biotech company road map,legal,regulatory and other business factors-World biotech companies - Biotech trends in recent era.

UNIT-II Identification of a Project

Project management: Search for a business idea, concept of project and classification-project identification, project formulation-project design and network analysis-project report, project appraisal.

UNIT- III Assessment of a Project

Financial analysis-Ratio analysis, Investment process, Break even analysis-Profitability analysis, Budget and planning process-Sources of finance: Source of development finance-Project financing, Institutional financing to Entrepreneurs-Financial institutions, Role of consultancy organizations.-Marketing channels: Methods of marketing- marketing channels, Marketing institutions and assistance.

UNIT-IVGeneration of Fund

Funding of biotech business (Financing alternatives, VC funding, funding for biotech in India, Exitstrategy,licensing strategies,valuation)-support mechanisms for entrepreneurship (Bio entrepreneurship efforts in India, difficulties in India experienced, organizations supporting biotech growth, areas of scope, funding agencies in India,biotech policy initiatives)-Role of knowledge centers and R&D (knowledge centers like universities and research institutions, role of technology and upgradation).

UNIT-V Biotechenterprises

Setting up Small, Medium & Large scale industry-Quality control in Biotech industries-Location of an enterprise, steps for starting a small industry-Incentives and subsidies, exploring export possibilities.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
28	5	4	17	5	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1. D.Hyne&JohnKapeleris.2006.Innovationandentrepreneurshipinbiotechnology:Concepts,theories& cases.
2. RichardDanaOno.1991.TheBusinessofBiotechnology:FromtheBenchoftheStreet.Butterworth-Heinemann.
3. MartinGrossmann.2003.EntrepreneurshipinBiotechnology:Managingforgrowthfromstart-up toInitialPublicOffering

References

1. YaliFriedman.2008. BestPracticesinBiotechnologyEducation.LogosPress.
2. RobertNicholasTrigianoandDennisJohnGray.2004.PlantDevelopmentandBiotechnologyCRC Press.358pages.
3. VasantDesai.2005.DynamicsofEntrepreneurialDevelopmentandManagement.6thEdition.HimalayaPublishingHouse,2005.
4. Prasannan.Projects:PlanningAnalysis,Selection,Implementation&Review.7thEdition.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse	Hours	Credits
III	20PBT3EC4:1	BiotechnologyforEntrepreneurs	5	4

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Number of Matches (✓) = 47 Relationship: Very High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-III

CourseCode:20PBT3EC4:2
InstructionHours: 5
Credits:4

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE-IV **DAIRY TECHNOLOGY**

Courseoutcomes

- Tohavetheabilitytouseetheacquiredknowledgeduringmilkprocessing
- Thecourseprovidesknowledgeaboutdairyindustry&manufactureofDairyproducts
- ToenlightentheIndustrialapproachofBiotechnology
- Thecourseprovidesknowledgeaboutdairyprocessingequipments
- Thecourseprovidesknowledgeaboutentrepreneurialskill

UNIT-I

Dairy Chemistry and Microbiology-Recent trends in dairy technology-Applications of dairy technology-History of Dairy technology - Scope of dairy technology - Introduction, Basic dairy terminology, milk as raw material, composition, food value, contaminants, milk reception in dairies and tests-History of dairy technology-Quality and Quantity tests at reception- Cell count and other tests - Milk transport and storage in dairy plants, Cholesterol, fatty acids and their relation to cardiovascular diseases-Dietary recommendations- Applications of enzymes in dairy industry.

UNIT-II

Dairy Processing Equipments - Milk processing terminology, Processing flow sheet, Equipment employed, Pasteurisers (Heat Exchangers), Plant piping, Pumps-Instruments used in dairy technology-Cream separating Centrifuges, Homogenizers, Bottle and pouch fillers - Milk Chillers, Ice Cream Freezers- Vacuum Evaporators, Spray and Drum Dryers- Product in stantizing equipment- Packaging of milk in bottles and sachet.

UNIT-III

Manufacture of Dairy Products- Cheese, Types of cheese- Defects in cheese- Manufacture of paneer, Toned Milk, Sweetened Condensed milk, Khoa - Milk powder, Qualityaspects.

UNIT-IV

Manufacture of Ice Cream and other Dairy Products - Manufacture of Ice cream - Chemistry and technology- Microbiology of ice cream- Quality aspects, Manufacture of Butter,Ghee, Grading of butter- Quality aspects, Extraction of casein from milk, properties, composition and industrial uses Production of lactose and whey.

UNIT-V

Fermented dairy products - Fermented product production - Product preservation - Fermented products Yoghurt, Curd, acido philus milk etc - Energy use in Dairy plant, sources of energy, cost of energy- Control of energy losses and Energy conservation.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
37	18	14	9	5	local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Textbooks

1. National Institute of Industrial Research, Modern Technology of Milk processing and Dairy products, II Edition, NIIR Publications, India, 2004.
2. Tufail Ahmad: Dairy Plant Systems Engineering Kitab Mahal, Allahabad, India (1985)
3. Edger Spreer & Axel Mixa: Milk and Dairy Product technology Mercel Dekker Inc. N.Y. (1998)

References

1. Arthur W. Farral: Engineering of Dairy and food Products (II Edition 1970) Robert E. Krieger Publishing Co. NY.
2. Garret Smit: *Dairy Processing (Improved Quality)* Woodhead Publishing Ltd. CRC Press (2003).
3. W.M. Clunie Harvey and Harry Hill: *Milk Products* BioTech Books, New Delhi (1999).
4. Prof. H.G. Kessler: *Food Engineering and Dairy Technology* Verlag Kessler Publishing House, Germany (1981).
5. W. James Harper and Carl W. Hall: *Dairy Technology and Engineering* AVI Publishing, Westport, USA (1976).
6. Edger Spreer: *Milk and Dairy Product Technology* Mercel Dekkar Inc. New York, USA (2005)

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
VI	20PBT3EC4:2	Dairytechnology					5	4			
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
NumberofMatches(✓)=43		Relationship:High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	34 Moderate	High	VeryHigh

SEMESTER-III

CourseCode:20PBT3EC4:3
InstructionHours: 5
Credits:4

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE- IV STEM CELL BASICS AND APPLICATION

Courseoutcomes

- To strengthen the knowledge of students on Stem cell basics and their applications for the benefit of mankind.
- To impart knowledge about stem cell culturing and stem cell signalling.
- To acquire knowledge about Embryonic Stem Cells and Adult stem cell
- To know about Stem cell policy, ethics and stem cell research.
- To acquire knowledge about Gene therapy

UNIT-I

Fundamentals of stem cell biology - **Historical aspects of stem cell technology** - Embryogenesis - Developmental stages – properties of stem cells - **Stem cell Introduction, History, Properties- Potency Totipotent, Pluripotent, Multipotent, Oligopotent, Unipotent-Definitions and molecular mechanisms factors that dictate stem cell behavior-** Identification and characteristic of pluripotent stem cells in animal and humans.

UNIT-II

Embryonic Stem Cells - Isolation of Embryonic stem cell and Adult stem cell- *In vitro* fertilization - culturing of embryos - **Types of embryo - Invitro culture of embryo**-isolation of human embryonic stem cells- **growing ES cells in labs- stimulation ES cells for differentiation identification , properties of ES cells**-Germ Line Stem Cell - Determination of the Germ Line; Identification, Characterization and Purification of Germ Line Stem cells- Germ Line Stem cell Niche- Establishment of Germ Line cells *in vitro*-Properties of Germ Line Stem cells-Stem cell bank

UNIT-III

Adult stem cell - Somatic stem cells - test for identification of adult stem cells – adult stem cell differentiation - trans differentiation - plasticity - different types of adult stem cells –properties of

adult stem cell- Epigenetic mechanisms in normal development - DNA Methylation, histone modifications and Micro RNAs- Cell Reprogramming- Induction and Maintenance of pluripotency and differentiation of pluripotency into various cell lineages-Epigenetic mechanisms in normal development

UNIT-IV

Gene therapy, application and reparative medicine - Gene therapy - stem cells and animal cloning- introduction to modeling cell behaviour unique characteristic of stem cell and modeling of signal transduction- Mechanisms for stem cell manipulation in controlled micro environments- Therapeutic applications and reparative medicine- Parkinson disease- neurological disorder - limb amputation - heart disease- diabetes, burns-HLA typing -Alzheimer’s Disease-Application of stem cells in disease management and treatment - Neurodegenerative diseases- autoimmune disease-ocular disease, spinal cord injury-cardiovascular disease-Cancer, diabetes, burns and skin ulcers, muscular dystrophy-cell replacement and gene therapy.

UNIT-V

Stem cell, based tissue regeneration and ethical issue - Tissue engineering application- production of complete organ, kidney, eyes, heart, brain-Establishment of human stem cell bank- Stem cell policy and ethics-stem cell research: Hype, hope and controversy.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
63	19	12	25	12	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. KursadTurksen, EmbryonicStemcells - Protocols,2ndEdition,HumanaPress, 2002.
2. Stemcellandfutureofregenerativemedicine.BycommitteeontheBiologicaland BiomedicalapplicationsofStemcellResearch.NationalAcademic press,2002.

References

1. AriffBongso,EngHinLee“StemCells:FromBenchtoBedside”WorldScientificPublishingComp any.2005.
2. CSPotten“StemCells” Elsevier,1996.
3. DanielR.Marshak“Stemcell biology” ColdSpringHarbor LaboratoryPress.
4. RobertLanza“EssentialsofStemCellBiology”Elsevier,2009.
5. Peter Quesenberry“StemcellbiologyandGeneTherapy”Wiley-Liss,1988.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits			
III	20PBT3EC4:3	StemCellBasicsand Application					5	4			
CourseO utcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
NumberofMatches(✓) =45Relationship:VeryHigh											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-IV

CourseCode:20PBT4CC9
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

CORECOURSE-IX BIOPROCESS TECHNOLOGY

Courseoutcomes

- The students will be able to demonstrate familiarity with the wide diversity of microbes, and their potential for use in microbial biotechnology
- The students will be able to understand screening methods for industrial microbes
- Have acquired a detailed knowledge of number of products which are produced by industrial fermentation processes
- The students will be able to understand Biology of Industrial Microorganisms
- The students will be able to know the Industrial production of various products

UNIT-I Basic principle of Biochemical engineering

Basic principle of Biochemical engineering Isolation, screening and maintenance of industrially important microbes- Types of enzymes produced from industries-Microbial growth and death kinetics (an example from each group-particularly with reference to industrially useful microorganisms)-Strain improvement for increased yield and other desirable characteristics – Microbial Growth and Preservation -Mathematical expression of bacterial growth, generation time and growth rate-Different phases of growth & growth curve and-Batch, continuous and synchronous cultures- Diauxic growth and factors affecting microbial growth-Stress response-Microbial death curve under adverse conditions.

UNIT- II Concepts of basic mode of fermentation processes

Bioreactor designs and types of fermentation and fermentors -Types of fermentor-Concepts & basic modes of fermentation -Batch, fed batch and continuous fermentation-Conventional fermentation versus biotransformation-Solid substrate, surface and submerged fermentation-Fermentation economics and fermentation media-Fermenter design - mechanically agitated, pneumatic and hydro dynamic fermenters- Large scale animal and plant cell cultivation and air sterilization-Upstream processing-media formulation, sterilization, aeration and agitation-Measurement and control of bioprocess parameters, scale up and scale down process.

UNIT- III Down stream processing

Bioseparation - filtration, centrifugation, sedimentation, flocculation, micro filtration, sonication-Cell disruption-enzymatic lysis and liquid –liquid extraction-Purification by precipitation (ammonium sulfate, solvent), electrophoresis and crystallization. -Extraction (solvent, aqueous twophase, supercritical) and chromatographic techniques-Reverse osmosis and ultra filtration- Drying, crystallization, storage and packaging-Treatment of effluent and its disposal.

UNIT-IV Applications of enzymes in food processing

Mechanism of enzyme function and reactions in food processing-Enzymic bioconversions e.g.starch and sugar conversion processes-High fructose corn syrup, hydrolyzed protein and their down stream processing-Baking by amylases, deoxygenation and de-sugaring by glucose oxidase,-beer mashing and chill proofing; cheese making by proteases and various other enzyme catalytic actions in food processing.

UNIT-V Applications of Microbes in food processing and production

Fermented foods and beverages, food ingredients and additives used in fermentation and their purification-Fermentation as a method of preparing and preserving foods-Microbes and their use in pickling, producing colours and flavours, alcoholic beverages and other products-Process wastes - whey, molasses, starch substrates and other food wastes for bioconversion to useful products –Bacteriocins from lactic acid bacteria -production and applications in food preservation.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
48	18	12	18	15	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Jackson AT.1991.Bioprocess Engineering in Biotechnology.PrenticeHall,EngelwoodCliffs.

2. Shuler M L and Kargi F. 2002. Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Englewood Cliffs.

References

1. Young M.M. and Reed. 2004. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine. Vol 1, 2, 3 and 4. Elsevier India Private Ltd, India.
2. Mansi E M T E L and Bryle C F A. 2007. Fermentation Microbiology and Biotechnology. 2nd Edition, Taylor & Francis Ltd, UK.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
IV	20PBT4CC9	Bioprocess Technology					5	5				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO3	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO4	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Number of Matches (✓) = 46 Relationship: Very High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

CourseCode:20PBT4CC9
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

CORE COURSE – X **FOOD TECHNOLOGY**

Courseoutcomes

- To gain knowledge on the basic principles of food processing and the various methods used to process foods
- To be aware of the processed food products available in the market.
- To understand the basic principles of processing and the unit operation employed in a food processing plant
- To help the students to understand about the industrial food process and consumer safety.
- Acquired knowledge about Technology of Fruits and Vegetables, milk, Cereals and Pulses

UNIT-I Technology of Fruit and Vegetable Processing

Climacteric and Non climacteric fruits-Overview of processing technologies-Edible coatings - Osmotic dehydration - Fruit and Vegetable dehydrations-Fruit ripening-Edible coating in fruits-Fruit and Vegetable powders-Quality control.

UNIT-II Cereals and Pulses Technology

Milling of Cereals - Rice, Wheat, Maize, Sorghum, Oats, Barley-Parboiling of rice - Products from rice –Convenience food products from rice, Maize –Processing of maize -Tortillas Quality control.

UNIT –III Dairy Technology

Milk- Physical and Chemical properties of milk-Pasteurisation of milk. Process for the manufacture of Cheese, Butter, Yogurt, Dahi, Ice-cream,- Whey products-Quality control.

UNIT-IV Technology of Plantation products

Tea, Coffee and Cocoa (Chemistry and Technology)-Process for manufacture of CTC and Green tea, Instant tea, Instant coffee-Cocoa processing -Fermentation, Manufacture of cocoa powder, chocolates

UNIT-V Technology of Meat, Fish and Poultry products

Comminuted meat products -cured meats - Bacon and Ham -Luncheon meats - Sausages, Canning and Dehydration, curing and Smoking-Irradiation- Eggs Processing-Liquid eggs,Pasteurisation, Egg white-Methods of analysis and quality control of Meat and egg products.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
35	14	10	6	5	local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

TextBooks

1. Mountney G.J. and Parkhurst R.C. Poultry Products Technology, 3rd Edition, Food Products Press Inc., N Y, 1995
2. Ranken Michael D. and Ranken M.D. Handbook of Meat Product Technology, Blackwell Science, U.K. 2000.
3. David, S. Robinson. 1997. Food Chemistry and nutritive value. Longman group, UK.
4. Frazier, W.C. and Westhoff, D.C. 1988. Food Microbiology, 4th Edition. McGraw-Hill, New York.
5. Pyke, M. 1981. Food Science and Technology, 4th Edition. John Murray, London.

References

1. Brenner, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E. V. 1979. Food engineering operations, 2nd Edition. Applied Sciences Pub. Ltd., London.
2. Desrosier, N.W. and Desrosier, J.N. 1987. The Technology of Food Preservation, CBS Publishers and Distributors, New Delhi.
3. Fennema, O.R. 1976. Principles of food science: Part I, Food chemistry, Marcel Dekker, New York.
4. Lindsay, W. 1988. Biotechnology, Challenges for the flavour and food Industries, Elsevier Applied Science.

5. Shakuntala, N. and Shadaksharaswamy, M. 1997. Foods; Facts and principles. 2nd Edition. New Age International Publishers, New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
1V	20PBT4CC10	Food Technology					5	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO4		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓)=41		Relationship: High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

CourseCode:20PBT4CP4

InstructionHours: 5

Credits:5

ExamHours:3

InternalMarks: 25

ExternalMarks: 75

COREPRACTICAL-IV BIOPROCESS AND FOOD TECHNOLOGY(P)

Courseoutcomes

- To students will get hands on exposure & understand the chemical nature and associated microbes of food and the principles of food processing, preservation and manufacture.
 - Acquired knowledge about various industrial production
 - To understand the various downstream processing methods and production of industrially significant products in fermentation.
 - Acquired knowledge about Production of yogurt, butter
 - Acquired knowledge about various techniques
1. Isolation of industrially important microorganisms.
 2. Selective isolation of actinomycetes –study their growth characteristics.
 3. Isolation and enumeration of lactic acid bacteria.
 4. Ethanol production by yeast.
 5. Wine production by yeast–setting up a lab experiment.
 6. Bio diesel production method
 7. Bioplastic production
 8. Estimation of alcohol content by colorimetric method and GLC.
 9. Enzyme production–amylase production.
 10. Production of organic acids citric acid production by solid state fermentation.
 11. Antibiotic production by different strains of microbes(Theory).
 12. Test for sensitivity of microorganisms.
 13. Down stream processes of enzymes– dialysis.
 14. Ion exchange chromatography–drying–cellulose column chromatography.
 15. Immobilization of yeast cell by alginate beads
 16. Bioassay techniques for antibiotics.
 17. Large scale production of organic acids, large scale production of solvents using fermentor(Demo).
 18. Visit to Distillery unit; alcohol production and pharmacological industries. Pasteur Institute(Fieldvisit).
 19. Isolation & identification microbes from spoiled food.

20. Production of cheese, yogurt, butter and icecream

Total Number of Topics	Local	Regional	National	Global	Category Based on %
20	10	1	7	2	Local

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

References

21. E.Mans,E.M.T.andC.F.A.Bryce,TaylorandFrancis,UK.2002.FermentationtechnologyandBiotechnology.
22. Ghose,T.KandP.Ghose. 2003.BiotechnologyinIndia.SpringerPublishers,India.
23. Glazer,A.NandH.Nikaido.1995.MicrobialBiotechnology.W.H.FreemanandCo.,New York.
24. Stanbury,P.F.,A.WhitakeransS.J.Hall.1995.PrinciplesoffermentationTechnology,Pergamon,UK.
25. Wolf.CruzerandAnnaliseCruzer.2000.BiotechnologyTextBookofIndustrialMicrobiology.Panama PublishingHouse,New Delhi.
26. Patel, A.H. 2001.IndustrialMicrobiology,Mac-MillanIndiaLtd.

RelationshipMatrixforCOs, POsandPSOs

Semester	Code	TitleoftheCourse					Hours	Credits				
IV	20PBT4CP4	BioprocessandFood Technology(P)					8	4				
Course Outcomes (COs)	ProgrammeOutcomes(POs)					ProgrammeSpecificOutcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO3	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NumberofMatches(✓)=45Relationship:VeryHigh										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh

SEMESTER-IV

CourseCode:20PBT4EC5:1
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE -V

ENVIRONMENT BIOTECHNOLOGY AND NANOTECHNOLOGY

Courseoutcomes

- Toacquireknowledgeaboutenvironmentalpollution-sources,effectsandcontrolmeasuresofenvironmentalpollution.
- Tobeawareofthenationalandinternationalconcernforprotectingtheenvironment.
- Togainknowledge onthe importance ofenvironmentaleducationandecosystem.
- GainanunderstandingofproducingnovelnanobiologicsandNanopharmaceuticals
Expandtheir knowledgeonEthical,SafetyandregulatoryissuesofNanomedicine.

UNIT-I **Introduction to Pollution**, Introduction, Types of pollution, Air, water, sound pollution- Measurement of pollution-Basic components of environment-Definition, concept and scope of ecosystem-abiotic and biotic components-Global environmental problems - ozone depletion, green house effect and acid rain-Control of pollution through Biotechnology-Biotechnological approaches for industrial waste water treatment- dairy, distillery, tannery, sugar, and pharmaceutical industrial- Biodegradation of inorganic and organic wastes, lignin, tannin-Bioremediation of oil spills- Biomonitoring of water pollution using algae, bacteria, plankton-Management for effluent toxicity,heavy metal pollution,thermal and radio active pollution.

UNIT-II

Solid waste management, Types of solid wastes-Solid waste characteristics and its impact on environment- Solid waste disposal, land filling, incineration, composting, mushroom farming- vermiculture and biogas production- Processing of sugar factory wastes-residential and municipal wastes- coir wastes and myco straw wastes- Biodegradation of xenobiotics compounds –Biotechnological methods for hazardous waste management-Bio peat production-Biofuel production technology

UNIT-III

Conservation Biotechnology, Biodiversity, types, uses and values – Loss of Biodiversity- Conservation and sustainable management of Biodiversity - In situ and Ex situ eco restoration-Environmental and biodiversity laws and environmental education.

UNIT-IV

Synthesis of Nano Materials and Characterisation-Definition of a nano system- dimensionality and size dependent phenomena, Quantum dots -Nano wires and Nanotubes- Methods for synthesis of Nanoscale Materials-Basic concepts and properties of nanostructured materials-Gold Nanoparticles- Nanopores. Characterisation of Nanomaterials-Scanning electron microscopes, transmission electron microscopes, Nuclear Magnetic Resonance Spectroscopy.

UNIT-V

Applications of nanotechnology -Nanosensors , types and its applications-Nano carriers for Drug Delivery - Polymeric Nanoparticles as Drug Carriers-Micelles for Drug Deliver-Microarray and Genome Chips- Microemulsions as Drug Delivery Vehicles- Lipoproteins as Pharmaceutical Carriers -Solid Lipid Nanoparticles as Drug Carriers- **Nanocapsules preparation, characterization and therapeutic Applications**- Nanomedicine- Recent technique in nanotechnolog- Nanotechnology for Cancer Research and Therapy-Environmental Nano Remediation Technology-Thermal,Physico Chemical and Biological Methods- Nano Filtration for the Treatment of Wastes-Removal of Organics, Inorganics and Pathogens- Nanotechnology for Water Purification.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
58	15	19	28	8	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Jogdand, S.N. 1995. Environmental Biotechnology. 1st Edition. Himalaya PublishingHouse,Bombay.
2. Technoglous,G.,Burton,F.L.andStensel,H.D.1995.WastewaterEngineeringTreatment, Disposal and Reuse.3rd Edition.Metcalf and Eddy,Inc., Tata Mc GrawHill,NewDelhi.
3. Jain, K.K. 2006. Nanobio-Technology in Molecular Diagnostics: Current TechniquesandApplications.HorizonBiosciences,India.
4. Parag Diwan and Ashish Bharadwaj. 2006. Nano Medicines Pentagon Press. ISBN 81-8274-139-4.

References

1. AlanScragg.1999.EnvironmentalBiotechnology.PearsonEducationLimited,England.
2. De,A.K.2004.EnvironmentalChemistry.WileyEasternLtd.NewDelhi.

3. Ratner, M. and Ratner, D. 2005. Nanotechnology: A Gentle Introduction to the Next Big Idea. Pearson Education, Inc. NJ, USA.
4. Christef, M., Niemeyer, C.A., Mirkin. 2004. Nano biotechnology. Concepts, Application and Properties. Wiley-VCH Publishers, New York.
5. Tuan Vo-Dinh. 2007. Nanotechnology in Biology and Medicine: Methods, Devices and Applications. Taylor and Francis Inc., London.
6. Challa S.S.R. Kumar (Ed). 2006. Biological pharmaceutical Nanomaterial, Wiley-VCH Verlag GmbH & Co, KgaA. Weinham, Germany.
7. Vladimir P. Torchilin (Ed.). 2006. Nanoparticulates as Drug Carriers. Imperial College Press, North Eastern University, USA. ISBN 1-86094.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20PBT4EC5:1	Environment Biotechnology and Nanotechnology					5	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓) = 45		Relationship: Very High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

CourseCode:20PBT4EC5:2
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVE COURSE – V

ENZYMETECHNOLOGY

Courseoutcomes

- Acquiretheknowledgeabouthistory,classification,purificationandseparationofenzymes
- Describethemechanismofenzymeactionandconstructtheknowledgeonenzymeregulation.
- TounderstandtheEnzymesactivityandkinetics.
- Tocreateabasicunderstandingoftheimportanceofenzymesascellular catalysts.
- Appraiseaboutthetechniquesofimmobilizationandapplicationinenzymes inindustries.

UNIT-I Historical aspects of enzymology

History, nomenclature and classification of enzymes-according to IUB EC 1964. Intracellular localization of enzymes, isolation and fractionation of enzymes -classical methods of purification and crystallization-Anti enzyme technique-Applications of antienzyme technique-criteria of purity, units of enzyme activity-Turn over number, specific activity -Active site definition-organization and determination of active site residues.

UNIT-II Kinetics of catalyzed reaction

Single substrate reactions, bisubstrate reactions -Concept and derivation of Michaelis -Menten equation-Lineweaver burk plot, Briggs Haldane relationship -Determination and significance of kinetic constants-Limitations of Michaelis-Menten Kinetics. Inhibition kinetics-competitive, non competitive and uncompetitive-Allosteric inhibition, cooperative,cumulative, feed back inhibition.

UNIT-III Mechanism of enzyme catalysis

Collision & transition state theories -specificity of enzymes -Proximity and orientation effects, general acid-base catalysis-covalent and electrostatic catalysis-nucleophilic and electrophilic attacks, catalysis by distortion-metal ion catalysis-Theories on mechanism of catalysis-Coenzymes - structure and function, Mechanism of enzymes action-mechanism of action of lysozyme and chymotrypsin-Isoenzymes.

UNIT-IV Enzyme Regulation

General mechanisms of enzyme regulation-Reversible (glutamine synthase & phosphorylase) and irreversible (proteases) covalent modifications of enzymes -Mono cyclic and multicyclic cascade systems with specific examples-Allosteric enzymes, qualitative description of “concerted” & “sequential” models for allosteric enzymes. Protein ligand binding measurement-analysis of binding isotherms.

UNIT-V Applications of enzymes in Industry

Immobilization and Immobilized enzymes -Various methods of immobilization-ionic bonding, adsorption, covalent bonding (based on R groups of amino acids)-micro encapsulation and gel entrapment-Applications of immobilized enzymes. Biosensors-glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors- Abzymes and Ribozymes-Enzymes of clinical importance- diagnostic significance and therapeutic effects –Enzyme Engineering.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
45	10	13	14	17	Global

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

Text Books

1. Thomas M Devlin. Textbook of Biochemistry with Clinical Correlations, 7th edition, Wiley publisher.2010.
2. Sathyanarayana U and Chakrapani U. Biochemistry, 4th edition, Elsevier publishers.2013.
3. Zubay, Principles of Biochemistry-4th ed, William C. Brown Publication 1998.
4. Palmer. Understanding enzymes. Prentice Hall.2004.

References

1. Blazej, A. & Zemek, J. 1987. InterBiotech, 87, Enzyme technologies, Elsevier.
2. Murray Moo-Young. 1988. Bioreactor immobilized enzyme and cells. Fundamentals and applications, Elsevier, applied science.
3. Rehm, H. J. & Yee, G. 1988. Biotechnology, Vol. 7a, Enzyme technology, Elsevier.
4. William, B. Jakoby, 1984. Methods in Enzymology, vol. 104, enzyme purification and related techniques.
5. Charlotte W Pratt and Kathleen Comely. Essential Biochemistry, 3rd edition Wiley publisher. 2013.
6. Deb A C. Fundamentals of Biochemistry, 10th edition, New Central Book Agency (p) Ltd, London. 2011.
7. Rajagopal, G. Concise textbook of Biochemistry, 2nd edition, Abuja Publishing House. 2010.
8. Reginald, H. Garrett and Charles M Grisham, 5th edition. Biochemistry, Brooks Cole publishers. 2012.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
V	20PBT4EC5:2	Enzyme technology					5	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
CO2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO3	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		
CO4		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		
CO5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Number of Matches (✓) = 42 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

SEMESTER-IV

CourseCode:20PBT4EC5:3
InstructionHours: 5
Credits:5

ExamHours:3
InternalMarks: 25
ExternalMarks: 75

ELECTIVECOURSE -V

QUALITY CONTROL AND HYGIENIC PRACTICES

Courseoutcomes

- AcquiretheknowledgeaboutQualitycontrolandmanagement
- TolearnthebasicknowledgeinFirstaidprocedures.
- Tomaintainthemicrobiologicalqualityin alltheneedyenvironment
- Tocreateabasicunderstandingofthehygienicpracticesinindustries.
- To learnthe hygienichealthypracticesandHealth fromenvironmentalfactors.

UNIT-I Quality control

Quality assessment of Equipment's, chemicals, glass wares and laboratory environments -Variance – Quality control calculations-Quality management- Maintenance of records and reports-Regulations of quality measurements-Types of quality measurement.

UNIT-II Quality assurance and policy I

Quality assurance- Definition, designing of microbiology laboratory, applications- In house Committee for quality assurance-Persons involved, Internal Microbial Quality control Policy-QualityCheck at every step from collection of raw materials till it reaches the customer-Implementation of ISO standards and history-definitions, principles and use of HACCP in Food Industry.

UNIT- III Quality assurance and policy II

Quality assessment of disposal –decontaminated matters and other biological effluents-Quality management in transportations of cultures-BIS, Biological parameters references and standards-Good laboratory practices-Management of laboratory hazards- knowledge in First aid procedures.

UNIT-IV Quality control organizations

Role, function, monitoring and mitigation activities of quality control (National, international and non govt.) organizations -ISO/TC 34, 48, 93, 147, 190, 194, 255; ISO 9000;ISO 22000; ISO 9001; ISO9004; ISO19011;- AS9100; ISO13485; ISO/TS16949; MBNQA;- Lean; Six Sigma; TQM-USDA, FDA, HARPC, IFPTI- Food Safety and Standards Authority of India.

UNIT-V Hygienic practice

Hygienic practices in industries- antibiotics-disinfectants, definition, sources, determination of antimicrobial efficiency- evaluation of disinfectants, factory and hospital hygiene-good manufacturing practices- sterilization control and sterility assurance.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
33	10	7	15	14	National

*Colour indicates –Green-Local, Pink-Regional, Blue-National, Brown-Global

References

1. Food Microbiology – Frazier and D.C. Westhoff, Third Ed, TATA McGraw Hill Pub. New Delhi.
2. Rajesh Bhatia and Rattan Lal Ichhpujani. 1995. I ed. “Quality assurance in Microbiology”.
3. Industrial Pharmaceutical Microbiology- II: Standards & Controls. Editors – Dr Norman Hodges and Professor Geoff Hanlon (University of Brighton). (REF; www.euromed.uk.com).
4. Water Analysis – A practical guide to Physico – Chemical & Microbiological water examination and Quality assurance – W. Schneider, W. Fresenius & K.E. Quentin. Springer – Verlag Pub. Heidelberg.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	20PBT4EC5:3	Quality Control and Hygienic Practices					5	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO2	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
CO3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
CO4	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CO5	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
Number of Matches (✓) = 41		Relationship: High									

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	VeryPoor	Poor	Moderate	High	VeryHigh



Syllabus for M. Phil., Biotechnology



PG & Research Department of Biotechnology
THANTHAI HANS ROEVER COLLEGE
Autonomous and affiliated to Bharathidasan University, Trichy
Nationally accredited by NAAC
Perambalur – 621 212
THANTHAI HANS ROEVER COLLEGE (Autonomous)
Perambalur – 621 212

M. Phil. Biotechnology – Course Structure under CBCS

(applicable to the candidates admitted from the academic year 2021-2022 onwards)

	Course and Subject code	Title of the course	Marks			Credit
			IA	UE	Total	
Semester I	Course I (20MPBT1CC1)	Research methodology	40	60	100	4
	Course II (20MPBT1CC2)	Advances in Biotechnology	40	60	100	4
	Course III (20MPBT1CC3)	Teaching and Learning skills	40	60	100	4
	Course IV (20MPBT1CC4)	Paper on topic of research (Guide will prepare the syllabus and it will be sent to the COE)	40	60	100	4
Semester II	20MPBTPW	Dissertation and Viva-Voce (Viva-Voce – 50 and Dissertation – 150 marks)	-	-	200	8

For each Course other than the Dissertation

Continuous Internal Assessment	=	40 Marks
End Semester Examination	=	60 Marks
Total	=	100 Marks

Question paper pattern for Course I - III

10 questions compulsory 10 x 01	=	10 Marks (2 from each unit)
5 questions 05 x 04	=	20 Marks (either or type, one from each unit)
3 questions from 5 03 x 10	=	30 Marks (one question from each unit)
Total	=	60 Marks

Question paper pattern for Course IV

5 Questions 05 x 12	=	60 Marks (either or type, one from each unit)
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CIA components

Tests (2x10)	=	20 Marks
Term Paper	=	10 Marks
Seminar & Assignment	=	10 Marks

Semester: I
Hours: 4

Course Code: 20MPBT1CC1
Credit: 4

COURSE –I: Research Methodology

Objectives

- To enable the research scholars understand the basic concepts of research methods.
- To expose the research scholars have thorough knowledge on Research.

UNIT - I

Introduction to research methodology-What is research? -Basic and applied research-Essential steps in research- Defining the research problem- Research/Experimental design- Literature collection- Literature citation- Research report: components Format of thesis and dissertation - Manuscript/research article-Review monographs -Bibliography and Reference -Significance of research.-Ethical issues of research

UNIT - II

Biophysical Methods- Scope of biophysics-Analysis of biomolecules using UV/Visible-Fluorescence- IR spectroscopy-IR scopy - Circular dichroism -NMR and ESR spectroscopy -Structure determination using x-ray diffraction and NMR -Analysis using light scattering - GCMS-GCMS application -Different type of mass spectrometry and surface plasma resonance methods -Radiolabeling techniques Properties of different types of radioisotopes normally used in biology their detection and measurement - Incorporation of radioisotopes in biological tissues and cells - Molecular imaging of radioactive material safety guidelines.

UNIT - III

Microscopic Techniques -Visualization cells and subcellular components by light microscopy, Resolving powers of different microscopes -Microscopy of living cells -Scanning and transmission microscopes -Different fixation and staining techniques for EM-Freeze, etch and freeze-fracture methods for EM - Image processing methods in microscopy -Histochemical and Immunotechniques Antibody generation-Detection of molecules using ELISA, RIA, western blot - Immunoprecipitation Monoclonal antibody-Hybridoma technology - Flowcytometry-immunofluorescence microscopy -Detection of molecules in living cells -In situ localization such as FISH and GISH.

UNIT - IV

Electrophysiological Methods -Single neuron recording - Patch clamp recording -ECG-Brain activity recording -Lesion and stimulation of brain -Pharmacological testing PET MRI -fMRI CAT -Computational methods- Nucleic acid and protein sequence database- data mining methods for sequence analysis- web based tools for sequence searches motif analysis and presentation.

UNIT - V

Statistical Methods -Applications of statistical methods-Measures of central tendency and dispersal -Probability distributions (Binomial, Poisson and normal)- Sampling distribution -Difference between parametric and non-parametric statistics -Confidence interval -Errors Levels of significance-Regression and correlation; T test; analysis of variance -X2 test -Basic introduction to Muetrovariate statistics, etc.,

Total Number of Topics	Local	Regional	National	Global	Category Based on %
72	22	17	37	20	National

References

1. C.R. Kothari, IInd edition (2004) Research methodology, Methods and techniques, New Age Internation (P) Ltd, Publishers, New Delhi.

2. Jerrod H. Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.
3. Attwood. T.K and Parry-Smith D.J. (2002) Introduction to Bioinformatics, Pearson education Singapore.
4. Sharma.BK.Instrumental methods of chemical analysis.
5. Upadhyay, Upadhyay and Nath, Biophysical chemistry.
6. KhandpurR.S. Handbook of biomedical instrumentation, Tata Mc GrawHill.
7. Brigal.L.Williams,A biologist guide to principle and techniques of practical biochemistry.

Semester: I
Hours: 4

Course Code: 20MPBT1CC2
Credit: 4

COURSE –II: Advances in Biotechnology

Objectives

- To enable the research scholars to understand current advances in Biotechnology.
- To expose the research scholars have thorough knowledge on genetic engineering, animal, plant, Microbial and Nano Biotechnology applications.

UNIT- I

Plant Biotechnology-**Applications of plant biotechnology**-Production of transgenic plants tolerant to biotic stresses-Genetically improved crops(Golden rice)-Bt and Terminator - Technology Protecting Systems (GURTs)-Clean Gene Technology-Gene silencing Anti Sense RNA technology (FlavrSavr)-RNA interference-Production technology for Plantigens-Plantibodies-Food vaccines-Bioplastics.

UNIT- II

Animal Biotechnology-Scope of animal biotechnology-Animal cell cultures-Primary & Continuous cell lines-Animal Virus derived vectors SV-40&Baculovirus-Expression vectors - GST and pET-based vectors-Protein purification -Histag GSTtag MBPtag-Inclusion bodies-Transgenic mice, fish and sheep-Hybridomatechnology-Recombinant vaccines production-**Gene therapy**-Stem cell technology -Somatic cell-Nuclear transfer-Xeno transplantation.

UNIT- III

Microbial Biotechnology-**Scope and techniques**-Importance of microbial technology-Selection and improvement of strains for biomass production-

Production of recombinant proteins-Enzymes and vaccines in microbes-
 Bioprospecting of Microbial diversity- Bioweapons and Bioshields-Direct
 Mutagenesis-Protein engineering-Principle of microbial reaction engineering and
 novel metabolites-Uses of Genetically Engineered Microbes in Agriculture,
 Industries and Medicine.

UNIT- IV

Nanobiotechnology-Carriers for Drug Delivery- Overview of nano technology-
 Nano carriers -Cubosomes-Hexosomes-Virosomes-Viruslike Nanoparticles-
 Microbial Nanoparticles Magnetosomes and Bacteriorhodopsins-Nanoparticles for
 Biomedical Imaging-Immuno fluorescent -biomarker Immunogold labeling-Iron
 oxide nanoparticles for Magnetic Resonance Imaging (MRI)- Nanosphere-
 Nanocapsule -Applications of Nanobiotechnology - Biochips, Nucleic acid
 nanoparticles-Nanotubes and Nano rods-Fullerenes for Drug Delivery.

UNIT- V

Ethical Issues in Biotechnology-Biosafety Biosafety cabinet-Biosafety cabinet
 types Biosafety for human health and environment. Social and ethical issues of
 biosafety-Use of genetically modified organisms (BT cotton and BT brinjal) and
 their release into the environment-Special procedures for r DNA based products-
 Intellectual property rights-patenting (Process and Product)-Bioethics-Ethical
 issues of Synthetic biology-Nanobiotechnology.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
76	14	24	37	34	National

References

1. Glick BR and Pasternak JJ. 2010. Molecular Biotechnology: Principles and applications of recombinant DNA, 4thEd. ASM Press, Washington, USA.
2. Watson JD *et al.*, 2007. Recombinant DNA: Genes and Genomes- a short course. 3rdEd. Cold Spring Harbor Laboratory Press, CSHL, New York, USA.
3. Brown TA. 2010. Gene cloning and DNA Analysis- An Introduction, 6thEd. Blackwell Science Ltd. Oxford, UK.
4. Satish MK. 2008. Bioethics and Biosafety. I K International Publishing House PvtLtd,India.
5. DeepaGoel and ShominiParashar. 2013. IPR, Biosafety and Bioethics. 1st Ed. Pearson Education, India

Semester I
Hours:4

Course Code: 20MPB1CC4
Credit: 4

COURSE –IV: Teaching and Learning skills

Objectives

- Acquaint different parts of computer system and their functions
- Understand the operations and use of computers and common accessories.
- Appreciate the role of ICT in teaching, learning and Research
- Acquire the knowledge of communication skill with special reference to its elements, types, development and styles
- understand the communication process through the web

Unit-I

Computer Application Skills Computer system-Characteristics, Parts and their functions -Different generations of Computer Operation of Computer: switching on / off / restart, Mouse control-Use of key board and some functions of key-

Information and Communication Technology (ICT)- Definition, Meaning, Features Trends -Integration of ICT in teaching and learning - ICT application Using word processors, spread sheets, Power point slides in the classroom - ICT for Research Online journals, ebooks, Courseware, Tutorials, Technical reports - Theses and Dissertations.

Unit- II

Communication Skills Communication -Definitions - Elements of Communication: Sender, Message, Channel, Receiver, Feedback and Noise-Types of Communication: Spoken and written- Non verbal communication - Intrapersonal, Interpersonal, Group and Mass communication-Barriers to communication - Mechanical, Physical, Linguistic & Cultural-Skills of communication: Listening, Speaking, Reading and writing-Methods of developing fluency in oral and written communication - style, Diction and Vocabulary - Classroom communication and dynamics.

Unit-III

Communication Technology Communication Technology -Bases, Trends and Developments - Skills of using Communication Technology-Computer Mediated Teaching-Multimedia- E content-Satellite based communication EDUSAT and ETV channels, Communication through web Audio and Video applications on the Internet, interpersonal communication through the web.

Unit-IV

Pedagogy Instructional Technology -Definition, Objectives and Types-Difference between Teaching and Instruction-Lecture Technique Steps, Planning of a Lecture, Delivery of a lecture-Narration in tune with the nature of different disciplines-Lecture with power point presentation Versatility of lecture technique - Demonstration Characteristics Principles Planning Implementation and Evaluation -Teaching Learning Techniques - Team Teaching Group discussion,

Seminar, Workshop, Symposium and Panel Discussion -Models of teaching: CAI, CMI and WBI.

Unit-V

Teaching Skills Teaching skill -Definition, Meaning and Nature-Types of Teaching skills -Skill of Set Induction-Skill of Stimulus Variation-Skill of Explaining-Skill of Probing Questions-Skill of Black Board writing and Skill of Closure - Integration of Teaching Skills -Evaluation of Teaching Skills.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
49	32	6	8	20	global

References:

1. Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi.
2. Don Skinner (2005), Teacher Training, Edinburgh University Press Ltd., Edinburgh.
3. Information and Communication Technology in Education: A Curriculum for Schools and programme of Teacher development, Jonathan Anderson and Tom Van Weart, UNESCO, 2002.
4. Kumar K.I (2008) Educational Technology, New Age International Publishers, New Delhi.
5. Mangal, S.K. (2002) Essential of Teaching – Learning and Information Technology, Tandon Publications, Ludhiana.

6. Michael D. and William (2000), Integrating Technology into Teaching and Learning: Concepts and Applications, Prentice Hall, New York.
7. Pandey S.K. (2005) Teaching Communication, Commonwealth Publishers, New Delhi.
8. Ram Babu A. and Dandapani S (2006) Microteaching (Vol.1&2) Neelakamal Publications, Hyderabad.
9. Singh V.K. and Sudarshan K.N. (1996) Computer Education, Discovery Publishing Company, New York.
10. Sharma R. A. (2006) Fundamentals of Educational Technology, Surya Publications, Meerut
11. Vanaja. M. and Rajasekar S. (2006) Computer Education, Neelkamal Publications, Hyderabad.

Semester: I

Hours: 5

Course Code: 20MPBTEC5:1

Credit: 4

PHYTOCHEMISTRY

UNIT - I

Biogenesis. General techniques involved in biosynthetic studies and brief introduction to the biogenesis of secondary metabolites -. Primary and secondary metabolites - Factors affecting secondary metabolites in medicinal plants.

UNIT - II

Biosynthetic studies on the following Alkaloids - Ephedrine, Hyoscyamine, Hyoscyne, Morphine - Papaverine, Reserpine and Ergometrine - Glycosides: Digitoxin, Scillaren and Sennosides.

UNIT - III

Extraction, Isolation and Purification of Phytoconstituents.- General Methods of extraction, isolation and purification of phytoconstituents Isolation, identification - tests and estimation methods for the following phytoconstituents with special emphasis on HPLC, HPTLC and other advanced techniques - a) Asavone from Acorus Calamus - b) Aloin from Aloes - c) Vasicine from Adhatoda vasica - d) Andrographolides from Andrographus paniculata - e) Curcumin from Curcumin Longa - f) Piperine from Piper Longum - g) Berberine from Berberis aristata - h) Gingerol from Zingiber Officinale - i) Hesperidine from Orange peels.

UNIT - IV

General methods for determining the structure of the following class of compounds - a) Alkaloids - b) Glycosides - c) Flavanoid - d) Terpenoids - e) Carotenoides.

UNIT - V

Structural elucidation of following class of phytoconstituents - Structural elucidation of important phytoconstituents belonging to different groups. - a) Alkaloids - Nicotine, Atropine, Morphine, Caffeine. b) Glycosides - Amygdalin, Strophanthidin c) Steroids - Cholesterol, d) Carotenoids- Vitamin A, Lycopine and Beta-carotene e) Terpenoids - Camphor, Eugenol, Taxol, Pyrethrin. f) Flavonoids: -Rutin - Quercetin.

Total Number of Topics	Local	Regional	National	Global	Category Based on %
36	12	11	17	4	local

References

1. Text book of Pharmacognosy, by G.E. Treese and W.C. Evans, 15th edition, W.B. SaundersEdenburg, New York.,
2. Phytochemistry – Volume I to IV, by Miller Jan, Nostrant Renhold
3. Recent advances in Phytochemistry - Volume I to IV, Scikel Runeckles Appleton century Crofts
4. Pharmacognosy and Phytochemistry of Medicinal plants by Jean Bruneton, Rechnique anddocumentation – Lavoiser, 1995
5. Pharmacognosy and Phytochemistry by Vinod D. Rangari Part I and II
6. Organic chemistry of natural products, Volume 1 and 2 by Gurdeep R. Chatawal
7. Organic chemistry by I.L. Finar – Vol. I and II
8. Natural product chemistry by Nakanishi Golo 9. Introduction to Molecular Phytochemistry by C.H. J.Wells (Chapman and Hall) 10. Comparative Phytochemistry, Ed. By T. swain
11. Natural products: A lab guide by Raphael Iran. IInd Edition Academic press, 1991
12. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae