VIVEKANANDHA
COLLEGE OF ARTS AND SCIENCES FOR WOMEN
[AUTONOMOUS]

An ISO 9001:2008 Certified Institution
Affiliated to Periyar University
(Approved by AICTE and Re-accredited with „A‟ Grade by NAAC)
Recognized Under 2(f) and 12 (b) of UGC Act, 1956.
Elayampalayam, Tiruchengode-637 205, Namakkal Dt., Tamil Nadu, India

DEPARTMENT OF BIOTECHNOLOGY
Bachelor of Science

B. Sc SYLLABUS

[For the Candidates admitted on 2021-2024 onwards under Autonomous, CBCS & OBE pattern]
(I to VI SEMESTERS)

SPONSORED BY
ANGAMMAL EDUCATIONAL TUST
ELAYAMPALAYAM – 637 205, TIRUCHENGODE Tk., Namakkal Dt., Tamil Nadu
VEERACHIPALAYAM – 637 303, SANKARI Tk., Salem Dt., Tamil Nadu
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B.Sc BIOTECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

GRADE	OBJECTIVE
PEO: 1	Biotechnology graduate students shall attain professional/industrial expertise by developing competent, creative and ever ready personality to accept recent, innovative and challenging roles in Industry and Academic and Research sectors
PEO: 2	Students shall inculcate in the development of entrepreneurial traits in order to cuddle innovative opportunities by adapting emerging biotechnological concepts in terms of techniques with subsequent development of leadership in the course of start-up of small-medium scale biotech based industry
PEO: 3	Students shall progressively adapt, follow and learn the concepts of biotechnology continuously by aiding modern teaching tools
PEO: 4	Imparting the basic and outstanding knowledge in all terms of biotechnology
PEO: 5	Students shall acquire the concepts to disseminate the advanced biotechnological aspects and its cutting edge developments in specific and developing area in the field of Biotechnology

PROGRAMME OUTCOMES (POs)

GRADE	OUTCOME
PO: 1	To train and develop students with the much needed biotechnological education, so that they develop added competitive skill metrics (CSM) for industrial employment higher education and employment upon graduation
PO: 2	To comprehend the assorted knowledge of biotechnical concepts domains and their applicability in the development of value added products for the welfare of the society
PO: 3	To develop a broad range of biotechnological skills and knowledge, development of general and specific competences to meet-out current expectations and requirements of medical, pharmaceutical, bio-molecular and agricultural sectors
PO: 4	To understand and merge the knowledge and concepts of biochemical, biophysical and bio statistical domains
PO: 5	To clarify various challenges in health care by integrating different biological domains including clinical, immunological, pharmaceutical and cancer genomics

PROGRAMME SPECIFIC OUTCOMES (PSOs)

GRADE	SPECIFIC OUTCOME
PSO: 1	To provide solutions for the challenges faced by pharmaceutical and molecular diagnostic Sectors
PSO: 2	To provide technical products with high frequency of reproducibility to the society
PSO: 3	To gain vertical mobility in career that will make students more competent to face national/international qualifying exams with practical knowledge acquaintance and in modern biotechnology field
PSO: 4	To solve complex problems in the field of Biotechnology with an understanding of social, ethical, legal and cultural aspects of the society
PSO: 5	To understand the over-all theme/concepts of each specialization in biotechnology and analysing the frequency of its applicability in industry, research and for the goodness of Society

SYLLABUS FRAMEWORK

Subjects	Inst. Hour/Week	Credits	Subjects	Inst. Hour/Week	Credits
Semester I			**Semester II**		
Language I	6	3	Language II	6	3
English I	6	3	English II	6	3
Core I	5	5	Core II	6	5
Allied I	4	3	Allied II	4	4
Core practical I	4	3	Core practical II	3	3
Allied practical I	3	3	Allied practical II	3	2
VAC - YOGA	2	2	VAC – EVS	2	2
Total	**30**	**22**	**Total**	**30**	**22**
Semester III			**Semester IV**		
Language III	6	3	Language IV	6	3
English III	6	3	English IV	6	3
Core III	5	5	Core IV	5	5
Allied III	4	3	Allied IV	4	3
Core practical IV	4	3	Core practical IV	4	3
Allied practical IV	3	3	Allied practical IV	3	3
SBEC I	2	2	SBEC II	2	2
Total	**30**	**22**	**Total**	**30**	**22**
Semester V			**Semester VI**		
Core V	5	5	Core VII	5	5
Core VI	5	5	Core VIII	5	5
Core practical V	5	3	Core practical V	5	5
Core practical VI	5	3	Elective II	5	4
Elective I	4	3	NMEC II	2	2
NMEC I	2	2	SBEC IV	2	2
SBEC III	2	2	Library/Sports	1	-
Library/Sports	1	-	Mini project	5	5
Extension activity	1	1	Extension activity	-	1
Total	**30**	**24**	**Total**	**30**	**29**
Grand total					**140**

CBCS SYLLABUS – UG (OBE PATTERN)
(For candidates admitted from 2021-2024 onwards)
YEAR I

Subject code	Part	Course	Title	Hrs/ week	Credit	Internal	External	Total
SEMESTER I								
21U1LT01 21U1LM01 21U1LH01 21U1LF01	I	Language I	Tamil I Malayalam I Hindi I French I	6	3	25	75	100
21U1LE01	II	Language II	Foundation English I	6	3	25	75	100
21U1BTC01	III	Core I	Cell Biology & Genetics	5	5	25	75	100
21U1BTCP01	III	Core I Practical	Lab in Cell Biology & Genetics	4	3	40	60	100
21U1BCA01	III	Allied I	Biochemistry I	4	3	25	75	100
21U1BCAP01	III	Allied Practical I	Lab in Biochemistry I	3	3	40	60	100
21U1VE01	IV	Value Education I	Yoga	2	2	25	75	100
Total				**30**	**22**	**205**	**495**	**700**
SEMESTER II								
21U2LT02 21U2LM02 21U2LH02 21U2LF02	I	Language II	Tamil II Malayalam II Hindi II French II	6	3	25	75	100
21U1LE02	II	Language II	Foundation English II	6	3	25	75	100
21U2BTC02	III	Core II	Microbiology	6	5	25	75	100
21U2BTCP02	III	Core Practical II	Lab in Microbiology	3	3	40	60	100
21U2BCA02	III	Allied II	Biochemistry II	4	4	25	75	100
21U2BCAP02	III	Allied Practical II	Lab in Biochemistry II	3	3	40	60	100
21U2VE02	IV	Value Education II	Environmental Studies	2	2	25	75	100
Total				**30**	**22**	**205**	**495**	**700**
Grand Total of First Year				**60**	**48**	**410**	**990**	**1400**

YEAR II

Subject code	Part	Course	Title	Hrs/ Week	Credit	Internal	External	Total
SEMESTER III								
21U3LT03 21U3LM03 21U3LH03 21U3LF03	I	Language III	Tamil III Malayalam III Hindi III French III	6	3	25	75	100
21U3LE03	II	Language III	Foundation English III	6	3	25	75	100
21U3BTC03	III	Core III	Molecular Biology	5	5	25	75	100
21U3BTCP03	III	Core Practical III	Lab in Molecular Biology	4	3	40	60	100
21U3BOA01	III	Allied III	Plant Science I	4	3	25	75	100
21U3BOAP01	III	Allied Practical III	Lab in Plant Science I	3	3	40	60	100
	IV	SBEC I	Optional	2	2	25	75	100
Total				**30**	**22**	**205**	**495**	**700**
SEMESTER IV								
21U4LT04 21U4LM04 21U4LH04 21U4LF04	I	Language IV	Tamil IV Malayalam IV Hindi IV French IV	6	3	25	75	100
21U4LE04	II	Language IV	Foundation English IV	6	3	25	75	100
21U4BTC04	III	Core IV	Genetic Engineering	5	5	25	75	100
21U4BTCP04	III	Core Practical IV	Lab in Genetic Engineering	4	3	40	60	100
21U4BOA02	III	Allied IV	Plant Science II	4	3	25	75	100
21U4BOAP02	III	Allied practical II	Lab in Plant Science II	3	3	40	60	100
	IV	SBEC II	Optional	2	2	25	75	100
Total				**30**	**22**	**205**	**495**	**700**
Grand Total of Second Year				**60**	**44**	**410**	**990**	**1400**

YEAR III

Subject code	Part	Course	Title	Hrs/ week	Credit	Internal	External	Total
SEMESTER V								
21U5BTC05	III	Core V	Immunology	5	5	25	75	100
21U5BTC06	III	Core VI	Plant Biotechnology	5	5	25	75	100
21U5BTCP05	III	Core practical V	Lab in Immunology	5	3	40	60	100
21U5BTCP06	III	Core practical VI	Lab in Plant Biotechnology	5	3	40	60	100
	III	Elective I	Optional	4	3	25	75	100
	IV	SBEC III	Optional	2	2	25	75	100
		NMEC I	Optional	2	2	25	75	100
21U5BTEX01	IV	Internship		1	1	40	60	100
		Library/Sports	Reference/Health Management	1	-	-	-	-
Total				**30**	**23**	**245**	**555**	**800**
SEMESTER VI								
21U6BTC07	III	Core VII	Bioprocess technology	5	5	25	75	100
21U6BTC08	III	Core VIII	Animal Biotechnology	5	5	25	75	100
21U6BTCP07	III	Core practical VII	Lab in Bioprocess technology and Animal biotechnoogy	5	5	40	60	100
	III	Elective II	Optional	5	4	25	75	100
	IV	SBEC IV	Optional	2	2	25	75	100
	IV	NMEC II	Optional	2	2	25	75	100
21U6BTMP01	IV	Research Activity	Mini project	5	5	40	60	100
		Extension activity		-	1	-	-	-
		Library/Sports	Reference/Health Management	1	-	-	-	-
Total				**30**	**29**	**205**	**495**	**700**
Total of Third Year					**140**	**1270**	**3030**	**4300**

LIST OF ELECTIVE PAPERS		
GRADE	**SUBJECT**	**SUBJECT CODE**
Elective I	Pharmaceutical Biotechnology	21U5BTE01
	Enzymology and Enzyme Technology	21U5BTE02
	Tissue Engineering	21U5BTE03
Elective II	Genomics and Proteomics	21U6BTE04
	Biophysics and Bioinstrumentation	21U6BTE05
	Environmental Biotechnology	21U6BTE06
LIST OF SKILLED BASED ELECTIVE PAPERS		
SBEC I	Lab in food processing and technology	21U3BTS01
	Developmental Biology	21U3BTS02
	Food biotechnology	21U3BTS03
SBEC II	Lab in poultry science	21U4BTS04
	Marine Biotechnology	21U4BTS05
	Forensic science and technology	21U4BTS06
SBEC III	Lab in Bioinformatics	21U5BTS07
	Biosafety, Bioethics and IPR	21U5BTS08
	Cancer Biology	21U5BTS09
SBEC IV	Lab in Entrepreneurship in Biotechnology	21U6BTS10
	Nano Biotechnology	21U6BTS11
	Biofarming	21U6BTS12
LIST OF NON-MAJOR ELECTIVE PAPERS		
NMEC I	Biosafety, Bioethics and IPR	21U5BTN01
	Bioinformatics	21U5BTN02
NMEC II	Concepts of Biotechnology	21U3BTN03
	Biotechnology for Society	21U3BTN04

BLOOM'S TAXONOMY BASED ASSESSMENT PATTERN		
KL	**CPD**	**DESCRIPTION**
K1	Remember	Retrieving, recognizing and recalling knowledge from long-term memory
K2	Understand	Constructing meaning from oral, written and graphic messages through interpreting
K3	Apply	Carrying out or using a procedure through executing or Implementing
K4	Analyse	Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing and attributing
K5	Evaluate	Making judgments based on criteria and standards through checking and critiquing
K6	Create	Putting elements to form a coherent or functional hole, reorganizing elements into a new pattern or structure through generating, planning or producing
Note: **KL: K**nowledge **L**evel**; CPD: C**ognitive **P**rocess **D**imension		

BLOOM'S TAXONOMY BASED INTERNAL ASSESSMENT PATTERN FOR MODEL AND SEMESTER EXAMINATION

SECTION	CPD/GRADE	MARKS	CONTENT	CUMULATIVE
A: 20 X 1	K1 & K2	20	Multiple choice questions	75
B: 1 out of 2 (5 X 5) Either or choice	K2, K3, K5 & K6	25	Short notes	
C: 3 out of 5 X 10	K3, K4, K6	30	Essay type descriptive	

BLOOM'S TAXONOMY BASED INTERNAL ASSESSMENT PATTERN FOR CIA I & II EXAMINATIONS

SECTION	CPD/GRADE	MARKS	CONTENT	CUMULATIVE
A: 10 X 1	K1 & K2	10	Multiple choice questions	25
B: 1 out of 2 (1 X 5)	K2, K3, K5 & K6	5	Short notes	
C: 1 out of 2 (1 X 10)	K3, K4, K6	10	Essay type descriptive	

SEMESTER I

CELL BIOLOGY & GENETICS

Paper	: CORE I	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: **21U1BTC01**	External	: 75

PREAMBLE

To make the students to understand the basics concepts living cellular organization and cellular function and to impart knowledge of classical genetics

COURSE OUTCOMES

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

Cos	Outcome	CPD
CO1	Acquire the conceptual knowledge of fundamentals of Cellular architecture	**K1**
CO2	Understand the functions of cellular organelles of cell, nucleus and familiarize with cellular physiology	**K1 & K2**
CO3	Have a comprehensive knowledge on cellular energetics and basics of genetics	**K2 & K4**
CO4	Gain expertise in gene interaction mechanisms and ploidy levels	**K3 & K5**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	L	M	M	M	L
CO2	M	S	S	S	M
CO3	S	S	S	S	S
CO4	S	S	M	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**History of cell biology and cellular architecture**: Cell theory. Classification of cell types (prokaryotic & eukaryotic). Cytoskeleton movements (Sliding & Contraction). Organization of plant and animal cell. Cell wall and cell membrane. Cytoskeletal structures (Micro tubules, Micro filaments and intermediary filaments). Nutrient transport (Active, passive & facilitated diffusion).	15

II	**Subcellular organelles and Chromosomal organization:** Structure and functions of Endoplasmic reticulum, Golgi apparatus, Chloroplast, Ribosomes, Mitochondria, Vacuoles, Lysosomes, Glyoxysomes, Peroxysomes, Nucleus. Chromosome: Morphology, Structure.	15
III	**Cell cycle, Cell communication and cell death;** Cell cycle - Mitosis and Meiosis, Signal transduction: definition, signals, ligands and receptors. Endocrine, paracrine and autocrinesignaling. - mechanism of signal transmission, G Protein coupled receptors- structure, regulatory GTPases, heterotrimeric G proteins and effector molecules of G Proteins. Cell death - types. Necrosis - causes and mechanism. Apoptosis: morphology, causes and mechanism Differences between apoptosis and necrosis.	15
IV	**Cellular energetics & History of genetics:** Concepts of Phenotype, genotype, heterozygous, homozygous, allele-dominant & recessive, wild type mutant), character, gene, gene locus, hybrids. Chromosome, Centrosome, telomere, Chemical composition of chromatin, structural organization of heterochromatin. ATP formation. Mendelian Principles, Segregation, Independent Assortment, Dominance relations, Multiple alleles, Incomplete dominance, Over dominance.	15
V	**Gene interaction and Chromosome variation:** Gene interaction, Epistasis, Sex determination and sex linkage in diploids, Linkage and crossing over. Sex determination on XX-XY, XX-XO, ZW-ZZ, ZO-ZZ types in animals. Chromosomal variation in number (Ploidy) and changes in chromosomal structure (addition, deletion, duplication, translocation & inversion).	15

SUGGESTED READINGS:

1. Alberts et al., 1994. Molecular Cell Biology of Cell – Bruce, Galand publications NY.
2. Jack D. Bruke Cell Biology – The William Company
3. Lodish et al., (2008). Molecular Cell Biology, 6th ed. Wilson J and Hunt T (2002). Molecular Biology of the Cell: A Problems approach, 4th ed.
4. EJ Gardner, MJ. Simmons and DP Snustad, 2006. Principles of Genetics 8th edition, John Wiley & Sons Publications.
5. Karp G. 2008. Cell and Molecular Biology, 5th edition. John Wiley and Sons Inc. Hardcover. ISBN: 978-0-470-04217-5.
6. PS. Verma and VS Agarwal. 1986. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S Chand and Company, New Delhi.
7. Lodish et al Molecular Cell biology 8th ed. Freeman, 2016.
8. Abouelmagd and Ageeley. Basic Genetics. 2 nd ed. Univ Publ. 2013.
9. Twyman. Advanced Molecular Biology. BIOS Sci Publ. 2000.
10. Karp. Cell & Molecular Biology 8 thed 2016. Wiley.
11. Elrod S. Schaum‟s Outline of Genetics. 5 th ed. McGraw Hill. 2010.
12. Fletcher et al. Instant Notes in Genetics. 4th ed. Garland Science. 2012.
13. Watson. Molecular Biology of the Gene. 7th ed. Pearson Edu, 2013.

MODEL QUESTION PAPER (CELL BIOLOGY AND GENETICS)

NAME OF THE COURSE: **CELL BIOLOGY AND GENETICS**	COURSE CODE: **20U1BTC01**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The cell was first discovered by_____			
a. Schwann	b. Robert Hooke	c. Debary	d. Tatum
2. Cell theory was proposed by ----------			
a. Schleiden and Schwann	b. Robert Hooke	c. Leeuwen Hooke	d. Beetle and Tatum
3. Microfilaments are composed mainly of a proteins called			
a. Actin	b. Tubulin	c. Myosin	d. chitin
4. The subunits of prokaryotic ribosome are ----------			
a. 60s + 40s	b. 70s + 30s	c. 60s + 30s	d. 50s + 80s
5. The plant cell wall mainly composed of ----------			
a. Cellulose	b. Starch	c. Protein	d. Lipid
6. Smooth endoplasmic reticulum is the site of _____			
a. Protein synthesis	b. Carbohydrate synthesis	c. Amino acid synthesis	d. Lipid synthesis
7. The cell theory not applicable to ----------			
a. Bacteria	b. Algae	c. Viruses	d. Fungi
8. Which one the power house of the cell?			
a. Cell wall	b. Mitochondria	c. Nucleus	d. Ribosome
9. Apoptosis cannot kill the following cells			
a. Cell infected with virus	b. Cell with DNA damage	c. Cancer cells	d. Immune cell
10. Special enzymes are released during necrosis from			
a. Lysosomes	b. Vacuoles	c. Cytoplasm	d. Golgi bodies
11. Chromosomes are duplicated during the cell cycle in_____			
a. B phase	b. G phase	c. S phase	d. P phase
12. Spindle fiber is formed during ----------			
a. Anaphase	b. Telophase	c. Prophase	d. Pro metaphase
13. Which of the following is the end product of respiration process?			

a. Release of oxygen	b. Release of CO_2	c. Anabolism	d. Transfer of CO_2
14. Who is regarded as the father of genetics?			
a. Bateson	b. Morgan	c. Mendel	d. Watson
15. Mendel experimental material was_____?			
a. Pisum sativum	*b. Lathyrus odaratus*	*c. Oryza sativa*	*d. Mirabilis jalappa*
16. What was the most commonly used "energy currency" of cells for all organisms?			
a. ATP	b. ADP	c. Inorganic phosphate	d. DNA
17. What does t-RNA bind with_____?			
a. DNA	b. mRNA	c. Northing	d. rRNA
18. Lethal genes were first discovered by?			
a. William Ernest Castle	b. Lucien Cuenot	c. Clarence Cook	d. Gluecksohn-Waelsch
19. Repetition of a chromosomal segment means _____?			
a. Deletion	b. Duplication	c. Inversion	d. Translocation
20. Walter Sutton and Theodore Boveri formally proposed that chromosomes contain the genes in the year of ----------			
a. 1903	b. 1901	c. 1920	d. 1930

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Write the classification of cell types? B) Write a short note on Cytoskeleton?	(OR)
22. A) Explain structure and functions of nucleus? B) Structure and morphology of chromosomes?	(OR)
23. A) Differences between apoptosis and necrosis? B) Explain the types of cell signaling?	(OR)
24. A) Write a short note on ATP formation? B) Redox potential of the cell membrane?	(OR)
25. A) What is gene and how to interact? B) Chromosomal theory of inheritance?	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Write the essay on cell types and cytoskeletal structures and movements
27. Explain the structure and functions of any five subcellular organelles
28. Write the essay on mitosis and meiosis and G-protein coupled receptor
29. Write an essay on mendlian principles
30. Explain the variation in chromosome structure and function

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

LAB IN CELL BIOLOGY& GENETICS

Paper	: CORE PRACTICAL I	Total Hours	: 60
Hours/Week	: 4	Exam Hours	: 05
Credit	: 3	Internal	: 40
Paper Code	: 21U1BTCP01	External	: 60

PREAMBLE

To make the students to understand the basics microscopy, cell division, histology, subcellular organelle isolation and mendelian principles

COURSE OUTCOMES

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

Cos	Outcome	CPD
CO1	Acquiring hands on skills on microscopy and visualization of prokaryotic and eukaryotic cells	**K1 & K2**
CO2	Exposure towards various stages of cell division	**K1 & K2**
CO3	Gain knowledge on basics concepts organelle isolation and Estimation	**K4**
CO4	Performing and validating mono and dihybrid crosses experiments and result interpretation	**K3 & K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	M	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	M	S
CO4	S	S	S	M	M

S: Strong; **M**: Medium; **L**: Low

Exp. No	Title	Hours
1	The Microscope: the bright field microscope, use of oil immersion (100x), Measurements: ocular and stage micrometers, measuring depth, measuring area and measuring volume.	8
2	Enumeration of cells (cell counting by Neubauer chamber).	4
3	Preparation of mitotic cells stages from onion root tip squash	4
4	Preparation of meiosis cell stages from Grass hopper testis cells.	8
5	Isolation of chloroplast from spinach leaves	4
6	Observation of specialized cells (Nerve cell, sperm cell, Muscle cell and Cardiac cell).	8
7	Staining of macro molecules (Carbohydrate, Lipid and Protein)	4
8	Histochemistry: preparation of permanent slides, Periodic acid Schiff (PAS) reaction	8
9	Mono & Dihybrid cross	4
10	Buccal smear preparation (Bar body preparation)	4

MODEL QUESTION PAPER (LAB IN CELL BIOLOGY & GENETICS)

NAME OF THE COURSE: **LAB IN CELL BIOLOGY & GENETICS**	COURSE CODE: 21**U1BTCP01**	DURATION: **6Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total: **20 MARKS**
1. (i) Explore any one of the stages of mitosis from the onion root tip squash (A) sample. Display the results for observation (OR)			
(ii) Isolate the mitochondria from the given plant sample (A). Display the results for observation (OR)			
(iii) Perform total blood cell count (cell counting by Neubauer chamber) from the given blood sample (A). Display the results for observation			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
2. (i) Perform carbohydrate staining from the given leaf sample (B). Display the results for observation (OR)			
(ii) Isolate chloroplast from the given leaf sample (B). Display the results for observation (OR)			
(iii) Determine the sex of the individual from given buccal epithelial cell sample (B) by appropriate method. Display the results for observation			
SPOTTERS (5 X 4 = **20 MARKS**)			
3. Identify the given spotters C, D, E, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

BIOCHEMISTRY I

Paper	: ALLIED I	Total Hours	: 60
Hours/Week	: 4	Exam Hours	: 03
Credit	: 3	Internal	: 25
Paper Code	: 21U1BCA01	External	: 75

PREAMBLE

To make the students to understand the basics biological molecules existing the living cell systems. Students also acquire knowledge on their biological functions and their importance in cell growth and development

COURSE OUTCOMES

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

Cos	Outcome	CPD
CO1	Acquiring knowledge on carbohydrate and its types in biological systems.	**K1 & K2**
CO2	Understanding the basic concepts on proteins and amino acids and their properties	**K1 & K2**
CO3	Under the role of biological catalysts (Enzymes) and lipids, their role in basic biochemical reactions	**K2, K3 & K4**
CO4	To gain over all information on vitamins, their physiological functions and deficiency symptoms and consequent diseases	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	M
CO2	S	S	S	S	M
CO3	S	S	S	S	S
CO4	M	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Carbohydrates** –Carbohydrate – classification, monosaccharide‟s (glucose, fructose, galactose & xylose)- physical and chemical properties, disaccharides (sucrose, lactose), polysaccharides (glycogen, starch, pectin, keratin sulphate & chondroitin sulphate).	**12**
II	**Amino acids and proteins:** Classification, Structure, Essential and Non-essential amino acids. Definition, Classification, Functions and Properties of protein. Proteins structure -primary, secondary, tertiary and quaternary structures.	**12**
III	**Enzymes:** Definition, holo enzyme, apo enzyme, active site, Enzyme units,	**12**

	classification, Lock and Key model and Induced fit hypothesis. Enzyme kinetics (MM & LB plot), factors affecting enzyme activity.	
IV	**Lipids:** Classification, structure, function and properties of simple, compound, Derived, Essential fatty acids and Non-essential fatty acids, cholesterol.	**12**
V	**Vitamins:** Classification, occurrence, deficiency symptoms and biochemical functions of vitamins (Fat soluble and water soluble vitamins).	**12**

SUGGESTED READINGS:

1. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper‟s Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
2. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
3. G.L Zubay (1999) Biochemistry, 4th Ed, WCB, McGraw-Hill, New York.
4. Ambika Shanmugam(1998)., Fundamentals of Biochemistry for Medical Students.
5. U. Satyanarayana., (2006) A textbook of Biochemistry, Books & Allied, Kolkata.
6. J.L Jain., (2005). Fundamentals of Biochemistry. S.Chand Publishing, New Delhi.
7. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York

MODEL QUESTION PAPER (BIOCHEMISTRY I)

NAME OF THE COURSE: **BIOCHEMISTRY I**	COURSE CODE: 21**U1BCA01**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The general formula of monosaccharide is ----------			
a. CnH_2nOn	b. Cn_2H_2On	c. CnH_2O_2n	d. CnH_2nO_2n
2. The aldose sugar is ----------			
a. Glycerose	b. Ribulose	c. Erythrulose	d. Dihydoxyacetone
3. Polysaccharides are ----------			
a. Polymers	b. Acids	c. Proteins	d. Oils
4. The most important epimer of glucose is ----------			
a. Galactose	b. Fructose	c. Arabinose	d. Xylose
5. A heteropolysacchraide among the following is ----------			
a. Inulin	b. Cellulose	c. Heparin	d. Dextrin
6. An example of a saturated fatty acid is ----------			
a. Palmitic acid	b. Oleic acid	c. Linoleic acid	d. Erucic acid
7. Molecular formula of cholesterol is ----------			
a. C27H45OH	b. C29H47OH	c. C29H47OH	d. C23H41OH
8. Sphingomyelins are ----------			
a. Phospholipids	b. Nitrolipids	c. Glycolipids	d. Alcohol
9. The end product of saponification is ----------			
a. Glycerol	b. Acid	c. Soap	d. Both (A) and (C)
10. All proteins contains ----------			
a. Same 20 amino acids	b. Different amino acids	c. 300 Amino acids occurring in nature	d. Only a few amino acids
11. Sulphur containing amino acid is ----------			
a. Methionine	b. Leucine	c. Valine	d. Asparagine
12. An essential amino acid in man is ----------			
a. Aspartate	b. Tyrosine	c. Methionine	d. Serine
13. Which of the following is a dipeptide?			
a. Anserine	b. Glutathione	c. Glucagon	d. β –Lipoprotein

14. Vitamins are ----------			
a. Accessory food factors	b. Generally synthesized in the body	c. Produced in endocrine glands	d. Proteins in nature
15. One manifestation of vitamin A deficiency is ----------			
a. Painful joints	b. Night blindness	c. Loss of hair	d. Thickening of long bones
16. Vitamin K is found in ----------			
a. Green leafy plants	b. Meat	c. Fish	d. Milk
17. In human body highest concentration of ascorbic acid is found in ----------			
a. Liver	b. Adrenal cortex	c. Adrenal medulla	d. Spleen
18. A nucleoside consists of ----------			
a. Nitrogenous base	b. Purine or pyrimidine base + sugar	c. Purine or pyrimidine base + phosphorous	d Purine + pyrimidine base + sugar + phosphorous
19. RNA does not contain ----------			
a. Uracil	b. Adenine	c. Thymine	d. Ribose
20. The major catabolic product of pyrimidines in human is ----------			
a. Alanine	b. Urea	c. Uric acid	d Guanine

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Explain Polysaccharides B) Write the structure and importance of maltose.	(OR)
22. A) Classify the fatty acids with examples. B) Write the structure of cholesterol.	(OR)
23. A) Explain the reactions of amino acid with ninhydrin B) Describe the primary structure of protein	(OR)
24. A) Write about energy rich bond B) Explain oxidative phosphorylation	(OR)
25. A) Write about Vitamin E B) Explain the structure & sources of Vitamin C	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Classify the carbohydrate with examples
27. Classify the lipids with examples
28. Write the structural organisation of protein
29. Explain the double helical structure of DNA
30. Write the structure, physiological function & deficiency symptoms of Vitamin A

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

LAB IN BIOCHEMISTRY I

Paper	: ALLIED PRACTICAL I	Total Hours	: 60
Hours/Week	: 3	Exam Hours	: 03
Credit	: 3	Internal	: 40
Paper Code	: 21U1BCAP01	External	: 60

PREAMBLE

To make students on understanding and identification of simple and polysaccharides, and to make them in understanding the knowledge on qualitative identification of amino acids. The students also gain hands on skills on basic separation of biomolecules by simple chromatographic techniques.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Acquiring knowledge on qualitative analysis of carbohydrates.	**K3, K4 & K5**
CO2	Acquiring knowledge on qualitative analysis of aminoacids.	**K3, K4 & K5**
CO3	Under the role of thin layer chromatography in the separation of amino acids	**K3, K4 & K5**
CO4	Under the role of thin layer chromatography in the separation of Lipids	**K3, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

Ex. No	CONTENT	HOURS
1	**PREPARATION OF SOLUTION** Normal, Molar, Percentage solution and calculation	**3**
2	**Analysis of sugars** a) Monosaccharides - Glucose, Fructose.	**6**
3	**Analysis of sugars** a) Monosaccharides - Galactose, Pentose.	**6**
4	**Analysis of sugars** b) Disaccharides - Sucrose, Maltose and Lactose.	**6**
5	**Analysis of sugars** c) Polysaccharide – Starch	**3**

6	**Analysis of amino acids** a) Histidine b) Tyrosine	**6**
7	**Analysis of amino acids** c) Tryptophan d) Methionine	**6**
8	**Analysis of amino acids** e) Cysteine f) Arginine	**3**
9	Separation of amino acids by paper chromatography	**3**
10	Separation of lipids by thin layer chromatography	**3**

MODEL QUESTION PAPER (LAB IN BIOCHEMISTRY I)

NAME OF THE COURSE: **LAB IN BIOCHEMISTRY I**	COURSE CODE: **21U1BCAP01**	DURATION: **3 Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT
Total **25 MARKS**
1. (i) Systematically analyze the give carbohydrate sample (A) and display the results for observation (OR)
(ii) Separate the given lipid sample (A) by thin layer chromatography.
MINOR EXPERIMENT
Total: **25 MARKS**
2. (i) Separate the given amino acid sample (B) by paper chromatography and display the results for observation (OR)
(ii) Systematically analyze the give amino acid sample (B) and display the results for observation.
RECORD (1 x 10 = **10 MARKS**)
TOTAL **60 MARKS**

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SEMESTER II

MICROBIOLOGY

Paper	: Core II	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 21U2BTC02	External	: 75

PREAMBLE

To make students on understanding and identification of simple and polysaccharides, and to make them in understanding the knowledge on qualitative identification of amino acids. The students also gain hands on skills on basic separation of biomolecules by simple chromatographic techniques.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand historical prospective on the evolution of microbiology and gaining the concepts microscopic techniques	**K1 &K2**
CO2	To acquire knowledge on the basic concepts on prokaryotic cellular structure	**K1 &K2**
CO3	To acquaintance of basic nutritional requirements of microorganism and their growth pattern and media requirements	**K2, K3 & K4**
CO4	To know about the anti-microbial therapy and their mode of action on controlling the growth of microorganisms	**K2, K3, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**DEFINITION AND SCOPE OF MICROBIOLOGY:** History and recent Developments: Contributions of Leevenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff, Edward Jenner, Alexnder fleming, Spontaneous generation, Biogenesis of Microbiology. Nobel prize winners in the field of Medicine.	**15**
II	**MICROSCOPY:** Simple and Compounds microcopes. Dark field contrast, Fluorescence microscopes. Electron microscopes (TEM & SEM). Stain and staining techniques – Simple, differential and special staining (Endospore and Capsular).	**15**

III	**CELLULAR STRUCTURES OF PROKARYOTES:** Ultra structure and functions of bacterial cell wall, Plasma membrane, Flagella, Pili and capsule. Ultra structure of fungi, Viruses and cyanobacteria.	**15**
IV	**STERILIZATION AND CULTURE TECHNIQUES:** Physical and chemical methods. Growth of bacteria – multiplication – nutritional requirements. Factors affecting growth. Growth curve, Determination of growth. Media and its types, Culture techniques (pure culture, anaerobic culture). Cultivation of anaerobes, Chemoautotrophs, chemoheterotrophs and photosynthetic microbes. Culture collection, preservation, lyophilization and freeze drying	**15**
V	**ANTIMICROBIAL CHEMOTHERAPY:** Definition and types of antibiotics. Mode of action of broad and narrow spectrum antibiotics. Anti-microbial resistance. Mechanisms of resistance. Test for evaluating anti-microbial effect. Microbial metabolism- Microbial metabolism. Photosynthesis in microbes. Role of chlorophylls, carotenoids and phycobilins, Calvin cycle.	**15**

SUGGESTED READINGS:

1. Microbiology – concepts and application by Paul A. Ketchum, Wiley Publications 2010.
2. Fundaments of Microbiology- Frobisher, Sauders & Toppan publications 1975.
3. Microbiology - Ronald M. Atlas 1993.
4. Introductory Biotechnology – R.B. Singh C.B.D. India (1990)
5. Industrial Microbiology – Casida, E. Wiley Eastern Ltd 1962.
6. Industrial Microbiology – Casida, E. Wiley Eastern Ltd 1962.
7. Fundamentals of Bacteriology – Salley 1996.
8. Microbiology – Pelczar, Chan, Krieg, Tata McGraw Hill Publications 2005.
9. Frontiers in Microbial technology – P.S. Bisen, CBS Publishers 1994.
10. Biotechnology: International Trends of perspectives - A.T.Bull, G. Holl, M.D.Lilly, Oxford & TBH publishers 1987.
11. General Microbiology-C.B.Powar, H.F. Daginawala, Himalayan Publishing House 2011.

MODEL QUESTION PAPER (MICROBIOLOGY)

NAME OF THE COURSE: **MICROBIOLOGY**	COURSE CODE: **21U2BTC02**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The third kingdom, protista, as suggested by E.H. Haeckel includes ----------			
a. bacteria	b. algae	c. fungi	d. all the above
2. Who discovered the bacteria that cause cholera?			
a. Pierre Berthelot	b. Robert Koch	c. Louis Pasteur	d. Rudolf Virchow
3. Which were the investigators lived at the same time?			
a. Darwin and Woese	b. Koch and Pasteur	c.Van Leeuenhoek and Ricketts	d. Berg and Hooke
4. Which of the following is not found in the kingdom Monera?			
a. Organelles	b. Organized cell structure	c. Ability to reproduce	d. Ability to use energy
5. Resolving power of a microscope is a function of ----------			
a. Wavelength of light used	b. Numerical aperture of lens system	c. Refractive index	d. Wavelength of light used and numerical aperture of lens system
6. In fluorescence microscopy, which of the following performs the function of removing all light except the blue light?			
a. Exciter filter	b. Barrier filter	c. Dichroic mirror	d. Mercury arc lamp
7. In Phase contrast microscopy, the rate at which light enters through objects is ----------			
a. Constant	b. Inversely proportional to their refractive indices	c. Directly proportional to their refractive indices	d. Exponentially related to their refractive indices
8. Which among the following helps us in getting a three-dimensional picture of the specimen?			
a. Transmission Electron Microscope	b. Scanning Electron Microscope	c. Compound Microscope	d. Phase Contrast Microscope
9. Which of the following is an example for prokaryotic cell?			
a. Hydra	b. Euglena	c. Chlamydomonas	d. mycoplasma
10. The unifying feature of the archaea that distinguishes them from the bacteria is ----------			
a. Habitats which are extreme environments with regard to acidity	b. Absence of a nuclear membrane temperature	c. Presence of a cell wall containing a characteristic outer membrane	d. Cytoplasmic ribosomes that are 70S
11. *Aspergillus niger* is used in the production of ----------			
a. cheese	b. citric acid	c. gluconic acid	d. citric acid and gluconic acid

12. Fungi are sensitive to which of the following antibiotics ----------			
a. Penicillin	b. Tetracyclin	c. Chloramphenicol	d. Griseofulvin
13. SDA that supports the growth of fungi is composed of ----------			
a.Glucose and ammonia	b. Maltose and peptone	c. Sucrose and peptone	d. Peptone
14. The portion of the growth curve where a rapid growth of bacteria is observed is known as ---------			
a. Lag phase	b. Log phase	c. Stationary phase	d. Decline phase
15. The generation time for *E.coli* is ----------			
a. 20 min	b. 35 min	c. 39 min	d. 13 min
16. What is the color of colonies of *Staphylococcus aureus* upon its growth in nutrient agar ?			
a. Pink	b. Red	c. Violet	d. Yellow
17. Which bacteria have an unusual capsule among the following?			
a. H. influenzae	*b. K. pneumonia*	*c. S. pneumoniae*	*d. B. anthracis*
18. What is the chemical nature of endotoxins?			
a. Protein	b. Polysaccharide	c. Lipo polysaccharide	d. lipid
19. Nystatin is effective in curing?			
a. Deep mycoses	b. Dermatophytosis	c. Systemic mycoses	d. Candidiasis
20. Which drug is used for treatment of leishmaniasis?			
a.Chloroquine phosphate	b. Metronidazole	c. Sodium stibogluconate	d. Suramin

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Explain the contributions of Louis Pasteur (OR) B) Explain about Biogenesis and Abiogenesis with examples
22. A) Describe the working mechanism of phase contrast microscope (OR) B) Explain about SEM
23. A) Write a short note on ultra-structure of bacterial cell (OR) B) Explain the structure of Fungi
24. A) Explain the process of reproduction in bacteria (OR) B) Brief various media involved in growth of microbes
25. A) Elaborate the antimicrobial resistance (OR) B) Explain the types of antibiotics
SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give detailed account on History of microbiology
27. Give detailed account on TEM and specimen preparation
28. Differentiate the Gram positive and negative organisms with examples
29. Write a detailed account on various sterilization techniques
30. Explain different types of antibiotics and antimicrobial resistance

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

LAB IN MICROBIOLOGY

Paper	: Core practical II	Total Hours	: 60
Hours/Week	: 3	Exam Hours	: 05
Credit	: 3	Internal	: 40
Paper Code	: 21U2BTCP02	External	: 60

PREAMBLE

To make students on understanding basic microbiological techniques, aseptic practices in laboratory. The candidate also shall know how to maintain and culture the microorganisms in laboratory and their biochemical identification mechanisms.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand and implement the principles of aseptic practices in Laboratory	**K1, K2 & K3**
CO2	To gain knowledge on the media preparation and culturing the Microorganism	**K2, K3 & K4**
CO3	To identify the microorganisms by staining techniques and biochemical tests	**K3, K4 & K5**
CO4	To check the growth pattern of microorganisms towards various classes antibiotics	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
1	General Laboratory rules to be followed in microbiological Laboratory	**3**
2	Sterilization techniques (Dry heat, Moist heat, Filtration - membrane and HEPA filters)	**4**
3	Preparation of nutrient media (Solid, semi - solid and liquid)	**5**
4	Isolation of pure culture (Streaking methods – simple, continuous, quadrant and „T" streaking)	**2**

5	Simple and negative staining	**3**
6	Differential staining (Gram‟s staining, Capsule staining, Spore	**10**
7	Fungal staining (LCB)	**5**
8	Determination of bacterial motility (Hanging drop method)	**5**
9	Biochemical characterization of microorganisms (IMViC), TSI test, Carbohydrate fermentation test, Urease test, Catalase test	**12**
10	Antibiotic sensitivity test (Kirby-Bauer method)	**10**

MODEL QUESTION PAPER (LAB IN MICROBIOLOGY)

NAME OF THE COURSE: **LAB IN MICOROBIOLOGY**	COURSE CODE: **21U2BTCP02**	DURATION: **6Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total **20 MARKS**
1. (i) Perform Gram"s staining for the given sample (A). Display the results for observation. (OR)			
(ii) Perform LCB staining for the given fungal (A) and display the results for observation. (OR)			
(iii) Identify the motility of the given bacterial strain (A) and display the results for Observation			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
2. (i) Determine the sensitivity pattern of the given bacterial culture (B) against the given antibiotics (OR)			
(ii) Perform quadrant streaking from the bacterial sample (B) and display the results for observation (OR)			
(iii) Perform catalase test for the given bacterial culture (B) for hydrogen peroxide production and display the results for observation			
SPOTTERS (5 X 4 = **20 MARKS**)			
3. Identify the given spotters A, D, H, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

BIOCHEMISTRY II

Paper	: ALLIED II	Total Hours	: 60
Hours/Week	: 4	Exam Hours	: 03
Credit	: 3	Internal	: 25
Paper Code	: 21U2BCA02	External	: 75

PREAMBLE

To make students on understanding basic biochemical reaction mechanisms of various biomolecules. The students also acquire knowledge on their regulation and also about the concepts of various endocrine systems and their deficiency consequences in human being.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To under the basic concepts of thermodynamics and energy production in living systems	**K1 & K2**
CO2	To understand the basic concepts of carbohydrate metabolism and their energy yield	**K1, K2 & K4**
CO3	To understand the basic concepts of protein & lipid metabolism and their energy yield	**K1, K2 & K4**
CO4	To understand the basic concepts of human endocrine system	**K1, K2 & K4**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Bio energetics –** Laws of thermo dynamics, Concepts of free energy and standard free energy, Exergonic and Endergonic reactions. Electron transport chain. Inhibitors of ETC. Oxidative phosphorylation, High energy compounds.	**12**
II	**Carbohydrate metabolism:** Glycolysis, Citric acid cycle with Energetics, glycogenesis, Glycogenolysis, HMP shunt.	**12**
III	**Protein metabolism:** Transamination, oxidative and non-oxidative deamination, decarboxylation- urea cycle. Interrelationship of carbohydrates, proteins and fat metabolism.	**12**
IV	**Lipid metabolism:** Basic principles of lipid metabolism. Oxidation of	**12**

	saturated (α, β and ω) and unsaturated fatty acids. Oxidation of odd chain fatty acids, Cholesterol biosynthesis and its importance.	
V	**Endocrinology –** Definition, Classification of Hormones, secondary messenger(cAMP) Biological function and disorders of Pancreatic Hormones (Insulin and Glucagon), Thyroid hormone (thyroxin).	**12**

SUGGESTED READINGS:

1. R.K. Murray, D.K. Granner, P.A. Mayes, D.W. Rodwell (2006), Harper‟s Biochemistry, twenty fifth edition, Prentice Hall, New Jersey.
2. D. Voet, and G.Voet (2006), Biochemistry, John Wiley and Sons, New York.
3. G.L Zubay (1999) Biochemistry, 4th Ed, WCB, McGraw-Hill, New York.
4. Ambika Shanmugam(1998)., Fundamentals of Biochemistry for Medical Students.
5. U. Satyanarayana., (2006) A textbook of Biochemistry, Books & Allied, Kolkata.
6. J.L Jain., (2005). Fundamentals of Biochemistry. S.Chand Publishing, New Delhi.
7. D.L.Nelson, and M.M. Cox (2008) Lehninger Principles of Biochemistry, 5th Ed, W.H. Freeman and Company, New York

MODEL QUESTION PAPER (BIOCHEMISTRY II)

NAME OF THE COURSE: **BIOCHEMISTRY II**	COURSE CODE: **21U2BCA02**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. In exergonic reaction heat is ----------			
a. Consumed	b. Liberated	c. No change in heat transfer	d. Enthalphy in more than 1
2. Hydrogen is transferred through a series of enzyme systems to form ----------			
a. Oxygen	b. Water	c. Carbohydrate	d. ATP
3. One molecule of ATP is equal to --------- molecules of NADP			
a. 1	b. 2	c.3	d. 4
4. Oxidative phosphorylation occurs in ----------			
a. Chloroplast	b. Mitochondria	c. Endoplasmic reticulum	d. Tonoplast
5. In which of the following phase in glycolysis does the ATP is consumed?			
a. Payoff phase	b. Interphase	c. Preparatory phase	d. Gap phase
6. The term glycogenolysis defines ----------			
a. Break down of glucose	b. Breakdown of glycogen	c. Synthesis of glucose	d. Synthesis of glycogen
7. HMP stands for ----------			
a. Hexo kinase shunt	b. Hexose mono nitrate shunt	c. Hexose mono phosphate shunt	d. Hexose mono butyrate shunt
8. Which of the following enzyme mainly involved in the process of glycogenesis?			
a. Glucagon lyase	b. Glycogen lyase	c. Glycogen synthase	d. Glucagon synthase
9. Transamination of amino acids is chiefly catalyzed by ----------			
a. Deaminase	b. Transaminase	c. Transketolase	d. Trans decarboxylase
10. Which of the following aminoacid involved in Urea cycle?			
a. Serine	b. Typtophan	c. Asparagine	d. Citrulline
11. SGOT is an enzyme that catalyzes---------- reaction			
a. Deamination	b. Trans deamination	c. Transamination	d. Decarboxylation
12. Non-oxidative deamination reactions is accomplished by ----------			
a. The conversion of alpha amino group to ammonia	b. Conversion of COOH group to CO_2	c. Removal of amino group as nitrogen	d. None of the above
13. Lipid metabolism entails the ----------			
a. Synthesis of fatty acids	b. Oxidation of fatty acids	c. Reduction of fatty acids	d. Conversion of fatty acids in to glycerol

14. Fatty acid synthase is a multi-enzyme complex composed of ---------- sub units			
a. 1	b. 2	c. 3	d. 4
15. Phenanthrene nucleus is found in ----------			
a. Stigmesterol	b. Ergosterol	c. Cholesterol	d. Levosterol
16. The precursor for the cholesterol biosynthesis is ----------			
a. Acyl Co-A	b. Acetyl Co-A	c. Aceto acetyl Co-A	d. Keto acyl Co-A
17. Ductless glands secretes ----------			
a. Serum	b. Hormone	c. Plasma	d. CSF
18. Hyper insulinism leads to ----------			
a. Decreased level of glycogen	b. Increased level of glucose	c. Increased level of glucagon	d. Increased rate of muscle phosphorylation
19. Which of the following is an example for secondary messenger?			
a. cGMP	b. cTMP	c. cUMP	d. cAMP
20. Thyroid hormone is highly concentrated on ----------			
a. Baso lateral plasma membrane of active histiocytes	b. Baso lateral plasma membrane of active hepatocytes	c. Baso lateral plasma membrane of active thyocytes	d. Baso lateral plasma membrane of active thrombocytes

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Write short notes on standard free energy B) Write about the inhibitors of ETC	(OR)
22. A) Explain the energetics of glycolysis B) Write shortly on the process of glycogenesis	(OR)
23. A) Write short notes on transamination reactions B) Write short notes on oxidative deamination reactions	(OR)
24. A) Explain the energetics of beta oxidation of fatty acids B) Explain the oxidation of odd chain fatty acids	(OR)
25. A) Explain the clinical manifestations of hypo parathyroidism B) Explain the complications faced by a victim having hyperglycemia	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give a detailed account on electron transport chain
27. Give a detailed account on TCA cycle
28. Elaborately discuss on Urea cycle with neat chemical reactions
29. Write an essay on cholesterol biosynthesis with neat chemical reactions
30. Explain the biological function thyroid hormone. Add a note on hypo and hyper thyroidism

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

ALLIED – LAB IN BIOCHEMISTRY II

Paper	: ALLIED PACTICAL II	Total Hours	: 60
Hours/Week	: 3	Exam Hours	: 03
Credit	: 3	Internal	: 25
Paper Code	: 21U2BCAP02	External	: 75

PREAMBLE

To make students on understanding basic biochemical calculations and preparing reagents and solutions. The students also gain knowledge on estimating quantitatively the biomolecules substances.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Become familiar in preparing different strengths of solutions for the basic requirement of executing biochemical experiments	**K1, K2, K4 & K5**
CO2	To know about the quantitative determination on the strength of various specific biomolecules	**K1, K2, K4 & K5**
CO3	Gaining knowledge on using basic instruments such as colorimeter and UV spectrophotometer for measuring the colour intensity developed in the reaction mixture	**K1, K2, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

Ex. No	CONTENT	HOURS
1	Estimation of glucose by ortho toluidine method	**3**
2	Estimation of glycine by formal titration method	**3**
3	Estimation of ascorbic acid by 2,4 dichloro phenol indo phenol method	**3**
4	Estimation of urea by diacetyl monoxime method	**3**
5	Estimation of DNA by diphenylamine method	**3**
6	Estimation of RNA by orcinol method	**3**
7	Estimation of protein by lowry‟s method	**3**
8	Estimation of cholesterol by zak‟s method	**3**

MODEL QUESTION PAPER (LAB IN BIOCHEMISTRY II)

NAME OF THE COURSE: **LAB IN BIOCHEMISTRY II**	COURSE CODE: 21U2BCAP02	DURATION: **3 Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT	
	Total **25 MARKS**
1. (i) Estimate the amount of glycine present in the given sample (A)	(OR)
(ii) Estimate the amount of ascorbic acid present in the given sample (A)	
MINOR EXPERIMENT	
	Total: **25 MARKS**
2. (i) Estimate the amount of protein present in the given sample (B)	(OR)
(ii) Estimate the amount of RNA present in the given sample (B)	
RECORD	(1 x 10 = **10 MARKS**)
TOTAL	**60 MARKS**

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SEMESTER III

MOLECULAR BIOLOGY

Paper	: Core IV	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21U3BTC03	External	: 75

PREAMBLE

To make students on understanding basic structure of genetic materials (DNA & RNA) and molecular concepts of a gene expression and its regulatory mechanisms

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To under the basic concepts of DNA/RNA structure and experimental evidences as genetic material	**K1, K2**
CO2	To under the mechanisms of replication of DNA and it regulation	**K1, K2, K4**
CO3	To know about the transcription process and its modifications into functional mRNA and translation into proteins	**K1, K2, K4**
CO4	To under the concepts of gene regulation and know about the mechanisms of transposition	**K2, K3, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Genetic material**: Evidences showing DNA and RNA as genetic material; DNA- Chemical composition & molecular structure, Watson and Crick‟s model - its biological significance; Forms of DNA (A, B, C, D & Z).Central dogma of molecular biology.	**12**
II	**DNA replication**: Origin & Models of - Meselson and Stahl‟s experiment - types of replication - Mechanism of DNA replication in prokaryotes and eukaryotes - Enzymology of replication. DNA repair- causes of DNA damage & biochemical mechanism of DNA repair. Homologous recombination- Holliday model	**16**
III	**Transcription:** RNA types and functions; RNA polymerase; Transcription in prokaryotes and eukaryotes; Post transcriptional modification -	**16**

	Transcription and processing of RNA in prokaryotes;Post transcriptional modifications, splicing, spliceosomes. Editing, Nuclear export of mRNA Transcription and processing of RNA in prokaryotes.	
IV	**Translation & Protein synthesis:** Genetic code: Properties of genetic code; codon- anticodon interaction- Wobble hypothesis and elucidation of genetic code; Translation in prokaryotes and eukaryotes; Post translational modification of proteins & molecular chaperonins .	**16**
V	**Regulation of gene expression**: Gene expression in transcriptional level (lac and trp operon); gene expression in bacteriophages. Transposons – types and mechanism of transposition. Gene silencing . Recombination – Homologous and Non – homologous recombination. Molecular techniques; DNA finger printing, DNA Microarray, Gene Mapping, Protein Micro array.	**15**

SUGGESTED READINGS:

1. David Freifelder . 1990. Molecular Biology, 2nd Edition. Narosa Publishing house
2. George M. Malacinski. 2008. Essentials of Molecular Biology, 4th Edition. Narosa Publishing house
3. Veer Bala Rastogi. 2010. Fundamentals of Molecular Biology. Ane Books India
4. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine and Richard Losile. 2008. Molecular Biology of the gene, 5th Edition. Pearson Education.
5. Lodhish, Berk, Matsun dairg, Kaiser, Krieger, Scott, Zipursky and Darnell. 2004. Molecular Cell Biology, 5th Edition. W. H. Freeman and Company
6. Robert F. Weaver. 1999. Molecular Biology. WCB Mc Graw Hill
7. E. D. P. De Robertis & E. M. F De Robertis, Jr. 2001. Cell and Molecular Biology, 8th Edition. Lipin cott William and Wilkins
8. Lehninger. 2005. Principles of Biochemistry. Nelson Cox, CBS Publishers
9. Alexander Mc Lenna, Andy Bates, Puil Turner & Mike White. 2015. Molecular Biology, 4th Edition. GS Garlan Sciences, Taylor and Francis Group
10. George M. Malacinski & David Freifelder. 1998. Essentials of Molecular Biology, 3rd Edition. Jones and Bartcett Publishers
11. Richard R. Sinden.1994. DNA Structure and function. Academic press
12. R.C. Rastogi. 2010. Cell and Molecular Biology. New Age International Publishers
13. Pragya Khana. 2008. Cell and Molecular Biology. IK International Publishing House
14. William D. Stanfield, Jaine S. Colome and Raul J. Cano. 2008. Shaum"s Outline- Molecular Cell Biology. Tata Mc Graw Hill
15. H.S. Bhamrah & Kavita Juneja. 2002. Molecular Cell Biology. Anmol Publications
16. G. P. Jeyanthi. 2009. Molecular Biology. MJP Publishers
17. N. Vidhyarasthi & D. M. Chelan. 2007. Molecular Biology. IK International Publishing House
18. P.S. Verma & V. K. Agarwal. 1998. Concepts of Molecular Biology. S. Chand and Company Ltd
19. Phil Turner, Alexander Mc Lennan, Andy Bates & Mike White. 2001. Molecular Biology, 3rd Edition. Bios Instant Notes
20. H. D. Kumar.2000. Molecular Biology, 2nd Edition. Vikas Publishing House
21. AVSS Sambamurhty. 2008. Molecular Biology. Narosa Publishing House

MODEL QUESTION PAPER (MOLECULAR BIOLOGY)

NAME OF THE COURSE: **MOLECULAR BIOLOGY**	COURSE CODE: **21U3BTC03**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Number of hydrogen bonds between adenine and thymine is ----------			
a. 1	b. 2	c. 3	d. 4
2. Difference between RNA and DNA lies on ----------			
a. Sugar	b. Phosphate group	c. Nitrogenous base	d. None of the above
3. The distance between two adjacent nitrogenous base pair is ---------- A°			
a. 2.4	b. 3.4	c.4.4	d. 5.4
4. DNA in chromosome is tightly packed with ----------			
a. Histones	b. Glycoproteins	c. Lipoproteins	d. Glycoproteins
5. Which of the following mode of replication is observed in a living cell?			
a. Conservative	b. Dispersive	c. Semi-Conservative	d. None of the above
6. Which of the following protein relaxes the frictional pressure found on the replication fork?			
a. Helicase	b. Gyrase	c. Topoisomerase	d. SSB
7. Which of the following maintains the single stranded nature of DNA?			
a. Helicase	b. Gyrase	c. Topoisomerase	d. SSB
8. Photo reactivation of DNA is catalyzed by ----------			
a. Gyrase	b. Topoisomerase	c. UVr B	d. Photolyase
9. The regulatory elements in a DNA is controlled by ----------			
a. Cis elements	b. Trans elements	c. Structural elements	d. Control elements
10. Introns in mRNA is removed by ----------			
a. Editing	b. Splicing	c. Capping	d. Poly adenylation
11. Difference between holo and core enzyme is ----------			
a. Alpha subunit	b. Beta subunit	c. Epsilon subunit	d. Zigma subunit
12. Formation of lariat is commonly found during ----------			
a. Transcription	b. Post transcriptional modifications	c. Translation	d. Post translational modifications
13. Each codon is characterized by ----------			
a. Singlet nucleotide	b. Doublet nucleotide	c. Triplet nucleotide	d. None of the above

14. The starting codon AUG codes for which of the following amino acid?			
a. Cysteine	b. Methionine	c. Serine	d. Threonine
15. Glycosylation of proteins describes the addition of----------to the growing poly peptide chain			
a. Glucose	b. Gelatin	c. Chalmoogric acid	d. Vitamin A
16. Which of the following machinery involved in post translational modifications of proteins?			
a. Molecular motors	b. Molecular chaperons	c. Molecular channels	d. Molecular locomotors
17. The function of trans acetylase is to ----------			
a. Transfer of CH_3C=O group	b. Transfer of CH_3C-OH group	c. Transfer of CH_2C=O group	d. Transfer of CH_3COOH group
18. Ty element is found in ----------			
a. Bacteria	b. Fungi	c. Protozoa	d. Yeast
19. Retroposons is commonly found in ----------			
a. Retroviridae	*b. Rhinoviridae*	*c. Adenoviridae*	d. *Poxviridae*
20. Catabolic repression refers to ----------			
a. Regulon	b. Operon	c. Citron	d. Recon

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Explain the experiments that proves DNA as genetic material B) Explain the structure of tRNA and mRNA with neat sketch	(OR)
22. A) Explain the Meselson‟s & Stahl experiment B) Write shot notes on prokaryotic DNA polymerase	(OR)
23. A) Explain RNA splicing B) Explain the process of transcription termination	(OR)
24. A) Explain Wooble hypothesis B) Explain the properties of genetic code	(OR)
25. A) Explain the mechanism of transposition B) Explain the structure of lactose operon	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Explain the chemical and physical structure of DNA
27. Give a detailed account on DNA replication in prokaryotes
28. Give a detailed account on Eukaryotic transcription
29. Explain the process of translation in prokaryotes
30. Explain the lac operon. Add a note on its regulation

LAB IN MOLECULAR BIOLOGY

Paper	: Core practical III	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 05
Credit	: 3	Internal	: 40
Paper Code	: 21U3BTCP03	External	: 60

PREAMBLE

To make students on understanding basic procedure in isolation separating purifying proteins. The students gain knowledge in DNA quantification and gene transfer methods

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To know about the isolation, purification and quantification of protein	**K1, K2, K3, K4 & K5**
CO2	To know about the separation and quantification of DNA	**K1, K2, K3, K4 & K5**
CO3	To know about the various types of gene transfer techniques	**K1, K2, K3, K4 & K5 K1, K2, K3, K4 & K5**
CO4	To identify and isolate the mutated bacterial by special techniques	**K2, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
1	Isolation of protein	**4**
2	Estimation of protein by Lowry‟s method	**4**
3	Purification of protein by dialysis	**4**
4	Separation of proteins by native – PAGE	**4**
5	Separation of DNA by agarose gel electrophoresis	**4**
6	Quantification of DNA by UV-visible spectrophotometer	**4**
7	Induction of mutation in bacterial cells UV light	**4**
8	Bacterial DNA transformation by CaCl method	**4**
9	Bacterial conjugation	**4**
10	Isolation of auxotrophic mutants by replica plating technique	**4**

MODEL QUESTION PAPER (LAB IN MOLECULAR BIOLOGY)

NAME OF THE COURSE: **LAB IN MOLECULAR BIOLOGY**	COURSE CODE: **21U3BTCP03**	DURATION: **6Hrs**
MAX MARKS: **60**		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total: **20 MARKS**
1. (i) Isolate protein from the given sample (A). Display the results for observation. (OR)			
(ii) Separate the protein from the given sample (A) by SDS-PAGE. Display the results for observation. (OR)			
(iii) Transform the given DNA sample (A) in to given host cell by appropriate method. Display the results for observation			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
2. (i) Purify the given protein sample (B) by dialysis. Display the results for observation (OR)			
(ii) Separate the given DNA sample (B) electrophoresis and display the results for observation (OR)			
(iii) Perform catalase test for the given bacterial culture (B) for hydrogen peroxide production and display the results for observation			
SPOTTERS (5 X 4 = **20 MARKS**)			
3. Identify the given spotters A, D, H, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

PLANT SCIENCE I

Paper	: ALLIED III	Total Hours	: 60
Hours/Week	: 4	Exam Hours	: 05
Credit	: 3	Internal	: 40
Paper Code	: 21U3BOA01	External	: 60

PREAMBLE

To make students on understanding basic concepts of fungi algae and bryophytes. The students also know about the lichenology and basic plant physiology

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To gain knowledge on basics of fungi and algae	**K1 & K2**
CO2	To gain knowledge on basics of bryophytes	**K1 & K2**
CO3	To gain knowledge on basics of lichens	**K1 & K2**
CO4	To gain knowledge on basic concepts of plant physiology	**K1, K2 & K4**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**ALGAE:** General characteristics of algae. Study on thallus structure, reproduction and life cycle of *Gellidium*, *Gracillaria* and *Polysiphonia*. Economic importance of algae in industries.	**12**
II	**FUNGI:** General characteristics of fungi. Study on thallus structure, reproduction and life cycle of *Agaricus*, *Penicillium* and *Saccharomyces cerevisieae*. Economic importance of fungi.	**12**
III	**LICHENS:** General characteristics of fungi. Study on thallus structure, reproduction of foliose, Crustose, Fruticose and Squamulose groups of lichens	**12**
IV	**BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS:** General characteristics. Study on the structure, reproduction and life cycle of bryophytes (*Marchantia*), Pteridophytes (*Lycopodium*), Gymnosperms (Cycus) and their economic importance.	**12**
V	**PLANT PHYSIOLOGY:** Absorption of water (Active and passive). Photosynthesis (Light and Dark reactions). Cyclic and non-cyclic photophosphorylation. Transpiration and its types (Stomatal transpiration).	**12**

SUGGESTED READINGS:

1. Vashishta BR, AK. Sinha. (2010). Botany for Degree student – Fungi. S. Chand & Co. New Delhi.
2. Pandey SN, Mishra SP and Trivedi PS. (2009). A text book of
3. Botany, Vol II, Vikas Publishing House Pvt. Ltd., Delhi.
4. Rao, KN, Krishnamoorthy KV and Rao GS. (1979). Ancillary Botany S. Viswanathan Pvt., Madras.
5. Text Book of Algae. (2018). KS. Bilgrami and LC Saha, 1st edition, CBS Publishers.
6. Algae. (2011). OP. Sharma, Tata Mc Graw Hill Education.
7. Advances in Mycology. (2012). Sohan Sharma, random Publications Publishers and Distributors, New Delhi.
8. BP. Pandey. (2011). A Textbook of Botany: Angiosperms – Taxonomy, Anatomy, Embryology and Economic Botany, S. Chand Limited.
9. BP Pandey. (1986). Text Book of Botany, Vol I & II Chand. S & Co. New Delhi.
10. Fuller. HJ and Tippo O. (1949). College Botany, Henry Holt & Company.
11. Ganguly AK. (1975). General Botany Vol I. (1971) and Vol II. The new Book stall, Calcutta.

LAB IN PLANT SCIENCE I

Paper	: ALLIED PRACTICAL III	Total Hours	: 60
Hours/Week	: 3	Exam Hours	: 05
Credit	: 3	Internal	: 40
Paper Code	: 21U3BOAP01	External	: 60

PREAMBLE

To make students on understanding basic concepts of fungi algae and bryophytes. The students also know about the lichenology and basic plant physiology

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To gain knowledge on the identification of fungi and algae	**K4, K5 & K6**
CO2	To gain knowledge on the identification basics of bryophytes	**K4, K5 & K6**
CO3	To gain knowledge on the economic importance of major plant Kingdoms	**K4, K5 & K6**
CO4	To gain experimental knowledge on plant physiology	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

1. Sectioning of given specimens (3 x 8 = 24 marks)
   a. Algae (or) Fungi 8 marks
   b. Bryophyte (or) Pteridophyte 8 marks
   c. Gymnosperms 8 marks
2. Identification of spotters (Permanent slides) (4 x 3 = 12 marks)
   d. Algae (or) Fungi 4 marks
   e. Bryophyte (or) Pteridophyte 4 marks
   f. Gymnosperms (or) Lichens 4 marks
3. Identification of spotters (Morphology) (3 x 3 = 9 marks)
   g. Algae 3 marks
   h. Fungi 3 marks
   i. Bryophyte/Pteridophyte/Gymnosperm 3 marks
4. Identification of the given setup (Physiology) (3 x 1 = 3 marks)
   j. Ganong‟s photometer (or) Wilmutt‟s bubbler
5. Identification of spotter (Economic importance) (1 x 2 = 2 marks)
   k. *Gellidium* (or) *Penicillium* (or) Yeast
6. Record 10 marks

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SBEC I

LAB IN IN FOOD PROCESSING AND TECHNOLOGY

Paper	: SBEC I	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 40
Paper Code	: 21U3BTS01	External	: 60

PREAMBLE

To make students on understanding basic concepts of food quality management and deals with various food processing concepts and technologies

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To gain knowledge of food preservation	**K4, K5 & K6**
CO2	To gain knowledge of self-life of different foods	**K4, K5 & K6**
CO3	To gain knowledge on the economic importance of Dairy and Dairy products	**K4, K5 & K6**
CO4	To gain experimental knowledge on Food processing	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
1	To study different types of blanching of fruits and vegetables	**4**
2	Preservation of food by canning	**4**
3	To perform cut out analysis of caned product	**4**
4	Preservation of food by high concentration of sugar i.e. jam	**4**
5	Preservation of food by high concentration of salt/acid i.e. pickle	**4**
6	Preservation of food by addition of chemicals i.e. tomato ketchup	**4**
7	Preservation of milk by pasteurization and sterilization	**4**
8	Determination of total fat, protein in milk and milk products	**4**
9	Estimation of synthetic Food colours from canned food. Natural Food coloring agents	**4**
10	Detection of adulterants in edible oil and ghee	**4**

MODEL QUESTION PAPER (LAB IN FOOD POCESSING AND TECHNOLOGY)

NAME OF THE COURSE: **LAB IN FOOD PROCESSING AND TECHNOLOGY**	COURSE CODE: **21U3BTS01**	DURATION: **6Hrs**
MAX MARKS: **60**		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total: **20 MARKS**
1. (i) Perform cutout analysis of the given canned food sample (A). Display the results for observation. (OR)			
(ii) Preserve the given food sample (A) by sugar/salt/acid (OR)			
(iii) Estimate the amount of total fat from the given milk sample (A)			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
2. (i) Perform food preservation by chemical additives for the given food sample (B) (OR)			
(ii) Perform pasteurization of milk from the given milk sample (B) (OR)			
(iii) Estimate the amount of synthetic Food colour in the given sweet/confectionary/beverage sample (B)			
SPOTTERS (5 X 4 = **20 MARKS**)			
3. Identify the given spotters A, D, H, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SBEC I
DEVELOPMENTAL BIOLOGY

Paper	: SBEC I	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U3BTS02	External	: 75

PREAMBLE

To make students on understanding basic concepts of mammalian developmental systems and also to deals with the developmental system plants

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand the concepts of animal system development	**K1, K2 & K3**
CO2	To understand the concepts of vertebrate system development	**K1, K2 & K3**
CO3	To understand the concepts of plantsystem development	**K1, K2 & K3**
CO4	To understand the concepts of invertebrate system development	**K1, K2 & K3**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Basic concepts of development in animal system-I** Stages of development- zygote, blastula, gastrula, neurula, cell fate & commitment – potency- concept of embryonic stem cells, lineages of three germ layers. Embryo development	**8**
II	**Basic concepts of development in animal system-II** Mechanisms of differentiation- cytoplasmic determinants, embryonic induction, concept of morphogen, mosaic and regulative development, model organisms in Developmental biology.	**8**
III	**Early Development in invertebrate / vertebrate models** Drosophila, *C.elegans*, Xenopus, Mouse/ human, Cleavage, gastrulation, Axis specification (Dorsoventral, anterior posterior), and body plan patterning. Hormones involved in reproduction.	**8**

IV	**Late Development in invertebrate /vertebrate models** Organogenesis- development of central nervous system in vertebrates, vulval formation in *C.elegans.* Distribution of cytoplasmic substances in the egg–Metamorphosis (Insects and amphibians) – Hormone control of metamorphosis.	**8**
V	**Basic concepts of development in Plant system** Organization of the plant cell, plant meristems and cell fate; root and shoot development; secondary growth; vascular development; Outline of experimental embryology. Sexual reproduction; flower development; mechanisms of gametogenesis and fertilization.	**8**

MODEL QUESTION PAPER (DEVELOPMENTAL BIOLOGY)

NAME OF THE COURSE: **DEVELOPMENTAL BIOLOGY**	COURSE CODE: **21U3BTS02**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. How many cleavages are completed in 16 cell stages of frog‟s egg?			
a. 3	b. 8	c. 4	d. 12
2. The expulsion of completely developed foetus from the uterus is known as ----------			
a. Ovulation	b. placentation	c. gestation	d. parturition
3. For fertilization of frog‟s egg ----------			
a. Sperms of same species are essential	b. Sperms do not need penetration	c. Sperms of any animal can fertilize	d. Only presence of male is sufficient
4. Grey crescent is present in ----------			
a. Zygote of frog	b. Brain of rabbit	c. Eye of frog	d. Retina of cockroach
5. Which of the following does not show metamorphosis?			
a. Frog	b. Housefly	c. Hydra	d. Mosquito
6. The first phase in the sexual reproduction of organisms is ----------			
a. Spermatogenesis	b. Oogenesis	c. Spermiogenesis	d. Gametogenesis
7. The formation, development and maturation of the female gamete is called ----------			
a. Ovulation	b. Oogenesis	c. Vitellogenesis	d. Folliculogenesis
8. During fertilization the spermatozoa penetrate through the egg membranes with the help of			
a. Flagellum	b. Acrosome	c. Sperm lysins released from the acrosome	d. Mitochondira located at the middle piece
9. During normal development the activation of the egg is achieved by ----------			
a. Vitellogenesis	b. Oogenesis	c. Spermatogenesis	d. Fertilization
10. When the eggs are released from the ovary of frogs they are at the ----------			
a. primary oocyte stage	b. secondary oocyte stage	c. ootid stage	d. matured ova stage
11. The formation of the neural tube is known as ----------			
a. Neurulation	b. Tubulation	c. Craniation	d. None of the above
12. During metamorphosis, the disappearance of larval organs is called ----------			
a. Histogenesis	b. Paedogenesis	c. Histolysis	d. Paedomorphosis
13. Cleidoic eggs are found in ----------			
a. Birds	b. mammals	c. insects	d. molluscs
14. Metamorphosis is a characteristic feature of ----------			

a. Direct ontogenic development	b. Indirect ontogenic development	c. Chordates	d. Embryogenesis in mammals
15. The sexual embryo of the male and female frogs is called ----------			
a. Copulation	b. Amphimixis	c. Syngamy	d. Amplexus
16. Human egg is ----------			
a. Centrolecithal	b. Microlecithal	c. Mesolecithal	d. Telolecithal
17. Which of the following develops from ectoderm?			
a. Spinal cord and brain	b. Liver and heart	c. Eye and skin	d. Notochord and vertebral column
18. In order to become structurally and functionally a spermatozoan, each spermatid has to undergo a process of differentiation called ----------			
a. Spermiation	b. Spermiogenesis	c. Spermatogenesis	d. Androgenesis
19. In the human female, the primary oocytes remain small without any growth for ----------			
a. 4-5 years	b. 6-8 years	c. 8 - 10 years	d. 12 -14 years
20. The sperm produces substances of enzymatic nature of sperm lysin. In mammals, it is called			
a. Hyaluronidase	b. Hyaluronic acid	c. Androgamone	d. Cryanogamone

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) What is differentiation? How it differs from redifferentiation? B) What is meant by embryonic period of development?	(OR)
22. A) State the functions of cytoplasmic determinants. B) Define inductive signals with an example.	(OR)
23. A) Define cleavage and mention its importance. B) What is gastrulation? State its significance.	(OR)
24. A) How the nervous system develops in human? B) What make up the central nervous system of vertebrates?	(OR)
25. A) Define plant meristem. State its types. B) Draw the structure of a flower and label its parts.	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. What are the stages of a developing embryo? Give illustrations.
27. Why *Drosophila melanogaster* is used as model organisms? Comment on it.
28. Justify the statement - *Caenorhabditis elegans* as an emerging model for studying the basic biology.
29. Describe germ layers and organs produced by them in detail.
30. Draw the structure of plant cell and elaborate its cell inclusions.

	NAME	SIGNATURE
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COMPILED BY		
AUTHORISED BY		

SBEC I
FOOD BIOTECHNOLOGY

Paper	: SBEC I	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 40
Paper Code	: 21U3BTS03	External	: 60

PREAMBLE

To make students on understanding basic concepts of food preservation methods by applying technological basics. The paper also deals with the food spoilage, food adulteration and development of value added products

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand the concepts of basic food preservation methods	**K1 & K2**
CO2	To understand the role of water in food spoilage and preservation	**K1 & K2**
CO3	To explore the physical factors involving in food processing	**K1 & K2**
CO4	To make familiar with food sanitation and its importance	**K2, K2 & K3**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Food Preservation by application of Heat: Principles of Heat Transfer, Blanching, Pasteurization, Heat Sterilization.	**8**
II	Food Preservation through Water Removal: Forms of Water in Foods, Sorption of Water in Foods, Water Activity, Drying Technology, Evaporation Technology.	**8**
III	Food Preservation through Physical and Chemical methods :Chilling, Freezing, Radiation, Ionizing, Microwave , Salt, Smoke, Sugar, Other Chemical Additives.	**8**
IV	Sensory evaluation of food quality, quality factors for consumer safety. FSSAI, HACCP, FDA. Food Packaging, Food Plant Sanitation, Environmental Aspects of Food Processing.	**8**
V	Genetically Modified Food – Bovine somatotropin, alpha lactalbumin & lactoferrin in milk, Edible vaccine (Cholera vaccine – potatoes & Hepatitis B vaccine - maize)	**8**

MODEL QUESTION PAPER (FOOD BIOTECHNOLOGY)

NAME OF THE COURSE: **FOOD BIOTECHNOLOGY**	COURSE CODE: **18U3BTS03**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Pasteurization is the process of heating milk ----------			
a. Above 121°C	b. Above boiling point	c. Below boiling point	d. Above 150 °C
2. Cold sterilisation refers to the preservation of food by ----------			
a. Refrigeration	b. Radiation	c. Dehydration	d. Lyophilisation
3. Who is regarded as the father of canning?			
a. Nicolas appert	b. Louis Pasteur	c. John hall	d. Bryan dokin
4. The reason for food spoilage is ----------			
a. Growth of microorganism	b. Autolysis	c. Rancidity	b. All the above
5. Before drying, vegetables should be ----------			
a. Autocleave	b.Salted	b. Blanched	c. Sulfured
6. A food additives that prevent colour and flavour loss ----------			
a. Enzymes	b. Yeast	c. Fruit buffer	d. Ascorbic acid
7. Preventing the growth of pathogens in food ----------			
a. Danger zone	b. Contamination	c. Food preservation	d. Cross contamination
8. Jam and jellies and preserves can be preserved by adding sugar at concentration of ----------			
a. 65%	b. 75%	c. 40%	d. 30%
9. A fungus that causes fermentation ----------			
a. Bacteria	b. Mold	c. Yeast	d. Virus
10. A type of food preservation technique that involves sealing food in sterilized air light containers ----------			
a. Irradiating	b. Canning	c. Freezing	d. Drying
11. Iodized salt contains iodine in the form of ----------			
a. NaCl	b. KIO3	c. Kl	d. Na
12. The first synthetic sweetening agent used as_____?			
a. Cyclamates	b. Aspartame	c. Sucralose	d. Sacchavrin
13. Agar-agar is used as ----------			

a. Antibiotic	b. Stabilizer and thickness	c. Nutrient supplement	d. Colouring agent
14. Frozen storage is generally operated at temperature of ----------			
a. -0^{o}C	b. -18^{o}C	c. -50^{o}C	d. 60^{o}C
15. What is the best method in storing nuts?			
a. Vacuum packing	b. Smoking	c. Drying	d. Freezing
16. _____Standard help ensure food quality?			
a. National	Packing	b. Legal	c. All of these
17. The freezing point for pure water is _____			
a. 10	b. 28	c. 15	d. 32
18. Corn syrup is a mixture of ----------			
a. dextrose and maltose	b. Dextrose and Galactose	c. Galactose and Maltose	d. Glucose and Galactose
19. _____is essential for forming haemoglobin in the blood			
a. Calcium	b. Iron	c. Phosphorn	d. Magnesium
20. Fat is completely digested in the ----------			
a. Stomach	b. Mouth	c. Small intestine	d. Mouth

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Write short notes on pasteurization B) Write a short notes on principles of food preservation	(OR)
22. A) Explain drying B) Define contamination? What is the role of water in contamination?	(OR)
23. A) Notes short notes on freezing? B) Explain the role of radiation in food preservation	(OR)
24. A) Write short notes on chemical additives? B) Describe the role of salt and sugar in food preservation?	(OR)
25. A) What is food processing? Explain? B) Food laws and regulations?	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Write the essay on food preservation principles and application?
27. Explain the evaporation methodology?
28. Write an essay on the physical, chemical methods of food preservation?
29. Write an essay on the environmental aspects of food processing?
30. Roles and scientific uses of water in food processing industries?

	NAME	SIGNATURE
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COMPILED BY		
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SEMESTER IV

GENETIC ENGINEERING

Paper	: Core IV	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21U4BTC04	External	: 75

PREAMBLE

To make students on understanding basic principles of gene manipulation and its application in the development of novel pharmaceutical and drug products

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To know about DNA manipulating enzymes and its role in rDNA Technology	**K1 & K2**
CO2	To gain knowledge on different types plasmid vectors and their Usage	**K1 & K2**
CO3	To acquire knowledge on basic gene cloning strategies	**K2, K3 & K4**
CO4	To evaluate the usage and applications of gene cloning for the development value added products	**K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**SCOPE AND MILESTONES OF GENETIC ENGINEERING:** Biomolecular tools and their applications in genetic engineering: Restriction endonucleases and its types, DNA polymerases, DNA Ligase, Methylase, Taq polymerase, Reverse transcriptase. DNA modifying enzymes (Alkaline phosphatase, Polynucleotide kinase, Terminal deoxy nucleotidyl transferase). S1nuclease, RNAse H and DNAse I. Ligation(cohesive & blunt end ligation) – linkers & adaptor.	**15**
II	**GENE CLONING VECTORS:** Plasmids (PBR322, PUC and BAC), Lambda vectors, Phagemids, Cosmids, M13 vectors, Shuttle vectors and artificial chromosomes (YAC and BAC). DNA sequencing (Maxam-Gilbert and Dideoxy) methods. DNA amplification: PCR (Principles & types - RT PCR, Real time PCR and Nested PCR). cDNA synthesis and cloning:	**15**
	mRNA enrichment, reverse transcription.	

III	**CLONING STRATEGIES:** Cloning of interacting genes - Yeast two hybrid systems. - Nucleic acid micro arrays and Site directed mutagenesis. Methods to study gene regulation: DNA transfection, Primer extension, S1 mapping, RNase protection assay.	**15**
IV	**INTRODUCTION TO CLONING:** Detection & Screening of clones. Expression strategies for heterologous genes. Vector engineering and codon optimization. *In-vitro* transcription, expression of cloned genes in prokaryotes (bacteria – Glucose promoter) and eukaryotes (Yeast – Alcohol promoter).	**15**
V	**APPLICATIONS OF rDNA TECHNOLOGY. 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. **Transgenic animals** – Pharmaceutical products - insulin. Farm animal production. Recombinant DNA Technology in the production of vaccine. T-DNA tagging and transposon tagging, Transgenic and gene knock out technologies	**15**

SUGGESTED READINGS:

1. Molecular cloning: a laboratory manual. J. Sambrook, EF. Frisch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.2000.
2. DNA cloning: a practical approach, DM. Glover and BD Hames, IRL Press, Oxford, 1995.
3. Molecular and Cellular Methods in Biology and Medicine, PB. Kaufman, W.Wu. D, Kim and L.J Cseke, CRC Press, Florida, 1995.
4. Methods of Enzymology vol. 152, Guide to molecular cloning techniques, SL. Berger and AR. Kimmel Academic Press, Inc. An Diego, 1998.
5. Methods in Enzymology. Vol 185, gene expression technology, DV. Goeddel Academic Press, inc. San Deigo, 1990.
6. DNA science. A first Course in Recombinant Technology. DA. Mickloss and GA. Freyer; CokJ Spring Harbor Laboratory Press, New York, 1990.
7. Molecular Biotechnology. SB. Primrose, Blackwell Scientific Publishers, Oxford, 1994.
8. Milestones in Biotechnology. Classic papers on genetic Engineering. JA. Davis and WS. Reznikoff, Butterworth-Heinemann, Boston, 1992.
9. Route maps in Gene technology, MR. Walker and R. Rapley, BlackwelScience Ltd., Oxford, 1997.
10. Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes, SM. Kingsman and AJ. Kingsman, Blackwell Scientific Publications, Oxford, 1998.
11. Molecular Biotechnology - Glick and Pasternak.
12. Principles of gene manipulations - Old & Primrose.

MODEL QUESTION PAPER (GENETIC ENGINEERING)

NAME OF THE COURSE: **GENETIC ENGINERING**	COURSE CODE: **21U4BTC04**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (20 X 1 = 20 MARKS) ANSWER ALL THE QUESTIONS

1. *Taq* polymerase is isolated from ----------

a. E.coli	*b. Thermus aquaticus*	*c. Thermus marinus*	*d. Bacillus stereothermophilus*

2. Which of the following sequence is recognized by Hind III?

a. AA GCTT	b. A AGCTT	c. GTCGA C	d. GT CGAC

3. RNase H cleaves----------hybrid

a. DNA-RNA	b. DNA-DNA	c. RNA-RNA	d. RNA-Protein

4. Which of the following enzyme is used to create the sticky ends on DNA?

a. Acid phosphatase	b. Polynucleotidyl kinase	c. Terminal deoxy nucleotidyl tranferase	d. Alkaline phosphatase

5. Which of the following vectors contains Ori „C‟ sites from two different species?

a. Cosmids	b. M13 vectors	c. Shuttle vectors	d. Phagemids

6. The insertional vector λgt10 can able to carry up to----------of foreign DNA

a. 4 kb	b. 5 kb	c. 7 kb	d. 8 kb

7. The size of YRp7 is ----------

a. 5.8 kb	b. 6.8 kb	c. 5.7 kb	d. 6.7 kb

8. Which of the following contains covalently closed single stranded circular DNA molecules?

a. Phagemids	b. M13 vectors	c. Shuttle vectors	d. Cosmids

9. Which of the following DNA is used as template in chain termination method DNA sequencing?

a. Plasmid DNA	b. Genomic DNA	c. Viral DNA	d. λ DNA

10. Denaturation of DNA during PCR is usually carried out at --------- °C

a. 94	84	b. 64	c. 74

11. The processed RNA is partially degraded by exonucleases to produce functional trancriptome. This method is called as ----------

a. cDNA library construction	b. mRNA enrichment	c. DNA sequencing	d. DNA amplification

12. In yeast two hybrid analysis, the target gene is fused with the gene for one of the pair if transcription factors and the vector construct is ligated in to a----------vector

a. YAC	b. BAC	c. SEN	d. Lambda

13. The glucoamylase (GOX) promoter found in *Aspergillus nidulans* is induced by----------and repressed by ----------

a. Starch, Glucose	b. Starch, Fructose	c. Starch, Galactose	d. Starch, Xylose
14. The chemical method of DNA sequencing can be used to rapidly sequence DNA that are ---------- kb			
a. < 0.5	b. > 0.5	c. < 1.0	d. > 1.0
15. The DNA – phosphate containing mixture is incubated with the recipient cells for ----------			
a. 24 hrs	b. 48 hrs	c. 72 hrs	d. 98 hrs
16. Short pulses are generated in electroporation in higher voltage at the rate of ----------			
a. 1100 V	b. 1200 V	c. 1300 V	d. 1400 V
17. Which of the following protein is first manipulated for enhancing its enzymatic activity through protein engineering?			
a. Amylase	b. Subtilisin	c. Anti-trypsin	d. Chymotrypsin
18. Which of the following assay is useful for monitoring for the purification and function mf many different enzymes catalysing the synthesis of polymers like DNA, RNA, or proteins?			
a. Enrichment assay	b. Manipulating assay	c. Incorporation assay	d. Sequence specific targeting assay
19. Which of the following method comes under gene tagging technology?			
a. Selection based gene tagging	b. rDNA tagging	c. Marker assisted tagging	d. Epitope tagging
20. The given chromosome can be engineered by the principle of ----------			
a. Addition	b. Point mutation	c. Inversion	d. None of the above

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Write short notes on DNA modifying enzymes (OR) B) Write short notes on type III restriction endonucleases
22. A) Write about PBR 322 with neat illustrations (OR) B) Explain about the principle of mRNA enrichment
23. A) Explain the process of site directed mutagenesis (OR) B) Explain the principle of S1 mapping with neat illustrations
24. A) Give a brief account on codon optimization (OR) B) Explain the expression of cloned in eukaryotes with suitable example
25. A) Write short notes on transposon tagging (OR) B) Write shortly about gene knock technology

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give detailed account on restriction endonucleases
27. Give detailed account on M13 vectors
28. Give detailed account on cloning differentially expressed genes
29. Give detailed account on expression of heterologous genes
30. Give detailed account on processing, purification, refolding and characterization of recombinant proteins

	NAME	SIGNATURE
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COMPILED BY		
AUTHORISED BY		

LAB IN GENETIC ENGINEERING

Paper	: Core Practical IV	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 06
Credit	: 3	Internal	: 25
Paper Code	: 21U4BTCP04	External	: 75

PREAMBLE

To make students on understanding basic principles on the usage of genomic and plasmid DNA in the development of microbial recombinant clones by selection strategies

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To isolate genomic and plasmid DNA, and to digest them restriction Enzyme	**K2, K3 & K4**
CO2	Shall acquire practical knowledge on ligating vector and target DNA	**K2, K3, & k4**
CO3	Shall know about the amplification strategies of cloned vector	**K3, K4 & K5**
CO4	To demonstrate the selection of recombinant clones by using selectable markers	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
1	Isolation of Genomic DNA from *E.coli*	10
2	Isolation of Plasmid DNA mini prep and maxi prep from *E.coli*	10
3	Construction of restriction map of a plasmid by Hind III and BamHI	10
4	Ligation of DNA and plasmid by T4 DNA ligase	5
5	Purification of DNA fragment from gel by electro-elution	5
6	Amplification of ligated plasmid by PCR	10
7	Transformation of recombinant DNA in Host *E.coli* by CaCl method	10
8	Selection of recombinant clones by (IPTG-X-gal: Blue white selection)	15

MODEL QUESTION PAPER (LAB IN GENETIC ENGINEEING)

NAME OF THE COURSE: **LAB IN GENETIC ENGINEERING**	COURSE CODE: **21U4BTCP04**	DURATION: **6 Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total **20 MARKS**
4. (i) Isolate genomic DNA from the given bacterial sample (A). Display the results for observation (OR)			
(ii) Isolate plasmid DNA from the given bacterial sample (A). Display the results for observation (OR)			
(iii) Perform restriction digestion of the given DNA sample (A) using the given enzyme/s. Display the results for observation			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
5. (i) Perform ligation of the given DNA sample (B) using DNA ligase. Display the results for observation (OR)			
(ii) Perform DNA transformation in the given host cell sample (B) using calcium chloride (OR)			
(iii) Purify the given DNA sample (B) by electro elution. Display the results for observation			
SPOTTERS (5 X 4 = **20 MARKS**)			
6. Identify the given spotters C, D, E, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

	NAME	**SIGNATURE**
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PLANT SCIENCE II

Paper	: ALLIED IV	Total Hours	: 60
Hours/Week	: 4	Exam Hours	: 05
Credit	: 3	Internal	: 40
Paper Code	: 21U3BOA01	External	: 60

PREAMBLE

To make students on understanding basic and applied principles of plant science, their anatomical, ecological and embryological prospectives.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand basic concepts of phyllotaxy	**K1 & K2**
CO2	To make clear cut understanding of Bentham‟s and Hooker‟s Classification	**K1 & K2**
CO3	To understand the concepts of plant anatomy and ecology	**K4 & K5**
CO4	To understand the concepts of plant embryology	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**EXTERNAL MORPHOLOGY:** Phyllotaxy. Types of leaf – simple and compound. Inflorescence – Rocemose, Cymose and special types (Head & Cyathium). Terminology with reference to flower description.	**12**
II	**TAXONOMY:** Bentham & Hooker‟s system of classification. Study of major plant families and their economic importance (*Annonaceae*, *Rubiaceae*, *Cucurbitaceae*, *Asteraceae* and *Poaceae*).	**12**
III	**ANATOMY:** Simple & Permanent tissues: Parenchyma, Collenchyma & Sclerenchyma. Complex permanent tissues: Xylem & Phloem. Primary structure of dicot root and stem; monocot root and stem.	**12**
IV	**PLANT ECOLOGY:** Climatic factors, morphological and anatomical adaptations in hydrophytes and xerophytes.	**12**
V	**EMBRYOLOGY:** Structure of anther and male gametophyte. Types of ovule and female gametophyte (Polygonum). Fertilization process. Structure and development of dicot embryo (Capsell - *Bursa pastoris*).	**12**

SUGGESTED READINGS:

1. Bhijwani SS and Bhatnagar SP. (2009). The embryology of angiosperms. Vikas Publishing House Private Limited, New Delhi.
2. Davis PH and Heywood VM. (1965). Principles of Angiosperm Taxonomy. Oliver and Boyd, Edinburgh.
3. BP. Pandey. (2011). A Textbook of Botany: Angiosperms – Taxonomy, Anatomy, Embryology and Economic Botany, S. Chand Limited, New Delhi.
4. Pandey BP. (2001). Plant Anatomy. S.Chand and Company Private limited, New Delhi.

LAB IN PLANT SCIENCE II

Paper	: ALLIED PRACTICAL IV	Total Hours	: 60
Hours/Week	: 3	Exam Hours	: 05
Credit	: 3	Internal	: 40
Paper Code	: 21U4BOAP02	External	: 60

PREAMBLE

To make students on understanding basic and applied principles of plant science, their anatomical, ecological and embryological prospective.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand the practical concepts of general plant families	**K1 & K2**
CO2	To understand the microscopic observations of anatomy	**K1 & K2**
CO3	To acquire practical exposure in sectioning of plant tissues	**K1, K2 & K4**
CO4	To acquire basic experimental approach on mounting and preparation of permanent slides	**K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

1. Identification of plant families (Any two out of five) (2 x 5 = 10 marks)
    a. *Annonaceae*, *Rubiaceae* and *Cucurbitaceaei* 5 marks
    b. *Asteraceae* and *Poaceae* 5 marks
2. Identification of spotters (Economic importance) (5 x 3 = 15 marks)
    c. *Annonaceae* 3 marks
    d. *Rubiaceae* 3 marks
    e. *Cucurbitaceae* 3 marks
    f. *Asteraceae* 3 marks
    g. *Poaceae* 3 marks
3. Sectioning of given plant part (Morphology) (2 x 5 = 10 marks)
    h. i) Monocot stem or monocot root
        ii) Dicot stem or Dicot root

i. i) Hydrophyte
ii) Zerophyte

4. Dissect and mount anyone stage of the given plant embryo (j) (1 x 6 = 6 marks)
5. Identification of spotters (Permanent slides) (3 x 3 = 9 marks)
    k. Anatomy (Simple and complex tissue) 3 marks
    l. Embryology (Transverse section of anthers and types of ovules) 3 marks
    m. Ecology (Zerophyte - *Nerium* and Hydrophyte – *Hydrilla*) 3 marks
6. Record 10 marks

	NAME	**SIGNATURE**
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COMPILED BY		
AUTHORISED BY		

SBEC – II

LAB IN POULTRY SCIENCE

Paper	: SBEC I	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U4BTS04	External	: 75

PREAMBLE

To make students on gaining practical exposure on poultry science and technology and its economic management and quality analysis of poultry products

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Evaluate quality control parameters of poultry for disease Diagnosis	**K4, K5 & K6**
CO2	To evaluate the microbial contamination of poultry products for quality enhancement	**K4, K5 & K6**
CO3	To evaluate poultry micro flora	**K4, K5 & K6**
CO4	To validate the preservation of poultry products and evaluation of its nutritive quality	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

Ex.no	CONTENT	HOURS
1.	Post-mortem examination of chickens and laboratory diagnosis of diseases	**4**
2.	Sero monitoring of viral infections in poultry	**4**
3.	Surveillance of common diseases prevailing in commercial poultry farms	**5**
4.	Screening of Salmonella of zoonotic importance in poultry and related Products	**4**
5.	Monitoring the health management in commercial poultry farms	**5**
6.	Isolation and prevalence of Microbes in poultry products	**5**
7.	Egg preservation by various methods	**4**
8.	Egg quality analysis	**4**
9.	Protein and Lipid estimation from egg samples	**5**

MODEL QUESTION PAPER (LAB IN POULTRY SCIENCE)

NAME OF THE COURSE: **LAB IN POULTRY SCIENCE**	COURSE CODE: **21U4BTS04**	DURATION: **6Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total **20 MARKS**
1. (i) Perform the enumeration of microbes from the given poultry sample (A) (OR)			
(ii) Perform preservation of the given egg sample (A) by salt method (OR)			
(iii) Estimate the protein level in the given poultry sample (A) by Lowry‟s method			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
2. (i) Perform lipid estimation from the given poultry sample (B) (OR)			
(ii) Perform preservation of given egg sample (B) by freezing (OR)			
(iii) Find out the thickness of given egg shell sample (B) by Gauge meter			
SPOTTERS (5 X 4 = **20 MARKS**)			
3. Identify the given spotters C, D, E, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SBEC – II

MARINE BIOTECHNOLOGY

Paper	: SBEC I	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U4BTS05	External	: 75

PREAMBLE

To make students on understanding the significance and importance of marine micro biota and its rational applicability in the development of industrially important products. The students also gain knowledge on the environmentally hazardous management marine ecosystem.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand basics of marine ecosystem and its pollution issues	**K1 & K2**
CO2	To understand basic biodegradation and bioremediation marine ecosystem pollutants	**K2 & K4**
CO3	To understand the principles of bio fouling	**K2 & K4**
CO4	To acquire knowledge of wastewater treatment in marine ecosystem	**K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Marine organisms and environment interaction:** Types of marine environment - Physical, Chemical and Biological aspects and their interaction with marine life; Air – Sea interaction; Green - house gases (CO2 and Methane)	**8**
II	**Pollution:** Marine pollution-major pollutants (heavy metal, pesticide, oil, thermal, radioactive, plastics, litter and microbial); Biological indicators (Marine microbes, algae and crustaceans) and accumulators: Application of Protein biomarkers; Biosensors and biochips.	**8**
III	**Biomaterial interaction:** Biodegradation and Bioremediation; Biodegradation of natural and synthetic waste materials; Bioremediation;	**8**

	Separation, purification and bio removal of pollutants.	
IV	**Fouling and corrosion:** Biofouling; Biofilm formation; Marine fouling and boring organisms - their biology, adaptation; Factors influencing the settlement of macrofoulers; Antifouling and Anti boring treatments; Corrosion Process and control of marine structures.	**8**
V	**Introduction to marine pharmacology:** Terms and definitions; Medicinal compounds from marine flora and fauna - marine toxins, antiviral and antimicrobial agents.	**8**

SUGGESTED READINGS:

1. Recent Advances in Marine Biotechnology Volume 3 – Milton fingerman et al., 1999.
2. Cynobacterial and Algal Metabolisms and Environment Biotechnology – Tasneem Fatma, 1999.
3. Environmental Biotechnology and cleaner Bioprocess – Olguni, E.J. et al., 2000.
4. Environmental Biotechnology Theory and applications – Evans et al., 2000.
5. Environmental Biotechnology – Gareth M.Evams et al., 2003
6. Biotechnology, Recombinant DNA Technology, Environmental Biotechnology – S.Mahesh et al., 2003

MODEL QUESTION PAPER (MARINE BIOTECHNOLOGY)

NAME OF THE COURSE: **MARINE BIOTECHNOLOGY**	COURSE CODE: **21U4BTS05**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Which of the following is/are example(s) of conventional source of energy?			
a. Fossil fuels	b. Solar energy	c. Tidal energy	d. all of the above
2. Global warming is caused due to ----------			
a. Decrease in CO_2 conc.	b. Decrease in CO_2 conc.	c. Decrease in SO_2 conc.	d. increase in NO_2 conc.
3. Which is the most primitive group of algae?			
a. Blue green algae	b. Red algae	c. Brown algae	d. Green algae
4. Ability to fix atmospheric nitrogen is found in ----------			
a. Leaves of some crop plants	b. Chlorella	c. Some marine Red algae	d. Some Blue green algae
5. Which of the following bacterium is called as the superbug that could clean up oil spills?			
a. *Bacillus subtilis*	b. *Pseudomonas putida*	c. *Pseudomonas denitrificans*	d. *Bacillus denitrificans*
6. Which of the following is a major cause of pollution?			
a. Plants	b. Bacterial spore	c. Fungi	d. Hydrocarbon gas
7. Minamata disease is caused by pollution of water by ----------			
a. Mercury	**b.** Lead	c. Tin	d. Methyl iso cyanide
8. To reduce the water pollution which of the following genetically modified organism will be the best choice?			
a. Plant	b. Animal	c. Bacteria	d. None of the above
9. Purification strategies in municipal water supplies involves ----------			
a. Sedimentation	b. Filtration	c. Disinfection	d. All the above
10. Sedimentation of large particulate matter is enhanced by ----------			
a. Aluminium	b. Potassium	c. Potassium	d. Chlorine
11. Septic tank is ----------			
a. An aerobic condition with growth treatment system	b. An aerobic condition with suspended growth biological treatment system	c. An anaerobic condition with growth biological treatment system	d. An anaerobic condition with suspended growth treatment system

12. The process of converting environmental pollutants into harmless products by naturally occurring microbes is called ----------			
a. Ex situ bioremediation	b. Intrinsic bioremediation	c. Extrinsic bioremediation	d. None of these
13. Dry corrosion is also called as ----------			
a. Chemical corrosion	b. Electrochemical corrosion	c. Wet corrosion	d. Oxidation corrosion
14. Which of the following comes under the wet corrosion?			
a. Concentration cell corrosion	b. Oxidation corrosion	c. Liquid metal corrosion	d. Corrosion by other gases
15. Initial attachment of microorganisms often involves ----------			
a. Flagella and is reversible	b. Flagella and is irreversible	c. Exopolymers and is reversible	d. Exopolymers and is irreversible
16. What is the value of fouling factor for sea water?			
a. 0.0001-0.0002 m^2 K/W	b. 0.0002-0.0003 m^2 K/W	c. 0.0003-0.0004 m^2 K/W	d. 0.0004-0.0005 m^2 K/W
17. The stage in which the biological processes are used to purify water in a wastewater treatment plants is called ----------			
a. secondary sewage treatment	b. primary sewage treatment	c. wastewater reduction	d. biochemical reduction
18. Aggregates of microbes as tiny masses in activated sludge process is called ----------			
a. Activated sludge	b. Masses	c. Colloidal masses	d. Floccules
19. High BOD indicates ----------			
a. Less polluted water	b. Less number of organisms	c. More polluted water	d. None of the above
20. BOD/COD ratio will always be ----------			
a. = 1	b. > 1	c. < 1	d. None of the above

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Describe the food and feeding habits of marine organisms B) Briefly describe the pigments present in marine organisms	(OR)
22. A) Discuss the role of microbes in the sea B) Discuss the sources of pollution in marine environment	(OR)
23. A) Discuss the current status of seaweed farming in India. B) Give an account on the NMR characterization of biomolecules.	(OR)
24. A) Discuss the role of biotechnology in fouling and corrosion B) Give an account of bio-deterioration in marine environment	(OR)
25. A) Describe the composition, fate and effects of sewage pollution in sea B) Give account of the sources and treatment of oil pollution in sea.	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Discuss “Sea is a Biological Environment”.
27. Discuss the sources of pollution and treatment methods in marine environment.
28. Give a detailed account on Biodegradation and Bioremediation
29. Describe the Corrosion process and control measures
30. Give detailed account on various techniques involved in waste water treatment using Microbes

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SBEC – II

FORENSIC SCIENCE AND TECHNOLOGY

Paper	: SBEC I	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U4BTS06	External	: 75

PREAMBLE

To make students on understanding the importance of forensic principles and technology and its practical applicability in identifying the candidate who convicted the crime scenery. The students also gain added skills in terms tracing the victim death by means of adapting the measurable molecular approaches.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Gain knowledge on forensic science laboratories across India	**K1, K2 & K3**
CO2	Acquires knowledge on fingerprint identification system	**K3, K4, & K5**
CO3	Know whereabouts on the FAI and the concepts of fatality Forensics	**K3, K4, & K5**
CO4	Understand the concepts of DNA finger printing technology	**K3, K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Introduction, definition, Scope and branches of forensic science. Central F.S.L. and State F.S.L. Biological Evidence: Nature, collection, identification, evaluation of hair and fibres.	**6**
II	Definition and Classification of fingerprints (Henry system). Taking fingerprints from living and dead persons. Automatic fingerprint identification system (AFIS).	**7**
III	Forensic Art Illustration: Introduction, Finding and identifying human face image. Post mortem drawing, methods of superimposition.	**5**
IV	Fatality Forensics: Introduction, cause, manner and characteristics of death, Road traffic fatality (RTF) investigation. General classification of RTFs.	**5**
V	DNA Fingerprinting (DFP) technology: An overview, Applications of DFP in forensic investigations, paternity disputes. DNA Profiling practice in India with reference to criminal cases.	**7**

SUGGESTED READINGS:

1. Richard Saferstein, 2001, Criminalistic: An Introduction to Forensic Science. 7th edition Prentice-Hall, New Jersey.
2. Chowdhri, S., Forensic Biology B.P.R. &D, Govt. of India.
3. Cammins, H. and Middle C., 1961. Fingerprints Palms and Soles. Dover Publications.
4. Furley, M.A. and Hamington, J.J. Forensic DNA Technology.
5. Kirby, DNA Fingerprinting Technology.
6. Epplen, J.T. and Eabjulm, T., 1999. DNA Profiling and DNA Fingerprinting Bukhaagar Verlag, Switzerland.
7. Taylor, 2000. Forensic Art and Illustration, CRC Press.

MODEL QUESTION PAPER (FORENSIC SCIENCE AND TECHNOLOGY)

NAME OF THE COURSE: **FORENSIC SCIENCE AND TECHNOLOGY**	COURSE CODE: 21U4BTS06	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The dark portion of the fingerprint is called ----------			
a. Core	b. Valley	c. Delta	d. Ridge
2. The most common type of fingerprint pattern is ----------			
a. Whorl	b. Accidental	c. Loop	d. Arch
3. Fingerprints dissolved in this only grow back with scars on them making them more unique			
a. Base	b. Water	c. Acid	d. Neutral
4. Most common fingerprint pattern. It has ridges that enter from the right and exit from the same side they enter			
a. Arch	b. Whorl	c. Wheel	d. Loop
5. The region in skin found in between the epidermis and dermis is the_____layer			
a. Top	b. Subcutaneous	c. Cuticle	d. Basal
6. The study of fingerprint is called ----------			
a. Dactylography	b. Printology	c. Anthropometry	d. None of the above
7. Fingerprints on paper can be sprayed with this chemical that reacts with amino acids in sweat to make a purple print appear			
a. Ninhydrin	b. Iodine	c. Cyanocrylate	d. Silver nitrate
8. What is the basis for the determination of the primary classification of fingerprints?			
a. The presence or absence of arch patterns	b. The presence or absence of whorl patterns	c. The presence or absence of loop patterns	d. The presence or absence of minutiae
9. For most fingerprint examiners, the chemical of choice for visualizing latent prints is ---------			
a. Ninhydrin	b. Iodine	c. Chlorate	d. Silver nitrate
10. The oldest chemical method used to visualize latent prints is ----------			
a. Laser illumination	b. Iodine fuming	c. Cyanocrylate ester fuming	d. Silver nitrate reagent
11. Identical twins have identical ----------			
a. Genetic makeup	b. Eyes	c. Fingerprints	d. None of the above
12. Fingerprints formation is ----------			
a. An on-going lifetime process	b. Complete by the age	c. Occurring at birth	d. Occurring during fetal development
13. The only way to permanently change your fingerprint is to ----------			

a. Damage dermal papillae	b. Wash with acid	c. Sand the ridges	d. Burn the skin
14. The most common ridge pattern is ----------			
a. Arch	b. Whorl	c. Wheel	d. Loop
15. Fingerprints are ----------			
a. Valuable evidence	b. Individual evidence	c. Class evidence	d. Always good
16. DNA finger printing was developed by ----------			
a. Francis Crick	b. Khorana	c. Alec Jeffrey	d. James Watson
17. The technique to distinguish the individuals based on their DNA print patterns is ----------			
a. DNA fingerprinting	b. DNA profiling	c. Molecular fingerprinting	d. All the above
18. The DNA fingerprint pattern of a child is ----------			
a. Exactly similar to that of both of the parents	b. 100% similar to the father‟s DNA print	c. 100% similar to the mother‟s DNA print	d. 50% bands similar to father and rest similar to mother
19. Each individual has a unique DNA fingerprint as individuals differ in ----------			
a. Number of minisatellites on chromosome	b. Location of minisatellites on chromosome	c. Size of minisatellites on chromosome	d. All the above
20. DNA profiling technique to demonstrate the similarity between different plant species with reference to some specific protein coding DNA sequences is called ----------			
a. Phyto blot	b. Garden blot	c. Plant profiling	d. All the above

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Write short notes Organizational set up of Forensic Science Laboratories (OR) B) Write short notes on Scope and branches of forensic science
22. A) Write about Classification of fingerprints (OR) B) How will you take fingerprints from living and dead persons?
23. A) How will you find and identify human face image? (OR) B) How will you perform post mortem drawing?
24. A) Write about Road traffic fatality (RTF) investigation (OR) B) Explain the basic injury mechanisms
25. A) Explain the applications of DNA fingerprinting technology (OR) B) Write short notes on statutory considerations

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give a detailed account on Organizational set up of Forensic Science Laboratories
27. Write an essay on digital comparison of finger prints
28. Write elaborately on Forensic artist in court
29. Give a detailed fatality forensic science
30. Write an essay on quality assurance measures of DNA fingerprinting

	NAME	**SIGNATURE**
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SEMESTER V

IMMUNOLOGY

Paper	: Core V	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21U5BTC05	External	: 75

PREAMBLE

To make students on exposing themselves to know in underlying concepts of biology of the immune system and how immunity being developed in human beings. In addition the students also know whereabouts on the mechanisms on the host pathogen interaction, principle defence mechanisms against infectious diseases and basic immune diagnostic techniques

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Acquire knowledge on history on immunology development, and cells and their role in developing overall host immune system	**K1 & K2**
CO2	Knowing about the functions and properties of immunoglobulin and its expression in genetic level	**K1 & K2**
CO3	Acquire knowledge on antigen recognition and its processing principles by host immune system	**K1, K2 & K4**
CO4	Acquire basic concepts of immune regulatory molecules and their role in defence and concepts of autoimmunity	**K1, K2, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**HISTORY AND SCOPE OF IMMUNOLOGY:** Types of Immunity. Cells of Immune system. Organs of Immune response and their functions. Haematopoiesis. Antigen- properties, classes, epitopes, haptens and adjuvants. Factors influencing antigenicity.	**13**

II	**IMMUNOGLOBULINS AND ITS EXPRESSION:** Immunoglobulin- Structure, types, properties and functions. Immunoglobulin gene re-arrangements. Generation antibody diversity. Somatic hyper mutation. Ig gene expression and its regulation.	**15**
III	**ANTIGEN PROCESSING AND PRESENTATION:** MHC – types and importance- distribution and function. Antigen processing and presentation to T- lymphocytes. Major classes of MHC genes and its regulation.Antigen – Antibody reactions – Agglutination, precipitation,RIA, ELISA, FACS and Immunopanning. Hybridoma Technology	**17**
IV	**CYTOKINES, IMMUNE CELL ACTIVATION AND ALLERGIC REACTIONS:** Definition of cytokines, classification and types of cytokine, Biological functions of cytokines. Cytokine receptors. T-cell and B-cell activation and differentiation. Hypersensitivity reactions and its types. Plasma cells and memory cells	**15**
V	**AUTOIMMUNITY:** Definition, types of autoimmune disorders. Mechanism of autoimmunity. Immunodeficiency disorder. Vaccines and its types. Immune response to bacterial, protozoal, parasitic diseases. Immuno deficiency diseases (HIV). Transplantation immunology – types of grafts. Mechanism of graft rejection. Immunosuppressive therapy.	**15**

SUGGESTED READINGS:

1. Ivan Riot – Blackwell, 1988. Essentials of Immunology (6th Edition): Scientific Publications, Oxford,
2. Paul W.E (Eds) Ravan prss 1988.Fundamentals of Immunology:, New York,
3. Harlow and David Lane, 1988.Antibodies A laboratory Manual: cold spring harbor laboratory.
4. Janis Kuby Immunology, 1997. WH Freeman & Company, New York.
5. Tizard,1995.Immunology IV Ed Saunders college publishers, New York.
6. Robert M.Coleman., 1992. Fundamental Immunology. 2 nd edition., Wim. C.Brown Publishers.
7. Eli Benjamini et al., 1991. Immunology A short course –Wiley Publishers, NY.

MODEL QUESTION PAPER (IMMUNOLOGY)

NAME OF THE COURSE: **IMMUNOLOGY**	COURSE CODE: **21U5BTC05**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The ability of an organism to resist infections by the pathogens is called?			
a. Infection	b. Hypersensitivity	c. Immunity	d. Allergy
2. Which of the following is NOT a poly morpho nuclear leukocyte?			
a. Eosinophil	b. Mast cell	c. Macrophage	d. Basophil
3. Name the first cell which recruited at the place of infection.			
a. Nk cell	b. Basophil	c. Neutrophil	d. Macrophage
4. Which of the following cell is a multipotent cell?			
a. T-cell	b. B-cell	c. HSC	d. Monocytes
5. Which of the following antibody gives a primary immune reaction?			
a. IgG	b. IgM	c. IgA	d. IgE
6. What is the origin of B-cell?			
a. Pancreas	b. Liver	c. Thymus	d. Bone marrow
7. Who discovered the structure of immunoglobulin by treating it with beta-mercaptoethanol?			
a. Nisonoff	b. Edelman	c. Porter	d. Whittekar
8. Name the heavy chain of IgG.			
a. M	b. E	c. α	d. γ
9. Which of the following is NOT the characteristic of a good antigen?			
a. Large in size	b. Foreignness	c. Highly complex	d. Reproduce only by binary fission
10. Name the molecule which constitutively expressed on the dendritic cell?			
a. Class I MHC	b. Class II MHC	c. APC	d. Antigen
11. Which of the following polypeptide is important for the expression of MHC I on the cell membrane?			
a. Interferon	b. β_2-microglobin	c. Lymphokine	d. Interleukin
12. Name the part of processed antigen that binds to the MHC molecule and recognized by T-cells?			
a. Immunoglobulin	b. Paratope	c. Epitope	d. Chaperone
13. Name the cytokines which released in response to virus infection?			
a. Monokines	b. Interferons	c. Lymphokines	d. Interleukins
14. Name the nerve stimulator which is responsible for the pain of the inflammation.			

a. Bradykinins	b. Prostaglandin	c. Histamines	d. Kinins
15. Name the class of immunoglobulin which takes part in hypersensitivity reaction?			
a. IgG	b. IgM	c. IgA	d. IgE
16. Out of these, which transcription factor does not take part in B-cell activation?			
a. Abl	b. NF- kB	c. Jun	d. Fos
17. Which among the following is not an autoimmune disease?			
a. Myasthenia gravis	b. Systemic lupus erythematosus	c.Grave‟s disease	d. Sickle cell disease
18. Vaccination was invented by?			
a. Jenner	b. Pasteur	c. Koch	d. Salk
19. Heat killed vaccines are ----------			
a. Dead cells of bacteria	b. Dead cells of virus	c. Dead cells of fungi	d. A & B
20. The major molecule responsible for graft rejection is ----------			
a. B-cells	b. T-cells	c. MHC	d. antibodies

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Explain the organs involved in immune system B) Write a short note on factors influencing antigenicity	(OR)
22. A) Give a short note on antibody production B) Explain the IgA and IgM	(OR)
23. A) Explain the process of MHC regulation B) Describe Apoptosis	(OR)
24. A) Explain Type II hypersensitivity B) Brief about the classification of Cytokines	(OR)
25. A) Explain Autoimmunity B) Describe AIDS and HIV types.	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give an detailed account on cells involved in Immune system
27. Explain Immunoglobulin‟s types, structure and functions
28. Give a detailed account on Antigen processing and presentation
29. Describe the types of hypersensitivity
30. Give detailed account on various types of vaccines and explain with suitable example

PLANT BIOTECHNOLOGY

Paper	: Core VI	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21U5BTC06	External	: 75

PREAMBLE

To make students on exposing plants technically, so as manipulate them for the production of disease free, nutritive elite plant varieties. In addition candidates are exposed to the use of vector based engineering of plant genome for the generation of genetically modified plants and food products.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Know about the historical development of plant tissue culture and basic tissue culture techniques and their principles	**K1 & K2**
CO2	Gaining knowledge on plant secondary metabolites and their role in defence mechanisms	**K1 & K2**
CO3	To acquire knowledge on the generation novel plant varieties by genetic manipulation strategies	**K3, K4 & K5**
CO4	Exposing towards the application of secondary metabolites in drug development and value added products	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**INTRODUCTION:** Plant tissue culture history, Laboratory organization sterilization methods, types of media, media preparation, plant growth regulators. Applications of crop improvement in agriculture,horticulture and forestry.	**12**
II	**PLANT TISSUE CULTURE TECHNIQUES**: Micropropagation, Callus induction. Cell culture techniques, Protoplast culture and fusion. Organogenesis and somatic embryogenesis. Haploid production of plants (Anther, Pollen and embryo cultures).	**12**
III	**PLANT SECONDARY METABOLITES:** Basic biosynthesis pathway of auxins and cytokinins. Role of secondary metabolites in plant defence. Plant genome organization (Chloroplast and mitochondria), Agrobacterium mediated gene transfer (Ti plasmid and Ri plasmids) methods in plants.	**18**
IV	**GENETIC ENGINEERING IN PLANTS:** Selectable markers, Reporter genes and promoters used in plant vectors Genetic engineering & crop improvement, herbicide resistance, insect resistance, virus resistance, plants as bioreactors. Production of antibodies.	**18**
V	**APPLICATIONS OF PLANT SECONDARY METABOLITES:** isolation and characterization - drug development. Production of Biopesticides and Biofertilizers. Development of value added plant products (Saline tolerance & Delayed fruit ripening). Organic food-Production,types and Identification of organic foods.	**15**

SUGGESTED READINGS:

1. Plant Biotechnology: An introduction to genetic engineering by Adrian Slater, Nigel W. Scott, Mark R. Fowler. Oxford University, Press, 2008.
2. Biochemistry and Molecular Biology of Plants. Bod Buchananm Wilhelm Gruissem, Russell Jones. John Wiley & Sons, 2002.
3. Molecular Biotechnology by Glick, B.R. and J.J. Pasternak. Scond Edition, ASM press, Washington, 1998.
4. Plant propagation by tissue culture: volume 1 & 2. E.F George. Exegetics Limited,1999.
5. Natural products: A laboratory Guide by Raphael Ikan, Academic press, 1991.
6. Chemistry of Natural products by sujatha V. Bhat, Bhimsen A. Nagasampagi, meenakshi Sivakumar. Birkhausr, 2005.
7. An introduction to plant tissue culture by MK Razdan. M.K. 2003. Oxford & IBH Publishing Co, New Delhi, 2003.
8. Plant tissue culture by Bhojwani, S.S and Razdan, M.K. 2004.
9. Phytochemical Methods: A guide to Modern Techniques of Plant Analysis by J.B. Harborne. Springer, 1998.
10. Plant cell culture, A practical approach, 2nd Edition, Edited by R.A. Dixon and R.A. Gonzales.

MODEL QUESTION PAPER (PLANT BIOTECHNOLOGY)

NAME OF THE COURSE: **PLANT BIOTECHNOLOGY**	COURSE CODE: **21U5BTC06**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Who is the father of tissue culture?			
a. Bonner	b.Haberlandt	c Laibach	b. Gautheret
2.The growth of plant tissues in artificial media is called_____			
a. Gene expression	b. Transgenesis	c. Plant tissue culture	d. Cell hybridization
3.A_____is an excised piece of leaf or stem tissue used in micropropagation.			
a.Microshoot	b.Medium	c.Explant	d.Scion
4.Cellular totipotency is the property of ---------			
a. Plant	b. Animal	c. Bacteria	d. All of these
5. In plant tissue culture, what is the term ORGANOGENESIS means?			
a. Formation of callus culture	b. Formation of root & shoot from callus culture	c. Genesis of organ	d. None of the above
6. In a cell, protoplast consists the following EXCEPT			
a. Cell wall	b. Cell membrane	c. Nucleus	d. Cytoplasm
7.In a callus culture			
a. Increasing level of cytokinin to a callus induces shoot formation and increasing level of auxin promote root formation	b. Increasing level of auxin to a callus induces shoot formation and increasing level of cytokinin promote root formation	c. Auxins and cytokinins are not required	d. Only auxin is required for root and shoot formation
8.The phenomenon of the reversion of mature cells to the meristematic state leading to the formation of callus is known as ----------			
a. Redifferentiation	b. Dedifferentiation	c. either (a) or (b)	d. none of these
9. T-DNA transfer and processing into plant genome requires products of which of the following genes?			
a. *vir* A,B	b. *vir* G,C	c.*vir* D,E	d. All of these
10. Which of the following are used as selection marker for the cells transformed with *Agrobacterium*?			
a. Neomycin phosphotransferase	b. Streptomycin phosphotransferase	c. Hygromycin phosphotransferase	d. Any of the above
11. Which technique is used to introduce genes into dicots?			

a. Electroporation	b. Particle acceleration	c. Microinjection	d. Ti plasmid infection

12. Genome is

a. Genes on nuclear DNA	b. Nuclear DNA + mitochondrial DNA	c. Nuclear DNA + chloroplast DNA	d. Nuclear DNA + Mitochondrial DNA + Chloroplast DNA

13. The process of expression of foreign genes in a plant is called _____

a. Gene expression	b. Transgenesis	c. Genetic transformation	d. Cell hybridization

14. Which of the following is considered as a visual marker?

a. Antibiotic marker	b. Resistance marker	c. Selectable marker	d. Screenable marker

15. Name the first transgenic virus resistant plant?

a. Rice	b. Cotton	c. Tobacco	d. Tomato

16. Which of the following is supplemented with vitamin A in order to improve its nutritional quality?

a. Cotton	b. Potato	c. Tomato	d. rice

17. Which of the following is NOT the class of secondary metabolite?

a. Amino acid	b. Terpenes	c. Phenolics	d. alkaloids

18. Name the class of secondary metabolites which is characterized by the presence of the hydroxyl group with an aromatic ring?

a. Glycosides	b. Phenolics	c. Alkaloids	d. Terpenes

19. Azolla is used as biofertilizer as it has

a. Rhizobium	b. Cyanobacteria	c. Mycorrhiza	d. Large quantity of humus

20. Which sterility is exploited in hybrid seed production?

a.Male genetic sterility	b. Cytoplasmic genetic male sterility is found	c. Cytoplasmic sterility	d. Genetic

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) List out the types of media. B) Mention about auxin.	(OR)
22. A) Write note on callus induction. B) Explain embryo culture.	(OR)
23. A) Briefly discuss particle bombardment. B) Biosynthesis pathway of cytokine-explain.	(OR)
24. A) What is called selectable marker? Explain with two examples. B) Write note on virus resistance.	(OR)
25. A) Explain about saline tolerance. B) Briefly explain Cytoplasmic male sterility.	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Illustrate on the application of crop improvement in agriculture, horticulture and forestry.
27. Explain protoplast isolation, culturing and fusion.
28. Draw and explain agrobacterium mediated gene transfer.
29. Write note on genetic engineering in plants.
30. Describe about isolation and characterization of secondary metabolites.

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

LAB IN IMMUNOLOGY

Paper	: Core Practical V	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 3	Internal	: 40
Paper Code	: 21U5BTCP05	External	: 60

PREAMBLE

To make students on practical exposure towards immunological techniques in-terms of handling of laboratory animals, qualitative and quantitative estimation of antigen - antibody specificity.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Gaining knowledge on handling of laboratory animals	**K1 & K2**
CO2	Knowing about the methods of immunization of bleeding and separation serum and plasma from blood	**K2, K3 & K4**
CO3	Analysis of qualitative and quantitative estimation of antigen and antibody interaction	**K4, K5 & K6**
CO4	To know about the basic principles of blotting techniques in terms of practical approach	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
1	Handling of laboratory animals	**5**
2	Methods of bleeding and routes of immunization	**10**
3	Preparation of Serum and plasma	**5**
4	ABO Blood grouping (Rh typing) (Agglutination)	**5**
5	WIDAL test (Agglutination)	**5**
6	ASO test (Agglutination)	**5**
7	Pregnancy test (Agglutination inhibition)	**5**
8	Radial immune diffusion test (Precipitation test)	**5**
9	Rocket Immuno electrophoresis test (Precipitation)	**5**

10	Ouchterlony double immunodiffusion technique (ODD) (Precipitation)	**5**
11	Counter current immunoelectrophoresis (CIE) (Precipitation)	**5**
12	DOT ELISA test	**5**
13	Western Blotting- Demonstration	**10**

MODEL QUESTION PAPER (LAB IN IMMUNOLOGY)

NAME OF THE COURSE: **LAB IN IMMUNOLOGY**	COURSE CODE: **21U5BTCP05**	DURATION: **6 Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total: **20 MARKS**
1. (i) Identify the Blood group for the given sample (A) and display the results for observation (OR)			
(ii) Perform Radial immune electrophoresis for the given serum and anti-serum sample (A) (OR)			
(iii) Perform WIDAL test for the given plant sample (A)			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
2. (i) Prepare Serum/Plasma from the given blood sample (B). Display the results for observation (OR)			
(ii) Perform DOT ELISA for the given serum sample (B)). Display the results for observation (OR)			
(iii) Perform ASO test from the given blood sample (B)). Display the results for Observation			
SPOTTERS (5 X 4 = **20 MARKS**)			
3. Identify the given spotters C, D, E, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

	NAME	**SIGNATURE**
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COMPILED BY		
AUTHORISED BY		

LAB IN PLANT BIOTECHNOLOGY

Paper	: Core Practical VI	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 3	Internal	: 40
Paper Code	: 21U5BTCP06	External	: 60

PREAMBLE

To make students familiar on basic plant tissue culture techniques and isolating plant pigment by chromatographic technique

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Know about basic aseptic conditions to be followed in plant tissue culture laboratory and preparing various tissue culture media	**K1, K2 & K3**
CO2	Micropropagation of explant for shooting and rooting and to isolate protoplast from plant cells	**K4, K5, & K6**
CO3	Extraction of plant pigments by column chromatography	**K4 & K5**
CO4	Exposing them in preparing synthetic seeds and its preservation	**K4 & K6**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
1	Isolation of Plant genomic DNA	**5**
2	Sterilization of performance of aseptic condition in plant tissue culture lab	**5**
3	Preparation of MS media	**10**
4	Establishment of seed germination from carrot seeds	**5**
5	Establishment of shoot tip culture using MS media	**10**

6	Establishment and maintenance of callus culture	**10**
7	Micro propagation of callus culture (Shoot & Root systems)	**10**
8	Isolation of protoplast (Enzymatic method)	**5**
9	Extraction & separation of Plant pigments (Chlorophyll A & B) Column chromatography	**10**
10	Preparation of synthetic seeds	**5**

MODEL QUESTION PAPER (LAB IN PLANT BIOTECHNOLOGY)

NAME OF THE COURSE: **LAB IN PLANT BIOTECHNOLOGY**	COURSE CODE: **21U5BTCP06**	DURATION: **6 Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total: **20 MARKS**
1. (i) Isolate plant genomic DNA from the given plant sample (A) (OR)			
(ii) Perform shoot tip culture from the given explant sample (A) (OR)			
(iii) Perform callus induction from the given explant (A)			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
2. (i) Isolate protoplast from the given plant mesophyll tissue sample (B) (OR)			
(ii) Prepare synthetic seeds from the given plant seed sample (B) (OR)			
(iii) Separate chlorophyll pigments from the plant leaf extract sample (B) by appropriate Method			
SPOTTERS (5 X 4 = **20 MARKS**)			
3. Identify the given spotters C, D, E, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

ELECTIVE - I

PHARMACEUTICAL BIOTECHNOLOGY

Paper	: Elective I	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 3	Internal	: 25
Paper Code	: 21U5BTE01	External	: 75

PREAMBLE

This paper encodes information on pharmacology, drug designing, sources and applications of drug discovery. Students also understand the basic and applications of pharmacology and sources of drug. Also enables them to understand the concepts of rDNA technology in drug designing.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand the principles of pharmacology and its development History	**K1 & K2**
CO2	To understand principles of action of drugs and mechanism of action to wards various diseases	**K2, K3 & K4**
CO3	To understand the concepts of developing therapeutic agents through genetic engineering principles	**K4, K5 & K6**
CO4	To explore the applications of pharmaceutical chemistry and its Development	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	S	S
CO2	S	S	S	S	S
CO3	M	S	S	M	S
CO4	M	S	S	S	S

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Introduction to pharmacology**: History & development in pharmacology. Principles of pharmacology. – Pharmacology in the 20th century – Drugs – Sources, dosage forms and routes of administration	**15**
II	**Drug names & Classification systems**: General Principles of Drug action	**15**

	Pharmacokinetics, Pharmacodynamics, measurement of drug action.	
III	**Diagnosis and Chemotherapy :** Prenatal diagnosis: Invasive Techniques- Amniocentesis, Fetoscopy, Non Invasive Techniques – Ultra Sonography. Diagnosis using protein & enzymes markers, DNA/RNA based diagnostics. Therapeutic drugs – Protein synthesis inhibitors, Antibacterial, antifungal, anti protozoal, antiviral, anti helmithic, anticancer, anti-inflammatory drugs.	**15**
IV	**Introduction to r-DNA technology**: production of biological: Human Insulin, HGH, GRF, Erythropoietins, IFN, TNF, Interleukins, Clotting factor VIII. Synthetic therapy**:** Synthetic DNA, therapeutic ribozymes, synthetic drugs	**15**
V	**Production and applications:** Probiotics, anticancer and anti-inflammatory agents. Biochips, biofilms and biosurfactants. Tissue Engineering, Recombinant vaccines and Cell adhesion based therapy	**15**

SUGGESTED READINGS

1. A Text Book of Biotechnology. R.C. Dubey. S.Chand& Co Ltd, New Delhi.
2. Pharmacology – H.P. Rang, M.M. Pale, J.M. Moore, and Churchill Livingston.
3. Basic Pharmacology – Foxter Cox. Butterworth‟s 1980
4. Pharmacology and Pharmacotherapeutics – R.S.Satoskar, S.D. Bhandhakam and S.S. Alinapure
5. Pharmaceutical Biotechnology – S.S. Purohit, Kaknani, Saleja
6. Pharmacology – Mary J. Myuk, Richard A.Hoarey, Pamala Lippinwitt, Williams Edition.
7. Integrated pharmacology – Page, Curtis, Sulter, Walker, Halfman. Mosby Publishing Co.

MODEL QUESTION PAPER (PHARMACEUTICAL BIOTECHNOLOGY)

NAME OF THE COURSE: **PHARMACEUTICAL BIOTECHNOLOGY**	COURSE CODE: **21U5BTE01**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Clinical pharmacology was established by_____?			
a. Schwann	b. Robert Hooke	c. William Withering	d. William Wroth
2. The most widely used drug classification systems are?			
a. ATC	b. ADP	c. AKT	d. ATP
3. The drugs that are taken though nasal route is called ----------			
a. Subcutaneous	b. Ear drops	c. Inhaler	d. Intraosseous
4. Parenteral administration can be performed by_____?			
a. Injection	b. Oral	c. Tablet	d. Powder
5. The action of drugs on the human body is called as?			
a. Pharmacodynamics	b. Pharmacokinetics	c. Drug action	d. Transporter protein
6. What the body does with the drug is called as_____?			
a. Drug action	b. Pharmacodynamics	c. Pharmacokinetics	d. Transporter protein
7. Initial consequence of drug–receptor combination is called ----------			
a. Pharmacodynamics	b. Drug action	c. Drug Effect	d. Pharmacokinetics
8. Biochemical and physiological changes that occur as a consequence of drug action called ---			
a. Drug action	b. Drug Effect	c. Pharmacodynamics	d. Pharmacokinetics
9. A group of materials that fight against pathogenic bacteria?			
a. Antibacterial agents	b. Antiviral agents	c. Antifungal agents	d. Anticancer agents
10. Anti-inflammatory drugs make up about half of_____?			
a. Analgesics	b. Prostaglandins	c. Paracetamol	d. Aspirin
11. Abnormal cell growth called as_____?			
a. Cancer	b. Viral	c. Cell growth	d. Tissues
12. Fungal cell wall synthesis inhibition as_____?			
a. Nystatin	b. Caspofungin	c. Azoles	d. Naftifine
13. Insulin hormone produced by?			
a. Pancreas	b. Liver	c. Mitochondria	d. Kidney

14. Erythropoietin is a hormone produced primarily by?			
a. Liver	b. Kidney	c. Pancreas	d. Mitochondria
15. Factor VIII is an essential blood-clotting protein, also known as?			
a. Anti-hemophilic factor	b. Coagulation	c. Glycoprotein	d. Embolism
16. Erythropoietin also known as_____			
a. Hematopoietin	b. Glycoprotein cytokine	c. Erythropoiesis	d. Hypoxia
17. Probiotics are often called as_____?			
a. Helpful" Bacteria	b. Helpless" Bacteria	c. Helpful Virus	d. Helpless Virus
18. _____is the property of a substance or treatment that reduces inflammation?			
a. Anti-cancer	b. Anti-inflammatory	c. Inflammatory	d. Cancer
19. _____are a collective of one or more types of microorganisms that can grow on many different surfaces?			
a. Biofilms	b. Anti-inflammatory	c. Biochips	d. Anti-cancer
20. Bio surfactants are also called as_____			
a. Microbial surfactants	b. Bacterial surfactants	c. Viral surfactants	d. Biochips

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Explain the history and development of pharmacology. B) Explain the various routes of administration of drug.	(OR)
22. A) Explain about pharmaco kinetics B) Write brief notes on the measurement of drug action	(OR)
23. A) Write shortly about Anticancer drugs B) Write short notes on antibacterial drugs	(OR)
24. A) Write short notes on Erythropoietins B) Write short notes on Interleukins?	(OR)
25. A) What is probiotics? Explain in brief B) Write short notes on Biochips	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Write the essay on pharmacology?
27. Explain in detail on the general principle of drug action?
28. Write an essay on therapeutic drugs?
29. Write an essay on r-DNA technology?
30. Explain in detail about the production and application of drugs?

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ELECTIVE I

ENZYMOLOGY AND ENZYME TECHNOLOGY

Paper	: Elective I	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 3	Internal	: 25
Paper Code	: 21U5BTE02	External	: 75

PREAMBLE

This paper concisely presenting the fundamentals of enzymes, enzyme kinetics and industrial applications of enzymes

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To familiarize the basics of enzyme classification, its unit measurement and extraction	**K1 & K2**
CO2	To explore to the usage of enzymes at molecular level such as active site, isoenzymes and their biochemical fundamentals	**K3 & K4**
CO3	To explore the enzyme kinetics and its mechanism of inhibitions	**K4**
CO4	To explore the industrial and clinical applications of commercial Enzymes	**K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Enzymes**: Introduction, Definition, History, Classification and Nomenclature of enzymes. Intracellular localization of enzymes, Extraction and purification of enzymes. Enzyme units. Substrate specificity.	**15**
II	**Active site**: Salient features, Theories of ES complex formation – Lock and Key, Induced fit and Substrate strain theory. Structure and functions of coenzymes, Isoenzymes and their separation rates. Collision and transition state theories. Factors affecting enzyme activity	**15**

III	**Enzyme kinetics**: Order of reaction, Activation energy, Kinetics of enzyme catalyzed reactions – Steady state kinetics – Michaelis Menten equation, and its transformation. Bi – substrate reaction – random, ordered and ping pong mechanisms. Enzyme - Enzyme interaction. Protein ligand binding	**15**
IV	**Enzyme inhibition**: Reversible and irreversible inhibitors. Mechanism of catalysis – acid base, electrostatic, covalent, metal ion and enzyme catalysis, electrostatic proximity and orientation effects. Mechanism and action of chymotrypsin, lysozyme and carboxy peptidase. Isoenzymes–multiple forms of Isoenzymes	**15**
V	**Immobilization of enzymes**: Methods and application. Clinical and Industrial application of enzymes, Enzyme engineering – site directed mutagenesis. Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes.	**15**

SUGGESTED READINGS

1. Enzymes: Biochemistry, Biotechnology, Clinical chemistry – Trevor Palmer, East West Press Edition, New Delhi, 2004.
2. Fundamentals of Enzymology - Nicholas C. Price Lewis Stevens, 2nd edition, Oxford University Press, Newyork, 1998.
3. Biochemistry – U.Satyanarayana & U.Chakrapani, Books and Allied (P) Ltd, Kolkata, 2008.
4. Lehninger Principles of Biochemistry – David L. Nelson and Michael M.Cox, W.H Freeman and Company, New York, 2007.
5. Biochemistry – Lubert Stryer, Jeremy M. Berg, John L.Tymoczko, V edition, W.H.Freeman & Company, Newyork, 2001.
6. Enzyme Technology – Ashok Pandey, Colin Webb, Calos Ricardo Soccl, Christian Larroche, Asiatech publishers Inc, New Delhi, 2005.

MODEL QUESTION PAPER (ENZYMOLOGY AND ENZYME TECHNOLOGY)

NAME OF THE COURSE: **ENZYMOLOGY AND ENZYME TECHNOLOGY**	COURSE CODE: **21U5BTE02**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Enzymes are broadly classified into----------types			
a. 4	b. 5	c. 6	d. 7
2. The function of isomerases is ----------			
a. Geometrical changes	b. Isomeric changes	c. Steric changes	d. Super numeric changes
3. Enzyme activity depends on ----------			
a. Substrate conc.	b. Substrate availability	c. Substrate binding site	d. All the above
4. Which of the following method is used in separating specific enzymes from its crude sample?			
a. Dialysis	b. Native PAGE	c. 2D PAGE	d. Isoelectric focusing
5. Which of the following concept model describes the conformational changes occurring at the active site of enzyme?			
a. Lock & Key model	b. Induced fit hypothesis	c. Substrate strain concept	d. None of the above
6. Michealis – Menton equation describes ----------			
a. Rate of enzyme activity	b. Rate of substrate activity	c. ES formation	d. All the above
7. Bi substrate reactions indirectly describes the concept of ----------			
a. Lock & Key concept	b. Induced fit hypothesis	c. Substrate binding theory	d. None of the above
8. Which of the following physical factor affects the enzyme activity?			
a. Enzyme conc.	b. Substrate Conc.	c. Binding site	d. pH
9. Which of the following is an example for isoenzyme?			
a. ACTH	b. GH	c. LDH	d. FSH
10. Activation energy is the energy required for ----------			
a. Activating enzyme	b. Activating substrate	c. Activating co factors	d. Activating physical factors
11. The kinetics of enzyme – catalysed reactions can be analysed in terms of steady state models if the substrate concentrations are ----------			
a. More than an order of magnitude higher than the enzyme level	b. Less than an order of magnitude lower than the enzyme level	c. More than the rate of magnitude higher than the enzyme level	d. Less than the rate of magnitude lower than the enzyme level
12. The reaction between ADP and phosphocreatine works under the principle of ----------			

a.Random mechanism	b. Double displacement mechanism	c. Ping pong mechanism	d. B & C
13. Which of the following type of enzyme inhibition shows an increase in KM value with constant Vmax?			
a. Competitive	b. Non – Competitive	c. Un – Competitive	d. None of the above
14. Allosteric enzymes displays a sigmoidal curve in contrast to the----------displayed by Michealis – Menton enzymes			
a. Hyperbolic curve	b. Parabolic curve	c. Quadratic curve	d. Transcendental curve
15. Chymotrypsin is an ----------			
a. Cysteine protease	b. Serine protease	c. Proline protease	d. Leucine protease
16. Carboxypeptidase A3 (CPA3) involved in the protein digestion by ----------			
a. Pancreatic cells	b. Liver cells	c. Mast cells	d. Tumour cells
17. Which of the following method is commonly used in maintaining enzyme activity			
a. Entrapment method	b. Encapsulation	c. Immobilization	d. All the above
18. Which of the following enzyme is used in leather industries?			
a. Amylase	b. Lipase	c. Protease	d. DNAse
19. Which of the following technology is followed for enriching the enzyme activity?			
a.Yeast hybrid analysis	b. Site directed mutagenesis	c.Feed back inhibition	d. None of the above
20. Which of following enzyme is used as deworming agent?			
a. Tryspin	b. Papain	c. Amylase	d. Protease

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Explain about enzyme units B) Explain about substrate specifity	(OR)
22. A) Explain about isoenzymes B) Explain the factors affecting the enzyme activity	(OR)
23. A) Explain the steady state kinetics of enzymes B) Write short notes on the order of the enzyme reaction	(OR)
24. A) Explain the mechanism of action of chymotrypsin B) Write short notes on mechanism of enzyme catalysis	(OR)
25. A) Explain the process of site directed mutagenesis B) Explain about enzyme engineering	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give detailed account on the classification of enzymes
27. Give detailed account on iso-enzymes
28. Give detailed account on MM and LB plot
29. Give detailed account on enzyme inhibition and its types
30. Give detailed account on industrial applications of enzymes

	NAME	SIGNATURE
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AUTHORISED BY		

ELECTIVE I

TISSUE ENGINEERING

Paper	: Elective I	Total Hours	: 75
Hours/Week	: 4	Exam Hours	: 03
Credit	: 3	Internal	: 25
Paper Code	: 21U5BTE03	External	: 75

PREAMBLE

This paper deals with the use of combination of cells, engineering and materials methods, and suitable biochemical and physicochemical factors to improve or replace biological tissues. Tissue engineering involves the use of tissue scaffold for the formation of new viable tissue for a medical purpose.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand the key topics in tissue engineering	**K1, K2 & K3**
CO2	To understand the stem cells and animal cells, processes, and strategies to regenerate or repair damaged tissues	**K3 & K4**
CO3	To develop students ability to identify, formulate and adapt engineering solutions to unmet biological needs	**K4 & K5**
CO4	To give students a knowledge of how the biomedical industry is regulated and the route to market of for tissue engineered products	**K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Introduction to tissue engineering: Basic definition; current scope of development; use in therapeutics, cells as therapeutic agents. Measurement of tissue characteristics, appearance, cellular component, ECM component, and physical properties.	**15**
II	Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Basic properties, Cell-Matrix & Cell-Cell Interactions, telomeres and Self renewal, Control of cell migration in tissue	**15**

	engineering.	
III	Biomaterials: Properties of biomaterials, Surface, bulk, mechanical and biological properties. Scaffolds & tissue engineering, Types of biomaterials, biological and synthetic materials, Biopolymers, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology.	**15**
IV	Stem Cells : Introduction, hematopoietic differentiation pathway Potency and plasticity of stem cells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cell markers. Stem cell systems - Liver, neuronal stem cells with characteristics: embryonic, adult, haematopoietic, fetal, cord blood, placenta, bone marrow, primordial germ cells, cancer stem cells and induced pluripotent stem cells.	**15**
V	Stem cell therapy, Molecular therapy, *in-vitro* organogenesis, Neurodegenerative diseases, spinal cord injury, heart disease and muscular dystrophy. Stem cells and Gene therapy: Physiological models, tissue engineered therapies, product characterization. Preservation of stem cells: freezing and drying. Patent protection and regulation of tissue engineered products and ethical issues.	**15**

SUGGESTED READINGS

1. Bernhard O.Palsson,Sangeeta N.Bhatia,"Tissue Engineering", Pearson Publishers 2009.
2. Raphael Gorodetsky, Richard Schäfer. "Stem cell based tissue repair", Cambridge: RSC Publishing, c2011.
3. John P. Fischer, Antonios G. Mikos, Joseph D. Bronzino. "Tissue Engineering", CRC Press, 2012.
4. Larry L. Hench, Julian R. Jones. "Biomaterials, Artificial Organs and Tissue Engineering", CRC Press, 2005.
5. C. S. Potten, "Stem Cells", Academic Press, 1997.

MODEL QUESTION PAPER (TISSUE ENGINEERING)

NAME OF THE COURSE: **TISSUE ENGINEEING**	COURSE CODE: **21U5BTE03**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The formation of blood vessel from the pre-existing blood vessel is known as ----------			
a. Angiogenesis	b. Vascularization	c. Osteogenesis	d. Phagocytosis
2. The Major Histocompatibility Complexes (MHCs) are ----------			
a. Signaling molecules	b. Growth factors	c. Cell surface markers	d. Cell adhesion molecules
3. Bone Morphogenic Protein (BMP) is a ----------			
a. Cell surface marker	b. Growth factors	c. Hormone	d. Neurotransmitter
4. Polyglycolic Acid (PGA) scaffold is ----------			
a. Biotolerant	b. Bioactive	c. Bioinert	d. Biodegradable
5. In tissue engineering, harvested cells are frozen away and stored in ----------			
a. Liquid hydrogen	b. Liquid nitrogen	c. Liquid helium	d. Autoclave
6. Cell signaling compounds cytokines are a group of ----------			
a. Proteins and peptides	b. Fats and triglycerides	c. Carbohydrates	d. Hormones and steroids
7. c-AMP and c-GMP functions as ----------			
a. Hormone	b. Receptor	c. Second messenger	d. Ligand
8. The signals which affect only cells of the same cell type as the emitting cell are ----------			
a. Endocrine	b. Autocrine	c. Paracrine	d. none of these
9. Carbon nanotubes are used for tissue engineering scaffolds as they are ----------			
a. Biocompatible	b. Biodegradable	c. Biopolymers	d. none of these
10. PLA degrades within the body to form ----------			
a. Amino acid	b. Glycolic acid	c. Lactic acid	d. Phosphoric acid.
11. An example of CAM is ----------			
a. Cadherin	b. Protease	c. Growth hormone	d. Serine
12. For skin grafting the scaffold used should be ----------			
a. Biodegradable	b. Bioactive	c. Biocompatible	d. Both (a) and (c)
13. Endocrine signaling is performed by ----------			
a. Enzymes	b. Hormones	c. Cytokines	d. Carbohydrates
14. Programmed Cell death is also known as ----------			
a. Apoptois	b. Lysis	c. Degeneration	d. Deformation
15. The protein of cell that binds to a specific molecules is known as ----------			
a. Ligand	b. Receptor	c. Hormone	d. Cytokine
16. Notch is a cell surface protein that functions as a ----------			

a. Receptor	b. Hormone	c. Protein-A	d. Cytokine.
17. Solid Free Forming is a fabrication technique for			
a. 2D scaffold	b. 3D scaffold	c. Micro scaffold	d. Nano-patterned scaffold
18. Hydrogels can also be used as scaffolds for ----------			
a. Cell growth	b. Cell delivery	c. Cell growth and cell delivery	d. None of these
19. GABA is a ----------			
a. Neurotransmitter	b. Neuro inhibitor	c.Contact inhibitor	d. Contact excitator
20. The family of receptors that play an important role in cell adhesion is			
a. Somatostatin	b. Interleukins	c. Integrins	d. Interferons

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) What are the different types of tissues in the mammalian body? B) Classify tissue based on their structure and function	(OR)
22. A) Briefly explain the different types of stem cells B) Briefly explain the process of cell placement on scaffold	(OR)
23. A) Describe different kinds of matrix materials used in tissue engineering B) Mention the importance of growth factors in the field of tissue engineering	(OR)
24. A) With the help of sketch, explain the process of differentiation of stem cells into cell lines B) What are the different risk factors involved with skin grafting?	(OR)
25. A) Mention the basic clinical goals and fundamental challenges of tissue engineering B) What are the basic criteria of a scaffold used for tissue reconstruction?	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. With the help of a flow-chart, explain the different processes involved in wound healing
27. Describe the signalling pathway for cell's response to the ligand
28. Describe the engineering materials used in scaffold fabrication. Mention the parameters for scaffold selection.
29. With the neat sketch, explain the mechanism of adhesion between leukocytes and endothelial cells
30. Demonstrate bioreactor for achieving nutrient transport in an engineered tissue construct

SBEC – III

LAB IN BIOINFORMATICS

Paper	: SBEC III	Total Hours	: 30
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U5BTS07	External	: 75

PREAMBLE

To make students on understanding basic principles of biological soft wares and their usage for generating molecular and genetic databases of living organisms

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand the basic concepts of functional and computational genomics and proteomics	**K2, K3, K5 & K6**
CO2	To acquire knowledge on the usage of biological software on generating databases both online/offline	**K2, K3, K5 & K6**
CO3	To understand the existence of globally available online soft wares and databases for nucleic sequence retrieval	**K2, K3, K5 & K6**
CO4	To understand the usage and deposition of sequences in to globally available structural databases	**K2, K3, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

Exp. No	TITLE	HOURS
1	Biological Databases with reference to Expasy and NCBI	**2**
2	Query finding based on biological databases	**2**
3	Sequence similarity searching using BLAST	**3**
4	Pairwise alignment	**2**
5	Multiple Sequence and Phylogenetic Analysis	**3**
6	Gene Prediction	**3**
7	Protein Structure prediction (Secondary and tertiary)	**3**

8	Homology Modeling Using Modeller	**3**
9	Protein- Ligand docking	**2**
10	Program to store a DNA sequence in NCBI : Bankit	**3**
11	Program to convert DNA to RNA/Protein	**2**
12	Program to find ORF	**2**

MODEL QUESTION PAPER (LAB IN BIOINFORMATICS)

NAME OF THE COURSE: **LAB IN BIOINFOMATICS**	COURSE CODE: **21U5BTS07**	DURATION: **6Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 10	Obs: 5	Res: 5	Total **20 MARKS**
1. (i) Retrieve the gene sequence from GenBank (A)			(OR)
(ii) Find out the given query sequence (A) by BLAST analysis			(OR)
(iii) Find out ORF in the given sequence sample (A)			
MINOR EXPERIMENT			
Exp: 8	Obs: 4	Res: 3	Total: **15 MARKS**
2. (i) Retrieve the protein structure of haemoglobin (B)			(OR)
(ii) Perform Phylogenetic Analysis for the given organism (A)			(OR)
(iii) Find out the RNA sequence from the given DNA sequence (B)			
SPOTTERS			(5 X 4 = **25 MARKS**)
3. Identify the given spotters C, D, E, F & G and comment on them			
RECORD			(1 x 5 = **5 MARKS**)
VIVA-VOCE			**5 MARKS**
TOTAL			**60 MARKS**

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SBEC – III

BIOSAFETEY, BIOETHICS & IPR

Paper	: SBEC III	Total Hours	: 30
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U5BTS08	External	: 75

PREAMBLE

To make students on understanding basic principles of biosafety guidelines and to understand concepts of intellectual property right and its types. The student also gain added knowledge on ethical, legal and social considerations on implementing/maketing biotechnological products.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Understand the concepts of basic biosafety and biosafety levels	**K1 & K2**
CO2	Understand biosafety guidelines and role genetically modified Organisms	**K1, K2 & K4**
CO3	Understand the basic principles of IPR, its types and patenting Procedures	**K4, K5 & K6**
CO4	Understand the concepts of ethical, legal considerations on the release of genetically modified organisms	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Bio safety: Introduction – bio safety issues in biotechnology - historical background. Biosafety Levels - Levels of Specific Microorganisms, Infectious Agents and Infected Animals.	**6**
II	Biosafety Guidelines: Guidelines and regulations (Cartegana Protocol). Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee, RCGM, GEAC.	**6**
III	Intellectual Property Rights: Introduction to IPR, Types of IP - Patents, Trademarks, Copyright & Related Rights, Importance of IPR – patentable and non-patentable.	**6**
IV	Patents and Patent Laws: Objectives of the patent system - Basic, principles	**6**

	and general requirements of patent law. Patentable subjects and protection in Biotechnology. Patent infringement- meaning, scope, litigation, case studies.	
V	Bioethics: Introduction to ethics and bioethics, framework for ethical decision making. Ethical, legal and socioeconomic aspects of gene therapy. Ethical implications of human genome project and GM crops, biopiracy and biowarfare.	**6**

SUGGESTED READINGS:

1. Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.

2. Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.

3. Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.

4. Sasson A, Biotechnologies and Development, UNESCO Publications.

5. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, India.

MODEL QUESTION PAPER (BIOSAFETY, BIOETHICS AND IPR)

NAME OF THE COURSE: **BIOSAFETY, BIOETHICS AND IPR**	COURSE CODE: **21U5BTS08**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Bio-related research activities may not involve ----------			
a. Micro organisms	b. Animal cells	c. Plant cells	d. All
2. A pathogen that is unlikely to cause any disease in humans or animals			
a. Risk group I	b. Risk group II	c. Risk group III	d. Risk group IV
3. *Korean hemorrhagic* fever is example for ----------			
a. Risk group II	b. Risk group III	c. Risk group IV	d. Risk group I
4. Physical containment is achieved by ---------			
a. One type	b. Two types	c. Three types	d. Four types
5. Which one of the following is not relevant to sterilization technique?			
a. Ethanol	b. Incinerator	c. Microscope	d. Autoclave
6. Cartagena Protocol on Biosafety to the Convention on Biological Diversity Effective from			
a. 11 September 2003	b. 12 September 2003	c. 11 September 2004	d. 12 September 2004
7. Each Institutional Biosafety Committee has a nominee for ----------			
a. DST	b. DBT	c. UGC	d. ICAR
8. How many RCGM meeting held in 2018?			
a. 7	b. 8	c. 9	d. 6
9. The RCGM shall not include the following representative			
a. DBT	b. ICMR	c. UGC	d. CSIR
10. GEAC established under			
a. MoEF & CC	b. UGC	c. DBT	d. DST
11. Trade name is otherwise called as -------			
a. Patent	b. Model	c. Business name	d. Trademark
12 ----------is any information of commercial value concerning production			
a. Trade name	b. Trade Secret	c. Patent	d. Industrial Design
13. IPR initially started in North Italy during the ----------			
a. Renaissance era. In 1471	b. Renaissance era. In 1472	c. Renaissance era. In 1473	d. Renaissance era. In 1474
14. Protection of IPR not allow the following			

a. Innovator	b. Brand owner	c. Teacher	d. Copyright holder
15. Intellectual property not refers to creations of the mind			
a. Hard work	b. Inventions	c. Literary and artistic works	d. Names
16. Which one is comes under type of intellectual property (IP)?			
a. Copyright	b. Patent	c. Trademark	d. All the above
17. Mathematical algorithms are--------			
a. Patentable	b. Non patentable	c. Both	d. None of the above
18. Software is a -------			
a. Patentable	b. Non patentable	c. Both	d. None of the above
19. Patentable biotechnological inventions is ----------			
a. Proteins	b. DNA sequences	c. Both of the (a) and (b)	d. None of the above
20. Early founders of bioethics put forth four principles which form the framework for moral reasoning			
a. 4	b. 3	c. 2	d. 1

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Explain different levels of biosafety. B) Explain different types of sterilization methods.
22. A) Explain the role of institutional committee. B) Explain RCGM and GEAC?
23. A) explain object of Intellectual property law? B) Explain the importance of IPR?
24. A) Write a note on benefits of patent. B) Explain patentable and non-patentable biotechnological inventions?
25. A) Define bioethics, explain purpose and scope of bioethics? B) Explain perspectives and methodology of bioethics?

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Explain different types of bio-safety measures in laboratory?
27. Explain Cartagena protocol on biosafety.
28. What is IPR and explain their different types?
29. Patent - Definition, History and Law
30. Explain framework for making ethical decisions.

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SBEC – III

CANCER BIOLOGY

Paper	: SBEC III	Total Hours	: 30
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U5BTS09	External	: 75

PREAMBLE

To make students on understanding basic principles of biosafety guidelines and to understand concepts of intellectual property right and its types. The students also gain added knowledge on ethical, legal and social considerations on implementing/marketing biotechnological products.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Understand the basic concepts of cancer biology and types of tumour	**K1 & K2**
CO2	Understand the mechanisms of cancer development and chemical involved in carcinogenesis	**K1 & K2**
CO3	Understand molecular mechanisms and genetic principles of oncogene expression	**K3, K4 & K5**
CO4	Acquiring the knowledge on developing drug discovery approach in the management and detection of cancer	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Fundamentals of cancer biology:** Regulation of Cell cycle, Mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes. Development and causes of cancer, Types of cancer, Benign and malignant tumours.	**6**
II	**Principles of carcinogenesis:** Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis.	**6**
III	**Principles of molecular biology of cancer:** Oncogenesis: Oncogenes, identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes, Growth factors related to transformations.	**6**

IV	**Principles of cancer metastasis:** Clinical significances of invasion, heterogeneity of metastatic phenotype, three step theory of invasion, Proteinases and tumor cell invasion.	**6**
V	**New molecules for cancer therapy:** Different forms of therapy, Chemotherapy, Radiation Therapy, Detection of Cancers, Prediction of aggressiveness of Cancer, Advances in Cancer detection.	**6**

SUGGESTED READINGS:

1. King R.J.B., Cancer Biology, Addision Wesley Longmann Ltd, U.K., 1996.
2. Maly B.W.J., Virology a practical approach, IRL press, Oxford, 1987.
3. Dunmock.N.J and Primrose S.B., Introduction to modern Virology, Blackwell Scientific Publications.
4. Ruddon.R.W.,Cancer Biology, Oxford University Press, Oxford, 1995.

MODEL QUESTION PAPER (CANCER BIOLOGY)

NAME OF THE COURSE: **CANCER BIOLOGY**	COURSE CODE: **21U5BTS09**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Cell cycle is regulated by ----------			
a. Kinase	b. CDKs	c. Cyclins	d. cAMP
2. Which of the following is tumour suppressor gene?			
a. MAP	b. EGF	c. RB	d. p53
3. Which of the following is an example for malignant tumour?			
a. Skin cancer	b. Hyperchromic macrocytic anaemia	c. Lung cancer	d. Liver cancer
4. Which of the following is not a process of metastasis?			
a. Attachment & Detachment	b. Invasion	c. Angiogenesis	d. Tissue degeneration
5. Which of the following chemical causes cervical cancer?			
a. Asbestos	b. Benzapyrene	c. Ethidium bromide	d. Acrylamide
6. Continuous exposure to asbestos causes ----------			
a. Intestinal cancer	b. Lung cancer	c. Liver cancer	d. All the above
7. Development of cancer in a specific site by the formation active tumour polyps is induced by the formation of ----------			
a. Blood vessels	b. Blood venous	c. Blood capillaries	d. None of the above
8. Metastatic mode cancer spreading is mainly achieved by ---------- system			
a. Respiratory	b. Nervous	c. Circulatory	d. Excretory
9. Development of blood cancer is induced by which of the following factor?			
a. Epithelial growth factor	b. Endothelial growth factor	c. Christmas factor	d. Vascular growth factor
10. Oncogenes are expressed from ----------			
a. RB gene	b. Protogenes	c. Tumor supressor genes	d. Proto oncogenes
11. Which of the following gene is responsible for cancer development by retroviruses?			
a. RTase	b. DNase	c. Retro transposons	d. None of the above
12. Eye cancer is caused due to the mutation in----------gene			
a. CAT	b. RB	c. Rho	d. CRISPER
13. Cancer cells of epithelial origin can even shed their typical qualities and characteristics and adopt a ---------- like phenotype			

a. Parenchyma	b. Cholenchyma	c. Mesenchyma	d. All the above
14. Interaction between the tumour cell and the surrounding stroma is extremely important in the development of tumor ----------			
a. Vasculogenesis	b. Capillary synthesis	c. A & B	d. Angiogenesis
15. The cell adhesion complex runs from the apical to the basal membranes and composed of ----------			
a. Tight junctions	b. Adherent junctions	c. Gap junctions	d. All the above
16. Which of the following factor is responsible for the development of liver cancer?			
a. EGF	b. VGF	c. HGF	d. EnGF
17. Treatment of cancer cells by targeting them with cytokines is mode of ----------			
a. Chemotherapy	b. Radiation therapy	c. Immunotherapy	d. Hormone therapy
18. The early stage of colon cancer is detected due to the expression of ----------gene			
a. dMMR	b. MACC 1	c. MACC 2	d. dMMR 2
19. Prostate cancer aggressiveness can be conveniently detected by ----------			
a. MALDI	b. ESR	c.pCaP	d. NMR
20. Mammary gland tumour is detected accurately by ----------			
a. Fluorescence imaging technique	b. Electrical impedance scanning	c. Digital mammography & Computer aided detection system	d. Nanotechnology based detection

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Explain the regulation of cell cycle (OR) B) Write short notes on signal switches
22. A) Write short notes on chemical carcinogenesis (OR) B) Write briefly on the metabolic consequences of carcinogenesis
23. A) How will you identify oncogenes (OR) B) Write shortly about the growth factors involved in the transformation of normal cell in to cancer cell
24. A) Write briefly on the clinical significances of invasion (OR) B) Write about three step theory of invasion
25. A) Explain the different forms of cancer therapy (OR) B) Write short notes on radiation cancer therapy

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give a detailed account on tumour suppressor gene
27. Give a detailed account on metabolism of carcinogenesis
28. Write an essay on retroviral oncogenes
29. Explain the basic principles of cancer metastasis
30. Write elaborately on the detection and prediction of cancer

	NAME	SIGNATURE
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COMPILED BY		
AUTHORISED BY		

SEMESTER VI

BIOPROCESS TECHNOLOGY

Paper	: Core VII	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21U6BTC07	External	: 75

PREAMBLE

To make students on understanding basic principles of fermentation techniques and applying them in the production value added products such as antibiotic, vitamins and organic acids. The students also gain added knowledge on the production of agrobased products for human welfare.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Understand the concepts of fermentation principles and its scope in downstream processing	**K1 & K2**
CO2	Understand the concepts of designing fermentor both in laboratory and pilot scale and its mode of operation	**K1, K2 & K3**
CO3	Gaining added information on the production of value added products from microorganisms	**K4, K5 & K6**
CO4	Propagate mass production of agriculturally important value added Products	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**BASICS OF BIOPROCESS TECHNOLOGY:** Introduction, Definition, Scope and applications of Bioprocess. Introduction to fermentation and downstream processing technology. Isolation and screening of industrially important microorganism. Strain improvement, preservation of microorganisms.	**15**

II	**DESIGN OF FERMENTOR:** Fermentation types. Design of fermentor – parts and its functions. Types of Bioreactors (Air lift, cyclone, column, packed tower) Mixed bioreactor systems. Monitoring and controlling Bioreactors (pH, temperature and dissolved oxygen), Instrumentation for process control - Heat and mass transfer, oxygen transfer mechanism. Principles of upstream processing – Media preparation, Inocula development and sterilization.	**14**
III	**DOWN STREAM PROCESSING:** Basic principles of Down-stream processing – microbial cell disruption methods (Centrifugation, filtration fermentation broths). Cell separation techniques (Ultra filtration, Liquid-Liquid extraction) Chromatographic techniques: (Column & Ion exchange), Physical methods (Distillation, Fluid extraction and Electro dialysis). Bioprocess measurement and control system with special reference to computer aided process control.	**15**
IV	**INDUSTRIAL BIOTECHNOLOGY:** Microbial synthesis and applications – organic acids (Citric acid & acetic acid), Enzymes (Amylase), Antibiotics (Penicillin & Streptomycin), Vitamins (ascorbic acid & B12) an amino acids (Lysine & Aspartic acid).	**16**
V	**PRODUCTION OF AGRICULTURAL PRODUCTS:** Importance of micro algae and its cultivation (*Spirullina* & *Chlorella*). Mass production of Biofertilizer (*Rhizobium* & *Azolla*). Mushroom cultivation (Milk and button mushroom). Production and applications of Biopesticide (*Bacillus thuringiensis*).	**15**

SUGGESTED READINGS:

1. Peppler H.J. and Perlman D. 2006. Microbial Technology: Microbial Processes, 2nd Edition, Vol I, Academic Press
2. Stanbury F, Whittaker A and Hall J.S. 1997. Principles of Fermentation Technology, Adithya Books, New Delhi.
3. Jogdand S.N. 2000. Medical Biotechnology, Himalayan Publishing House.
4. Jayanto A. 2006. Fermentation Biotechnology, Dominant Publishers and Distributors, New Delhi.
5. Cassida J.R. 2005. Industrial Biotechnology, New Age International (P) Ltd, New Delhi.
6. Juan A and Senjo A. 2007. Separation Process Biotechnology, Taylor & Francis group.
7. Patel A.H. 1997. Industrial Microbiology, Macmillan India limited.
8. Glazer A.N. and Nikaido, H. 2007. Microbial Biotechnology: Fundamentals of Applied Microbiology, 2nd Edition, Cambridge University Press.
9. Prescott C and Dunn G. 2006. Industrial Microbiology, Agrobios (India).
10. Purohit S.S. Saluja A.K. and Kakrani H.N. 2004. Pharmaceutical Biotechnology. 1st Edition, Agrobios (India).

MODEL QUESTION PAPER (BIOPROCESS TECHNOLOGY)

NAME OF THE COURSE: **BIOPROCESS TECHNOLOGY**	COURSE CODE: **21U6BTC07**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Fed batch process belong to ----------			
a. Closed system	b. Continuous system	c. Intermediate fed batch system	d. Discontinuous system
2. Soyameal, peptone and tryptone are used as the source of ----------			
a. Carbon	b. Carbon & nitrogen	c. Mineral	d. Nitrogen
3. Batch sterilization cycle time consists of ----------			
a. Two phases	b. Three phases	c. Four phases	d. Five phases
4. Protected fermentation uses which of the given below ----------			
a. Sterilized media	b. Pasteurized media	c. Pasteurized media with low pH	d. Unsterilized media
5. A spray dryer works on the principle of ----------			
a. Contact drying	b. Sublimation	c. Lyophilisation	d. Adiabatic drying
6. Which is not a fruit or a vegetable based fermented product?			
a. Wine	b. Beer	c. Vinegar	d. Sauerkraut
7. Which of the following is an upstream process?			
a. Product recovery	b. Product purification	c. Media formulation	d. Cell lysis
8. Pyrogen free water is related to ----------			
a. Endotoxin	b. O-polysaccharide	c. Peptidoglycan	e. Teichoic acid
9. Which one is down steaming process?			
a. Product recovery	b. Screening	c. Media formulation	d. Sterilization of media
10. Which is the following is not a physical method for the cells rupturing?			
a. Milling	b. Homogenization	c. Ultra sonication	d. Enzymatic digestion
11. Ethanol fermentation is carried by ----------			
a. *Lactobacillus*	b. *E.coli*	c. *Saccharomyces cerevisiae*	d. *Bacillus* sp.
12. What is the percentage range of variation in recovery costs?			
a. 50-55%	b. 0-20%	c. 5-7%	d. 15-75%
13. Cell lysis becomes an important operation if the product is ----------			

a. Extra cellular	b. Heat labile	c. Toxic	d. Intra cellular
14. . *Bacillus thuringiensis* is used as ----------			
a. Insecticide	b. Fungicide	c. Microbicidal agent	d. Rodenticide
15. Yeast cells are good sources of ----------			
a. Vitamin A&B	b. Vitamin A&D	c. Vitamin B&D	d. All the above
16. The sugar concentration of molasses used in fermentation ranges between ----------			
a. 10-18%	b. 20-30%	c. 4-5%	d. 30-38%
17. The protein found in milk is ----------			
a. Rennin	b. Pepsin	c. Casein	d. Trypsin
18. *Spirullina* is a ----------			
a. Edible fungus	b. Bio fertilizer	c. Biopesticidal	d. Single cell protein
19. What is the scientific name of mushroom?			
a. *Funaria* sp.	b. *Dryopteris* sp.	c. *Agaricus campestris*	d. *Fergus* sp.
20. Agar-Agar is obtained from ----------			
a. Diatoms	b. *Gracilaria*	c. *Fomes*	d. *Laminaria*

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) State the scope and application of bioprocess technology B) Write notes on strain improvements	(OR)
22. A) Explain about airlift bioreactors B) Illustrate the packed tower bioreactor with its uses.	(OR)
23. A) Briefly mention the principles and uses of centrifugation B) Elaborate on cell separation techniques	(OR)
24. A) List out the application of amylases B) Explicate the production and applications of lysine	(OR)
25. A) Highlight the importance of bio fertilizers B) What are mushrooms? Explain its cultivation methods	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. How will you develop an improved strain through recombination technique?
27. Illustrate the criteria for design of fermenters and specify its functions.
28. Explain basic principles of down streaming process
29. Explain the large scale production of penicillin and state its uses.
30. Describe the production and application of *Bacillus thuringiensis.*

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

ANIMAL BIOTECHNOLOGY

Paper	: Core VIII	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 25
Paper Code	: 21U6BTC08	External	: 75

PREAMBLE

To make students on understanding the concepts of biotechnological approaches in animals so as to produce therapeutically products from animal systems.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Understanding the development of animal cell culture techniques and basic concepts of cell lines	**K1 & K2**
CO2	Gain knowledge on cell culture, animal cell growth dynamics	**K1 & K2**
CO3	Manipulating animal cell for genetic improvement by modern recombinant techniques	**K3 & K4**
CO4	Knowing about the principles of ethical, legal and public issues on using genetically animals in producing value added products	**K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Introduction and history of animal cell culture development. Types of cell culture methods (Primary & secondary). Animal Cell lines (Primary & Continuous cell lines). Suspension culture and organ culture. Culturing of lymphocytes, epithelial cells & stem cells.	**15**
II	**Basics of cell culture:** Different types of animal cell culture media, growth supplements serum free media, Balanced salt solutions. Behaviour of cells in culture cell division, Cell growth kinetics, Metabolism and estimation of cell number.	**15**

III	**Gene transfer methods in animals:** Microinjection, Embryonic stem cell gene transfer, Retroviral gene transfer. Transgenic animals (Production of transgenic Mice, Cow and Sheep). Animal viral vectors (SV40 virus and Retro virus). Baculo virus expression system. Improvement of silk production and quality.	**15**
IV	**Animal Propagation and health care:** Artificial insemination, Embryo transfer techniques. Gene therapy and its types, vectors in gene therapy. Production and development of animal vaccines for FMD, BTD, Rabies and anthrax.	**15**
V	**Public aspects of Animal Biotechnology:** Ethical issues in Animal Biotechnology, Management aspects of Biotechnology and Genetic Engineering. Manipulation of animal growth using hormones and probiotics. Manipulating lactation and wool growth in sheep and Rabbits.	**15**

SUGGESTED READINGS:

1. Portner R. Animal Cell Biotechnology: Methods and Protocols, Second Edition, Humana Press, 2007.
2. Babink L.A. and Philips J.P. Animal Biotechnology, Comprehensive Biotehcnology First Supplement, Pregamon press, Oxford, 1989.
3. Rossant J. and Pederson R.A. Experimental approaches to Mammalian Embryonic Development, Cambdrige University Press, Cambridge, 1996.
4. Ian Gordon. Reproductive Technologies in farm animals, first edition, CABI Inter., 2004.
5. Lewis R. Human Genetics: Concept and applications. McGraw Hill Company, 2003.
6. Barrer JSF, Hammond K, McClintok AE, Eds., Future Developments in the Genetic improvements of Animals. Academic Press, 1992.
7. Freshney R.L. Animal Cell culture – A practical approach, IRL press, 1992.
8. Freshney R.L. Culture of animal cells: A manual of basic technique and specialized applications. 6th Edition, Wiley and Blackwell publications, 2010.
9. Ian Gordon. Reproductive Technologies in farm animals, first edition, CABI Inter., 2004.

MODEL QUESTION PAPER (ANIMAL BIOTECHNOLOGY)

NAME OF THE COURSE: **ANIMAL BIOTECHNOLOGY**	COURSE CODE: **21U6BTC08**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The growth of animal cells in vitro in a suitable culture medium is called_____?			
a. LB medium	b. MS medium	c. NITCH‟s medium	d. MEM medium
2. Who introduced HAT medium?			
a. Littlefield	b. Ham	c. Amold	d. Rous and Jones
3. Name the type of culture which is prepared by inoculating directly from the tissue of an organism to culture media?			
a. Primary cell culture	b. Secondary cell culture	c. Cell lines	d. Transformed cell culture
4. What is cell line?			
a. Multilayer culture	b. Transformed cells	c. Multiple growth of cells	d. Sub culturing of primary culture
5. Which of the following is NOT the part of growth medium for animal culture?			
a. Starch	b. Serum	c. Carbon source	d. Inorganic salts
6. Which of the following is NOT the major function of the serum?			
a. Promotion of tuber and bulb formation	b. Stimulate cell growth	c. Enhance cell attachment	d. Provide transport proteins
7. For culturing, plasma from the adult chicken is preferred to mammalian plasma because			
a. It forms a clear and solid coagulum even after dilution	b. It is too opaque	c. It doesn't produce solid clots	d. It forms a semi solid coagulum
8. Disaggregating of cells can be achieved by			
a. Physical disruption	b. Enzymatic digestion	c. Treating with chelating agents	d. All the above
9. The technique of organ culture may be divided on the basis of employing			
a. solid medium	b. liquid medium	c. semi-solid medium	d. both (a) and (b)
10. What are the main constituents of culture for animal cell growth?			
a. Glucose and Glutamine	b. Growth factors	c. Cytokines	d. All of the above
11. In animal cell culture, particularly mammalian cell culture, transformation means:			

a. Uptake of new genetic material	b. Phenotypic modifications of cells in culture	c. both (a) and (b)	d. Release of genetic information

12. During the growth of animal cells in culture, it is noticed that the cells do not look very healthy. After an investigation, this is found that there is a lot of lactic acid in the culture fluid. What is probably wrong with this culture?

a) Ethyl alcohol is being produced in excess	b) The cells have too much oxygen	c) Glycolysis is being inhibited	d) The cells do not have enough oxygen

13. Sometimes cell lines can be cultured for such a long time that they apparently develop the potential to be sub-cultured indefinitely in vitro. Such cells lines are called ----------

a) established cell lines	b) primary cell lines	c) secondary cell lines	d) propagated cell lines

14. Higher dissolved oxygen concentration in the culture media are toxic and leads to ---------

a) DNA degradation	b) lipid per oxidation	c) Rate of metabolism is greater than its consumption	d) all of the above

15. Which of the following is the technique used for the embryo culture?

a) Organ cultures on plasma clots	b) Organ cultures on agar	c) Whole embryo cultures	d) All of these

16. The major problem associated with the isolation of free cells and cell aggregates from organs is that of ----------

a) releasing the cells from their supporting matrix	b) inhibiting the cells from their supporting matrix	c) disintegrating the cells from their supporting matrix	d) none of the above

17. The technique of organ culture may be divided on the basis of employing

a) solid medium	b) liquid medium	c) both (a) and (b)	d) semi-solid medium

18. An established cell line can be called where it has been sub-cultured at least?

a) 70 times at an interval of 3 days between subcultures	b) 40 times at an interval of 3 days between subcultures	c) 70 times at an interval of 1 day between subcultures	d) 50 times at an interval of 3 days between subcultures

19. In animal cell culture, particularly mammalian cell culture, transformation means

a) Uptake of new genetic material	b) Phenotypic modifications of cells in	c) both (a)and (b)	d) Release of genetic information

20. Which of the following is not the explant technique**?**

a) Slide culture	b) Carrel flask culture	c) Roller test tube culture	d) Adherent primary culture

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS

21. A) Write notes about primary cell culture techniques. (OR)

B) Explain the techniques and application in organ culture.

22. A) Write a detailed account on different types of media used in animal cell culture. (OR)

B) Explain the behaviour of cell division and cell kinetics.

23. A) Explain the principle and methodology of PCR Techniques (OR) B) Give detailed account of the mechanism application of Microinjection
24. A) Explain the principle, methodology and application of embryo transfer technology (OR) B) Write detailed about production and development of animal vaccines.
25. A) Explain various strategies of ethical issues in Animal Biotechnology. (OR) B) Discuss about a special features and applications of Stem cell culture.

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Write a detailed account on Animal cell culture Steps and maintenance?
27. Explained in detail about the Animal cell culture Media and Balanced salt solutions?
28. Describe about the Gene Transfer Techniques in Detail?
29. Production and development of Animal vaccines with Good examples?
30. Explain about cancer Gene therapy and Stem cell in detail?

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY	**Dr. M. Balasubramanian**	
AUTHORISED BY	**Dr. M. Ram Mohan**	

LAB IN BIOPROCESS TECHNOLOGY AND ANIMAL BIOTECHNOLOGY

Paper	: Core Practical VII	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 5	Internal	: 40
Paper Code	: 21U6BTCP07	External	: 60

PREAMBLE

To make students on exposing to practical principles of fermentation techniques and applying them in the production value added products such antibiotic, vitamins and organic acids. The students also gain added knowledge on the production of agrobased products for human welfare. To make students on exposing to practical principles of tissue culture media preparation, cell viability, subculturing and viability assay techniques

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Understand the basic concepts on the production of alcohol, organic acid and SCP production. Prepare animal cell media and its sterilization techniques.	**K1, K2 & K3**
CO2	Understand in determining the microbial growth. To filter sterilize the sensitive media ingredients and filtration technique.	**K1 & K2**
CO3	Estimating the production of single cell protein by biochemical method. Prepare suspension culture and cultivating viruses in embryonated egg.	**K2, K4 & K5**
CO4	Analysing milk qualitatively and separating aflatoxin fungal species by chromatographic method. Observation of different types of animal cell lines.	**K2, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
1	Enumeration of microorganisms from bread	**5**
2	Production of alcohol from grapes	
3	Production and estimation of citric acid from *Aspergillus* species	**10**
4	Estimation of alcohol from grapes	

5	Production and estimation single cell protein from *Azolla* and *Spirullina* by Lowry‟s method	**10**
6	Immobilization of amylase by entrapment method	
7	Determination of bacterial growth by growth curve method	**10**
8	Determination of Thermal Death point (TDP) of the bacterial sample	
9	Quality analysis of milk a. MBRT test and b. Rezasurin test	**10**
10	Analysis of fungal aflatoxin by TLC	
11	Enumeration of microorganisms from bread	**5**
12	Production of alcohol from grapes	
13	Production and estimation of citric acid from *Aspergillus* species	**5**
14	Estimation of alcohol from grapes	
15	Production and estimation single cell protein from *Azolla* and *Spirullina* by Lowry‟s method	**5**
16	Immobilization of amylase by entrapment method	
17	Determination of bacterial growth by growth curve method	**10**
18	Determination of Thermal Death point (TDP) of the bacterial sample	
19	Quality analysis of milk c. MBRT test and d. Rezasurin test	**5**
20	Analysis of fungal aflatoxin by TLC	

MODEL QUESTION PAPER (LAB IN BIOPROCESS TECHNOLOGY AND ANIMAL BIOTECHNOLOGY)

NAME OF THE COURSE: **LAB IN BIOPROCESS TECHNOLOGY AND ANIMAL BIOTECHNOLOGY**	COURSE CODE: **21U6BTCP07**	DURATION: **6Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total: **20 MARKS**
1. (i) Estimate the amount of alcohol from the given fruit sample (A) /Isolate genimice DNA from the given animal tissue sample (A) (OR)			
(ii) Estimate the amount of citric acid from the given batch culture medium (A)/ Perform single cell suspension culture from the given animal cell sample (A) (OR)			
(iii) Estimation single cell protein from the given sample *(*A) by Lowry‟s method/ Perform viability test of the given animal cell suspension (A) sample			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **15 MARKS**
2. (i) Perform immobilization of the given enzyme sample (B)/ Inoculate the given infectious sample in the embryonated egg sample (B) (OR)			
(ii) Determine thermal Death point (TDP) of the bacterial sample (B)/ Perform monolayer culture from the given chick embryo fibroblast cells (B)(OR)			
(iii) Determine the quality of the given milk sample (B) by MBRT/Resazurin test/ Disintegrate the given monolayer culture (B) by appropriate method			
SPOTTERS (5 X 4 = **20 MARKS**)			
3. Identify the given spotters C, D, E, F & G and comment on them			
RECORD (1 x 5 = **5 MARKS**)			
VIVA-VOCE **5 MARKS**			
TOTAL **60 MARKS**			

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

GENOMICS AND PROTEOMICS

Paper	: Elective II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: **21U6BTE04**	External	: 75

PREAMBLE

This paper deals with the basic principles of genome and its manipulating strategies end up with the development of novel candidate gene.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Understand the basic structure of genome map in prokaryotic and eukaryotic organisms	**K2 & K3**
CO2	To understand the mapping of different regions of DNA and its amplification protocols	**K2 & K3**
CO3	To acquire knowledge on different tools used in the fields of Proteomics	**K2, K3 & K4**
CO4	To explore with the different application of proteomics in terms of protein mapping	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Genomics**-Overview of Genome anatomies. Prokaryotic Genome Organization: operons. Eukaryotic Genomes, Nuclear Genomes and gene families, Organelle genomes: origin, Repetitive DNA contents, Tandem repeats, Transposons and transposable elements.	**15**
II	**DNA sequencing methods**: Shot gun sequencing – Contig assembly. Techniques for gene location: ORF findings, Northern Hybridization, RT-PCR, RACE, S1 nuclease mapping, exon trapping. Transcriptome analysis: SAGE and Microarray technology	**15**
III	**Genome Mapping**: Genetic Mapping: RFLP, SSLP, SNP-Physical	**15**

	Mapping, Restriction site Mapping: FISH, STS mapping. Human genome organization. Gene therapy for inherited disorders and infectious diseases and ethics.	
IV	**Tools of Proteomics**: The proteome – the life cycle of protein-analytical techniques. Protein separation: 1D PAGE, 2D-PAGE, RPHPLC, Protein digestion techniques: peptide analysis- MALDI-TOF-ESI, Tandem Mass analyzers, Peptide Mass finger printing.	**15**
V	**Applications of Proteomics:** Protein mining, SALSA algorithm for mining specific features. Protein expression profiling. Identifying protein - protein interactions. Mapping of protein modifications.	**15**

SUGGESTED READINGS

1. Terence A Brown.(2002) Genomes, 2nd Edition, Bios Scientific Publishers.
2. Tom Strachan and Andrew P Read (1999) Human Molecular Genetics, 2nd edition, Bios Scientific Publishers.
3. Daniel C. Liebler (2002) Introduction to Proteomics, tools for the New biology- Humana press. Totowa, NJ.
4. Pennington.S, M. Dunn (2001) Proteomics: From Protein Sequence to Function 1 edition Bios Scientific Publishers.

MODEL QUESTION PAPER (GENOMICS AND PROTEOMICS)

NAME OF THE COURSE: **GENOMICS AND PROTEOMICS**	COURSE CODE: **21U6BTE04**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The study of full complement of proteins expressed by a genome is called			
a. Proteome	b. Proteomics	c. Genomics	d. Protein formation
2. The effects of protein on an entire organism is described in			
a. Phenotypic function	b. Cellular function	c. Molecular function	d. Structural genomics
3. The precise biochemical activity of a protein is described in			
a. Structural genomics	b. Molecular function	c. Cellular function	d. Phenotypic function
4. The network of interactions engaged in by protein at cellular level is described in			
e. Molecular function	f. Phenotypic function	g. Structural genomics	h. Cellular function
5. The goal of structural proteomics project is to			
a. Crystallize and determine the structure of proteins	b. Identify and sequence of all the genes present in the human body	c. Introduce new genes to human beings	d. Remove disease causing genes from humans
6. Conserved gene order can be termed as ----------			
a. Ortholog	b. Synteny	c. Paralog	d. Microarray
7. Sequencing of genomic DNA is included in			
a. Structural genomics	b. Molecular function	c. Cellular function	d. Phenotypic function
8. Genes of different species, possessing a clear sequence and functional relationship to each other are			
a. Ortholog	b. Synteny	c. Paralog	d. Microarray
9. *Rawolfia serpentina*, to save this plant under the threat of extinction, which of the following techniques is useful?			
a. Genetic engineering	b. In vitro culture	c. DNA fingerprinting	d. Hybridoma technology
10. Transgenic organisms are generally			
a.Extinct organisms	b. Naturally occurring and endemic	c. Produced by plant breeding technique	d. Produced by gene transfer technology
11. Genes of same species, similarly related to each other are			
a. Paralog	b. Ortholog	c. Microarray	d. Synteny
12. Dolly, the first animal produced by cloning is a			
a. Cow	b. Sheep	c. Rat	d. Dog

13. Collection of microscopic DNA spots attached to solid surface are?			
a. Ortholog	b. Microarray	c. Synteny	d. Paralog
14. Gene therapy is a technique preferred to cure inherited diseases by			
a.Repairing the faulty gene	b. Introducing the correct copy of the gene	c. Adding new cells to the body	d. PCR
15. Which of the following is a repressible operon?			
a. Lac	b. Trp	c. Gal	d. glu
16. Explant can be a ----------			
a. Cut part of the plant used in tissue culture	b. Plant extract used in tissue culture	c. Source of growth regulators added to media	d. Solidifying agent
17. Which of the following is used to transfer genes in plants?			
a. Ti plasmid	b. pBR 322	c. EcoR 1	d. pUC 18
18. Which of the following bacterium is used for gene transfer in plants?			
a. Agrobacterium	b. Azotobacter	c. Rhizobium	*d. E.coli*
19. Which of the following is an inducible operon?			
a. Glu	b. Lac	c. Gal	d. trp
20. Integrated state of DNA from other organisms in host DNA is termed as			
a. Plasmids	b. Phasmids	c. Episomes	d. cosmids

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Elaborate on the mechanism of DNA Gyrase in nucleic acid replication B) What are lampbrush chromosomes? State its special features.	(OR)
22. A) How DNA sequencing is achieved by shot gun method? B) Write notes on Pharmacogenomics.	(OR)
23. A) Enlist the inherited disorders and its treatment by gene therapy B) Derive the protocol for human pedigree analysis.	(OR)
24. A) State the features of MALDI proteome analysis. B) Briefly write about peptide mass finger printing.	(OR)
25. A) State the applications of Global Biochemical Network. B) Affirm about the micro array techniques for proteins.	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Illustrate the different levels of packaging of DNA in eukaryotes.
27. State the mechanism of gene expression using RT-PCR technique.
28. Describe the implication of Human Genome Project.
29. Explain the principle, process and applications of 2-D gel electrophoresis.
30. Elucidate the principle and mechanism of mass spectroscopy in the analysis of metabolomics.

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

ELECTIVE II

BIOPHYSICS AND BIOINSTRUMENTATION

Paper	: Elective II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 21U6BTE05	External	: 75

PREAMBLE

This paper deals with the basic instrumental principles leading to biological research outputs. It also describes the biophysical concepts of different biomolecules.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Explores student towards the biophysical properties of nucleic acids Proteins	**K1 & K2**
CO2	Acquiring knowledge with the basic concepts of chromatographic Techniques	**K1, K2 & K3**
CO3	Acquiring knowledge with the basic concepts of spectroscopic Techniques	**K3, K4 & K5**
CO4	Exploring towards the use of radiation principles in the field of biomedical science	**K3, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	M	M
CO3	S	S	M	S	S
CO4	S	S	S	S	M

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Biophysics Of Nucleic Acids:** Transitional angles and their ranges. The pseudo-rotation cycle, syn – anti orientation of glycosyl bond. Geometries of Watson- Crick and Hoogsteen base pairs.	**10**
II	**Biophysics Of Proteins:** Amino acids – Conformations. Phi and Psi angles. Ramachandran plot. Peptide bond isomerisation. Disulphide bonds, electrostatic forces, van der waals interaction and hydrogen bonds.	**12**

III	**Analytical techniques:** Principles and applications of Chromatography (Paper, thin-layer, column, GC-MS, GLC, Ion exchange chromatography, HPLC). Principles and applications of spectroscopy. (UV- Vis, NMR, Raman spectroscopy, AAS and X-ray crystallography).	**13**
IV	**Separation techniques:** Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting	**13**
V	**Radiation Biophysics:** Basic concepts of radiography. Measurement of radioactivity: GM counter, Liquid and solid scintillation counter. Advantage and disadvantage of radio active compounds.	**10**

SUGGESTED READINGS

1. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi
2. Roy R.N. (1999) A Text Book of Biophysics New Central Book Agency. Biophyscial chemistry – principles and Techniques- Upadhyay, Upadhyay Nath.1997
3. Biophysical chemistry – Cantor and Schinmel. 2002
4. Biophysical chemistry – principles and Techniques- Upadhyay, Upadhyay Nath.1997
5. Biophysics – Arora, First edition, Himalaya Publications, New Delhi
6. Palanivelu, P (2001). Analytical Biochemistry, and separation techniques, Tulsi Book Centre. Madurai.

MODEL QUESTION PAPER (BIOPHYSICS AND BIOINSTRUMENTATION)

NAME OF THE COURSE: **BIOPHYSICS AND BIOINSTRUMENTATION**	COURSE CODE: **21U6BTE05**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The right handed double helix of DNA contains ---------- base pairs per turn			
a. 9.5	b. 10.5	c. 11.5	d. 12.5
2. Which of the following bas pair geometry is considered as a rotation of one base with respect to the other in the same base pair?			
a. Shear	b. Buckle	c. Propeller	d. Stagger
3. The twisting degree of B form of DNA is about ----------			
a. 60°	b. 90°	c. 120°	d. 360°
4. When the ends of a piece of double stranded helical DNA are joined so that it forms a circle the strands are----------knotted			
a. Topologically	b. Geometrically	c. Physically	d. Isometrically
5. A typical stability of a protein domain range from ----- to ----- kcal/mol			
a. 2, 5	b. 3, 6	c. 3, 7	d. 2, 6
6. ---------- spectroscopic suggest that lipid binding by apo lipoproteins is mediated via the molten globule-like state in plasma			
a. NMR	b. CD	c. AAS	d. Raman
7. The most common type of protein folding is described by the principle of ----------			
a. Tunnel landscape	b. Folding funnel	c. Realistic landscape	d. Levinthal paradox
8. Which of the following angle of proteins folding is essentially flat and fixed to 180°?			
a. Alpha	b. Beta	c. Gamma	d. Omega
9. Retention factor is related to ----------			
a. PC	b. TLC	c. a & b	d. GC
10. The sample prepared is sent in to the column in the form of gas so that ionic species are quantitatively determined. Which of the following chromatographic technique is employed?			
a. MS	b. GC	c. AAS	d. Ion exchange
11. Elemental species of the given sample is determined by ----------			
a. TLC	b. GLC	c. GC-MS	d. AAS
12. Cationic and anionic resins are used in ----------			
a. PC	b. TLC	c. AAS	d. IEC
13. The substances found in colourless solutions can be measured by ----------			
a. Colorimeter	b. UV-VIS	c. NMR	d. X-ray

14. Sweep generator is used in ----------			
a. NMR	b. X-ray	c. UV-VIS	d. Raman spectroscopy
15. Nickel oxide is used as monochromator in ----------			
a. X-ray crystallography	b. Raman spectroscopy	c. UV-VIS	d. XRD
16. Activation energy of a given system can be conveniently determined by ----------			
a. XRD	b. NMR	c. AAS	d. UV-VIS
17. Becquerel is a unit of measurement of ----------			
a. Fossil age	b. Radioactivity	c. Carbon dating	d. None of the above
18. Which of the following particle has medium energy?			
a. Alpha	b. Beta	c. Gamma	d. Omega
19. GM counter is used for measuring ----------			
a. Radiation frequency	b. Ionizing radiation	c. Effect of radiation	d. Gamma radiation
20. The main substance used for nuclear imaging in cardiology is ---------			
a. Thallium isotope	b. Boron isotope	c. Uranium isotope	d. Tritiated water

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Write shots notes on syn – anti orientation of glycosyl bond (OR) B) Write short notes on transition angles of nucleic acids
22. A) Write shot notes on peptide bond isomerization (OR) B) Write notes on electrostatic forces involved in protein stability
23. A) Explain the applications of Thin layer chromatography (OR) B) Explain the principle of HPLC
24. A) Explain the instrumentation of Raman spectroscopy (OR) B) List out the applications of atomic absorption of spectroscopy
25. A) Explain the working principle of solid and liquid scintillation counter (OR) B) Briefly explain the disadvantages of radio active compounds

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give a detailed account on the geometrics of Watson & Crick model.
27. Give detailed account on Ramachandran plot
28. Write an essay on the working principle, instrumentation, applications, advantages and disadvantages of GC-MS
29. Give a detailed account on NMR. Add a note on its applications in the fields of medicine and defence
30. Write an essay on GM counter

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

ELECTIVE II
ENVIRONMENTAL BIOTECHNOLOGY

Paper	: Elective II	Total Hours	: 75
Hours/Week	: 5	Exam Hours	: 03
Credit	: 4	Internal	: 25
Paper Code	: 21U6BTE06	External	: 75

PREAMBLE

This paper provides insight into environmental issues, relevant biotechnological concepts for facing environmental issues, available biotechnological applications in environmental issues, relevant policies. The course also tries to impart knowledge and skill in environmental biotechnology for sustainable development

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To provide knowledge in environmental impacts in biotechnology	**K1 & K2**
CO2	To understand the concepts in various bioremediation techniques related environmental aspects	**K2 & K3**
CO3	To impart new thoughts about biotechnological applications on environmental issues	**K3 & K4**
CO4	To create awareness regarding the environmental policies for the improvement of environmental safety	**K3, K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

Cos	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	S	M
CO2	S	S	S	S	S
CO3	S	S	S	S	M
CO4	S	S	S	S	S

S: Strong; **M:** Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Environment - basic concepts and issues, global environmental problems - ozone depletion, UV-B, greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management.	**15**
II	An overview of atmosphere, hydrosphere, lithosphere and anthrosphere - environmental problems. Environmental pollution - types of pollution, sources of pollution, measurement of pollution, methods of measurement of pollution, fate of pollutants in the environment, Bioconcentration, bio/geomagnification.	**15**

III	Microbiology of waste water treatment, aerobic process - activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process - anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industries	**15**
IV	Xenobiotic compounds - organic (chlorinated hydrocarbons, substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants) and inorganic (metals, radionuclides, phosphates, nitrates). Bioremediation of xenobiotics in environment - ecological consideration, decay behavior and degradative plasmids, molecular techniques in bioremediation	**15**
V	Role of immobilized cells/enzymes in treatment of toxic compounds. Biopesticides, bioreactors, bioleaching, biomining, biosensors, biotechniques for air pollution abatement and odour control.Environmental significance of genetically modified microbes, plants and animals.	**15**

SUGGESTED READINGS

Reference

1. Waste water engineering - treatment, disposal and reuse, Metcalf and Eddy Inc., Tata McGraw Hill, New Delhi.

2. Environmental Chemistry, AK. De, Wiley Eastern Ltd, New Delhi.

3. Introduction to Biodeterioration, D.Allsopp and K.J. Seal, ELBS / Edward Arnold.

4. Bioremidation, Baaker, KH and Herson D.S., 1994. Mc.GrawHill Inc, NewYork.

5. Industrial and Environmental Biotechnology - Nuzhat Ahmed, Fouad M. Qureshi and Obaid Y. Khan, 2006. Horizon Press.

6. Environmental Molecular Biology, Paul. A, Rochelle, 2001.Horizon Press.

MODEL QUESTION PAPER (ENVIRONMENTAL BIOTECHNOLOGY)

NAME OF THE COURSE: **ENVIRONMENTAL BIOTECHNOLOGY**	COURSE CODE: **21U6BTE06**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Phytoplanktons provide food to ----------			
a. Whales	b. Shrimp	c. Snails	d. All the above
2. The term biodiversity hotspot specifically refers to -------- biologically rich areas around the World			
a. 15	b. 25	c. 35	d. 45
3. The upper reaches of the Himalayas forming part of the ----------			
a. Indomalaya ecozone	b. Palearctic ecozone	c. Indo-Burma	d. Sundaland
4. Endangered (EN), as categorized by			
a. LC	b. IUCN	c. VU	d. CR
5. Approximately----------per cent of the total geographical area of the country has been earmarked for extensive in situ conservation of habitats and ecosystems			
a. 4.7	b. 7.7	c. 5.7	d. 6.7
6. New policy on seed development was formulated by the ministry of ----------			
a. Science and technology	b. Agriculture	c. External affairs	d. None of the above
7. The Convention of biodiversity was opened for signature at the Earth summit in ----------			
a. 5th June 1992	b. 5th August 1992	c. 5th June 1995	d. 5th August 1995
8. The Cartagena Protocol on Biosafety of the Convention, also known as the Biosafety Protocol, was adopted in ----------			
a. January 2000	b. February 2000	c. March 2000	d. June 2000
9. Arsenic contamination in soil is recovered by ----------			
a. Bioleaching	b. Phytoremediation	c. Bioremediation	d. Bio feasability
10. Heavy metal toxicity increases the production of----------thereby decreasing the antioxidant Systems			
a. ROS	b. Hydrogen ions	c. Organic nutrients	d. Oxygen
11 ---------- is defined as the removal of metal or metalloid species, compounds and particulates from a solution by low cost biological materials			
a. Bioleaching	b. Bioremediation	c. Biosorption	d. Phytoremediation
12. Algae are of special interest in search for and the development of new biosorbents materials due to their ---------- and their ready availability in practically unlimited quantities in the seas and oceans			
a.High filtration capacity	b. High reflection capacity	c. High Adsorption capacity	d. High sorption capacity

13. The bacteria present in the pond decompose the biodegradable organic matter and release ----------			
a. CO_2	*b.* Ammonia	*c.* Nitrate	*d.* All the above
14. Laggons are also called ----------			
a. Aerobic ponds	b. Oxidation ponds	c. Facultative ponds	d. Aerated ponds
15. The activated sludge process is a type of wastewater treatment process for treating sewage or industrial wastewaters using aeration and a biological floc composed of bacteria and ----------			
a. Viruses	b. Fungi	c. Helminthes	d. Protozoa
16. Research performed at the Division of Environmental Microbiology has over the last years resulted in the isolation of ---------- with efficient nutrient removal properties			
a. Comamonas denitrificans	*b. Brachymonas denitrificans*	*c. Aeromonas hydrophila*	*d. All the above*
17. Which of the following is Not common, and generally not successful because of high capital, technical, and operation costs, high moisture content in the waste, and high percentage of inerts?			
a. Incineration	b. Land filling	c. Source reduction	d. Composting
18. Which of the following is NOT a component of bio compost?			
a. Carbon	b. Nitrogen	c. Oxygen	d. Hydrogen
19. The most common eath worm used for vermicomposting is ----------			
a. Eisenia foetida	*Lumbricus terrestris*	*Lumbricus rubellus*	*Perionyx excavatus*
20. The most common worms used in composting systems, red worms feed most rapidly at temperatures of ----------			
a. 10–25 °C	b. 15–20 °C	c. 15–25 °C	d. 10–20 °C

b. *c.* *d.*

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Write short notes on hot spots of Biodiversity B) Write short notes on endangered and threatened species	(OR)
22. A) Write short notes on cryopreservation B) Write short notes on Biodiversity Conservation	(OR)
23. A) Write short notes on Bioleaching of heavy metals B) Write short notes on Commercial biosorbents	(OR)
24. A) Write short notes on activated sludge treatment B) Write short notes on percolating filters	(OR)
25. A) Write short notes on composting systems B) Write short notes on vermicomposting	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give a detailed account on Aquatic common flora and fauna in India
27. Give a detailed account on tissue culture and artificial seed technology

28. Give a detailed account on Bioremediation
29. Give a detailed account on Waste water Treatment
30. Give a detailed account on sewage treatment

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY	**Dr. M. Balasubramanian**	
AUTHORISED BY	**Dr. M. Ram Mohan**	

SBEC – IV

LAB IN ENTREPRENEURSHIP IN BIOTECHNOLOGY

Paper	: SBEC IV	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U6BTS10	External	: 75

PREAMBLE

To make students in understanding the basic concepts of developing entrepreneurship quality, so as to produce biologically generated value added products for the development of human welfare.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Develop the practical concepts of mushroom, spirullina, sericulture	**K3, K4, K5 & K6**
CO2	Develop the practical concepts of apiculture, aquaculture and vermicomposting technology	**K3, K4, K5 & K6**
CO3	Develop the practical concepts of wine production and sauerkraut production	**K3, K4, K5 & K6**
CO4	Develop the practical concepts of biogas production	**K3, K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	M	S
CO2	M	S	S	M	S
CO3	M	S	S	M	S
CO4	M	S	S	M	L

S: Strong; **M**: Medium; **L**: Low

Ex.no	CONTENT	HOURS
1.	Mushroom cultivation	4
2.	Azolla cultivation	4
3.	Spirullina cultivation	4
4.	Sericulture	4
5.	Epiculture	4
6.	Aquaculture (Fish/Prawn/Pearl)	4

7.	Vermicomposting	4
8.	Biogas production	4
9.	Sauerkraut production	4
10.	Wine production	4

MODEL QUESTION PAPER (LAB IN ENTREPRENEURSHIP IN BIOTECHNOLOGY)

NAME OF THE COURSE: **LAB IN ENTREPRENEURSHIP IN BIOTECHNOLOGY**	COURSE CODE: **21U6BTS10**	DURATION: **6Hrs**
MAX MARKS: 60		

MAJOR EXPERIMENT			
Exp: 12	Obs: 5	Res: 3	Total **20 MARKS**
1. (i) Perform *Azolla* cultivation using the given sample (A)			(OR)
(ii) Perform *Spirullina* cultivation using the given sample (A)			(OR)
(iii) Peform vermi composting using the given earth worm sample (A)			
MINOR EXPERIMENT			
Exp: 6	Obs: 2	Res: 2	Total: **10 MARKS**
2. (i) Perform wine production using the given fruit sample (B)			(OR)
(ii) Perform biogas production using the given raw sample material (B)			(OR)
(iii) Perform sauerkraut production using the given cabbage sample (B)			
SPOTTERS			(5 X 4 = **20 MARKS**)
3. Identify the given spotters C, D, E, F & G and comment on them			
RECORD			(1 x 5 = **5 MARKS**)
VIVA-VOCE			**5 MARKS**
TOTAL			**60 MARKS**

	NAME	**SIGNATURE**
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

SBEC – IV

NANOBIOTECHNOLOGY

Paper	: SBEC IV	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U6BTS11	External	: 75

PREAMBLE

To make students in understanding the basic concepts of developing entrepreneurship quality, so as to produce biologically generated value added products for the development of human welfare.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Know basic concepts of nanotechnology and nano materials	**K1, K2 & K3**
CO2	Know the concepts of fabrication of bio molecular structures	**K3 & K4**
CO3	Develop miniaturized nano elements	**K3 & K4**
CO4	Understand various applications of nanotechnology in the field medicine, health care and drug discovery	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

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

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	**Nanobiotechnology:** Definition, prospects and challenges; Topology of DNA, protein and lipids and self-assembly from Natural to artificial structures. Top up and bottom down approaches in nanomaterial fabrication.	**8**
II	**Nanomaterials and its properties**: Carbon nanotubes and nanorods, Quantom dots, metal based nanostructures (Iron oxide nanoparticles), nanowires, polymer based nanostructures (dendrimers), Gold nanostructures (nanorods, nanocages, nanoshells), nanocomposites.	**8**
III	**Fabrication and Analysis of biomolecular nanostuructures:** Atomic Force Microscopy, Scanning Probe Electron Microscopy and	**8**

	Lithography. Nanoscale detection: Lab on a Chip. Fabrication of bionanochip & microarray technology.	
IV	**Miniaturized devices in nanobiotechnology:** Types and applications; Nanobiosensors: different classes, molecular recognition elements (MRE), transducing elements, applications of MRE in nanosensing of different analytes.	**8**
V	**Applications of Nanobiotechnology:** Nanomedicine, Diagnosis and treatment of infectious diseases, cancer research and therapy, tissue engineering and regenerative therapy; Nanostructures in drug discovery & drug delivery.	**8**

SUGGESTED READINGS:

1. Nanobiotechnoogy: concepts, applications and perspectives. Christ of M. Niemayer, chad A. Mirkin, Wiley VCH publishers 2004.
2. Bionanotechnology: Lessons from Nature, David. S. Goodshell, Jhonwiley 2006.
3. Buddy, D.R. Allan, S.H. Frederick, J.S. and Jack, E.L. Biomaterials Sciences: An Introduction to Materials in Medicine. 2nd edition.
4. David, L.N. and Michael, M.C. (2006). Lehninger‟s principles of Biochemistry. 4th edition.
5. David, S. and Goodshell, J. (2006). Bionanotechnology: Lessons from Nature.
6. Molecular Design and Synthesis of Biomaterials. (2005). Biological Engineering Division, MIT Open Course Ware.

MODEL QUESTION PAPER (NANOBIOTECHNOLOGY)

NAME OF THE COURSE: **NANO BIOTECHNOLOGY**	COURSE CODE: **21U6BTS11**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Who first used the term nano biotechnology?			
a. Norio taniquchi	b. Richard Feynman	c. Eric Drexler	d. Sumio
2. 10 nm =_____m			
a. 10^{-8}	b. 10^{-9}	c. 10^{-7}	d. 10^{-10}
3. The size of the nano particles range from_____nm			
a. 100 to 1000	b. 0.1 to 10	c. 1 to 10	d. 1 to 100
4. Nano science can be studied with the help of ----------			
a. Quantum mechanics	b. Newtonian mechanism	c. Macro dynamics	d. Geophysics
5. The size of *E.coli* bacteria is_____nm			
a. 2000	b. 5000	c. 50	d. 90
6. What does „F" stands for in AFM?			
a. Fine	b. Force	c. Flux	d. Front
7. The two important properties of nano substances are ----------			
a. Pressure and friction	b. Sticking and temperature	c. Sticking and friction	d. Temperature and friction
8. 1 nanometer is =_____cm			
a. 10^{-9}	b. 10^{-8}	c. 10^{-7}	d. 10^{-6}
9. Protein-coding genes can be identified by_____			
a. Transposons tagging	b. ORF scanning	c. Zoo -blotting	d. Northern analysis
10. Nano particles target the_____causing cells and remove them from blood			
a. Tumor	b. Fever	c. Infection	d. Cold
11. The_____to the ceramics are superior coating			
a. Nano particles	b. Nano power	c. Nano crystal coding	d. Nano materials
12. Which one is used in electron microscope?			
a. Electron beams	b. Magnetic fields	c. Light waves	d. Electron beams and magnetic fields

13. Electron microscope can give a magnification up to_____

a. 400,000x | b. 100,000x | c. 15000x | d. 100x

14. Which of these biosensors use the principle of heat released or absorbed by a reaction?

a. Potentiometric biosensor | b. Optical biosensor | e. Piezo-electric biosensors | f. Calorimetric biosensors

15. Biosensor made up of_____

a. A probe and a surface | b. A sensing layer and a transducer | c. Transfer the probe molecule | d. of thes e

16. Which materials are suitable for electrical signal transducing?

a. PDMS | b. Sillicon | c. Glass | d. Polyethylene

17. Which one is anti-cancerous agent?

a. Paclitaxol | b. Insulin | c. Polyethylene glycol | d. Poly glutamic acid

18. Which of the following co-solvents are used to increase the solubility of a drug?

a. Ethanol | b. Sorbitol | c. Glycerin | d. All of these

19.The size of the RBCis_____nm

a. 50 | b. 90 | c. 20000 | d. 5000

20. The width of a typical DNA molecule is_____nm

a. 1 | b. 2 | c. 5 | d. 10

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS

21. A) What are the challenges faced in the field of nano biotechnology?

B) Write a short note on nano material fabrication

22. A) Explain nano materials and its properties

B) Write short notes on quantum dots

23. A) Explain atomic force microscope

B) Explain about scanning probe microscope

24. A) Write short notes on types of biosensors

B) Explain the molecular recognition elements (MRE)

25. A) What is drug? Explain its discovery?

B) Short notes on nano medicine

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS

26. Write the essay on topology of DNA

27. Explain the structure and function nano tubes nanowires

28. Write an essay on micro array technology and its applications

29. Write an essay on mode action of biosensors and application of biosensors

30. Explain about cancer research and cancer therapy

	NAME	SIGNATURE
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COMPILED BY		
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SBEC – IV

BIOFARMING

Paper	: SBEC IV	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U6BTS12	External	: 75

PREAMBLE

To make students in understanding the basic concepts of developing entrepreneurship quality, so as to produce biologically generated value added products for the development of human welfare.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Understand the principles of conventional cropping systems and natural Farming	**K1 & K2**
CO2	Manipulate integrated pest management fo the development of pesticide free plant products	**K2 & K3**
CO3	Develop the concepts of organic farming	**K4 & K5**
CO4	Understand the concepts of organic agricultural policy and GMOs	**K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	L	L
CO2	S	S	S	M	M
CO3	S	S	S	M	M
CO4	S	S	S	M	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Agro-ecological zones and geographical distribution of crop plants in Tamil Nadu. Cropping systems - different types and their importance in food production- Package and practices followed for major crops and cropping systems in Tamil Nadu.	8
II	Green revolution in India - After effects - Definitions of Natural Farming, Traditional farming - Their concepts and scope - Natural Farming - Institutions- their activities and role.	8
III	Pest - Definition - categories of pests-pest control - natural, artificial-pest management IPM. Store grain pest management. Pesticides consumption and hazards. Role of biopesticides and biofertilizers in IPM.	8
IV	Organic farming - concept and relevance in the agriculture - problems and	8

	remedies - Encouragement and dissemination for effective practicing of organic farming. Production and marketing of Organic products.	
V	Organic agriculture policy, Genetically Modified Organisms as organic regulation	8

SUGGESTED READINGS:

1. Basu, D.N. and Guha, G.S. (1996). Agroclimatic regional planning in India, ARPU, Ahmedabad
2. Krishna, K. R., (2010). Agroecosystems of south India, Brownwalker press, Florida
3. John H. Perkins, *Geopolitics and the Green Revolution: Wheat, Genes, and the Cold War*, Oxford University Press, 1997.
4. Lester R. Brown, *Seeds of Change: The Green Revolution and Development in the 1970's*, 1970, Praeger Publishers, New York.
5. Kogan, M 1998. Integrated Pest Management: Historical Perspectives and Contemporary Developments, Annual Review of Entomology Vol. 43: 243-270 (Volume publication date January 1998)
6. Dharam P. Abrol (Editor), Uma Shankar 2013. Integrated Pest Management: Principles and Practice Amazon text book store
7. NPCS Board of Consultants & Engineers, (2008). The complete book on organic farming and production of organic compost, Asia Pacific Business Press Inc.
8. Shalini Suri, APH, (2012). Organic farming Vedams books from India.

MODEL QUESTION PAPER (BIOFARMING)

NAME OF THE COURSE: **BIOFARMING**	COURSE CODE: **21U6BTS12**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Agro ecological zoning can be used as the basis of a methodology for ----------			
a. Calculating maximum yield	b. Natural source analysis	c. Land resource appraisal	d. Land use planning
2. Some of the nutrients contained in the dead tissues are made available to crops during decomposition, reducing the need of----------inputs			
a. Forage leaves	b. Fertilizer	c. Chemical fertilizer	d. Soil organic matter
3. World geographical scheme for recording plant distributions (WGSRPD) is included within the larger region of India in ----------			
a. Fauna of India	b. Flora of India	c. Fauna of Tamilnadu	d. Flora of Tamilnadu
4. In Tamilnadu, Coimbatore receives an average rainfall from North east Monsoon of ----------			
a. 444.3mm	b. 443.4 mm	c. 434.4 mm	d. 344.4 mm
5. Natural farming is an ecological farming established by ----------			
a. Yamamoto Kombai	b. Masanobu Fukuoka	c. Shizen noho	d. Yoshikazu Kawaguchi
6. Cop rotation and companion planting are the methods adopted when ---------- farming is carried Out			
a. Traditional	b. Organic	c. Mixed crop	d. Natural
7. Green revolution in India refers to a period when ----------			
a. Indian agriculture was converted into revenue generating system	b. Indian agriculture was converted into waste management system	c. Indian agriculture was converted into renewable resource system	d. Indian agriculture was converted into industrial system
8. HYV seeds technically can be applied only in a land with assured ----------			
a. Fertilizer supply	b. Soil supply	c. Water supply	d. Seed supply
9. Pery Adkisson and Ray F. Smith received the ---------- World Food Prize for encouraging IPM			
a. 1995	b. 1996	c. 1997	d. 1998
10. The most important insect damaging pulses in field and storage are referred as ----------			
a. Bruchids	b. Weevils	c. Beetles	d. None of the above
11. Biopesticides are important tools in integrated pest management programs for conserving the natural enemies and maintaining environmental health was described in ----------			
a. 2014	b. 2015	c. 2016	d. 2017
12. Which of the following pesticide is responsible for ----------			
a. Carcinogen	b. Susceptibility to fungal infection	c. Egg shell thinning	d. Decline in juvenile population
13. Which of the following is NOT the advantage of organic farming?			

a.Maintains environment by reducing pollution level	b. Helps in keeping agriculture at a sustainable level	c.Ensures optimum utilization of natural resources for short term benefit	d. Enhances crop production by tillage utilization and forage cropping system
14. Which of the following state first received the organic certification in India?			
a. Madhya Pradesh	b. Rajasthan	c. Maharashtra	d. Uttar Pradesh
15. NPOF stands for ----------			
a. National project on organic farmers	b. National Project on organic farming	c. National Project on organic fertilizers	d. National project on organic forages
16. Indian agricultural policy was framed and drafted by ----------			
a. ICAR	b. IARI	c. CSIR	d. ICAS
17. The genetically engineered seeds were introduced in ----------			
a. 1994	b. 1995	c. 1996	d. 1997
18. „Round-up ready crops" is a common name of ----------			
a. Pesticide crops	b. Herbicide crops	c. Saline resistant crops	d. Drought resistant crops
19. The use of toxic and pervasive pesticides and petroleum based fertilizers is not allowed in the production of ----------			
a. Organic farm products	b. Biopesticides	c. Bioinsecticides	d. Bt - Cotton
20. Organic food production act (OFPA) was amended in ----------			
a. 1990	b. 1991	c. 1992	d. 1993

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Write shot notes on the different types of cropping systems (OR) B) List out the packages and practice methods followed for major crops
22. A) Briefly write about green revolution (OR) B) Explain the benefits of natural farming
23. A) Explain about store gain pest management (OR) B) Explain the role of biopesticides in IPM
24. A) Explain in brief about Organic farming (OR) B) Explain the marketing of organic products
25. A) List out the organic agriculture policies (OR) B) Explain the use of organic policies in the development of forage products

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Write an essay on different types and their importance of cropping system
27. Give a detailed account on natural farming
28. Write an essay in Integrated Pest Management (IPM)
29. Give a detailed account on organic farming, their production and marketing
30. Write elaborately on the role genetically modified organisms in framing the organic farming policies

	NAME	SIGNATURE
PREPARED BY		
COMPILED BY		
AUTHORISED BY		

NMEC – I

BIOSAFTEY, BIOETHICS & IPR

Paper	: NMEC I	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U5BTN01	External	: 75

PREAMBLE

To make students on understanding basic principles of biosafety guidelines and to understand concepts of intellectual property right and its types. The student also gain added knowledge on ethical, legal and social considerations on implementing/maketing biotechnological products.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	Understand the concepts of basic biosafety and biosafety levels	**K1 & K2**
CO2	Understand biosafety guidelines and role genetically modified Organisms	**K1, K2 & K4**
CO3	Understand the basic principles of IPR, its types and patenting Procedures	**K4, K5 & K6**
CO4	Understand the concepts of ethical, legal considerations on the release of genetically modified organisms	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Bio safety: Introduction – bio safety issues in biotechnology - historical background. Biosafety Levels - Levels of Specific Microorganisms, Infectious Agents and Infected Animals.	**8**
II	Biosafety Guidelines: Guidelines and regulations (Cartegana Protocol). Definition of GMOs & LMOs. Roles of Institutional Biosafety Committee, RCGM, GEAC.	**8**
III	Intellectual Property Rights: Introduction to IPR, Types of IP - Patents, Trademarks, Copyright & Related Rights, Importance of IPR – patentable and non patentables.	**8**
IV	Patents and Patent Laws: Objectives of the patent system - Basic, principles	**8**

	and general requirements of patent law. Patentable subjects and protection in Biotechnology.	
V	Bioethics: Introduction to ethics and bioethics, framework for ethical decision making. Ethical, legal and socioeconomic aspects of gene therapy. Ethical implications of GM crops, biopiracy and biowarfare.	**8**

SUGGESTED READINGS:

1. Beier F.K, Crespi R.S and Straus T. Biotechnology and Patent protection, Oxford and IBH Publishing Co. New Delhi.

2. Jeffrey M. Gimble, Academia to Biotechnology, Elsevier Academic Press.

3. Rajmohan Joshi (Ed.). 2006. Biosafety and Bioethics. Isha Books, Delhi.

4. Sasson A, Biotechnologies and Development, UNESCO Publications.

5. Senthil Kumar Sadasivam and Mohammed Jaabir M. S. (2008). IPR, Biosafety and Biotechnology Management, Jasen Publications, India.

MODEL QUESTION PAPER (BIOSAFETY, BIOETHICS AND IPR)

NAME OF THE COURSE: **BIOSAFETY, BIOETHICS AND IPR**	COURSE CODE: **21U5BTN01**	DURATION: **3 Hrs**
MAX MARKS: **75**		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Bio-related research activities may not involve ----------			
a. Micro organisms	b. Animal cells	c. Plant cells	d. All
2. A pathogen that is unlikely to cause any disease in humans or animals			
a. Risk group I	b. Risk group II	c. Risk group III	d. Risk group IV
3. *Korean hemorrhagic* fever is example for ----------			
a. Risk group II	b. Risk group III	c. Risk group IV	d. Risk group I
4. Physical containment is achieved by ---------			
a. One type	b. Two types	c. Three types	d. Four types
5. Which one of the following is not relevant to sterilization technique?			
a. Ethanol	b. Incinerator	c. Microscope	d. Autoclave
6. Cartagena Protocol on Biosafety to the Convention on Biological Diversity came with effect from ----------			
a. 11 September 2003	b. 12 September 2003	c. 11 September 2004	d. 12 September 2004
7. Each Institutional Biosafety Committee has a nominee for ----------			
a. DST	b. DBT	c. UGC	d. ICAR
8. How many RCGM meeting held in 2018?			
a. 7	b. 8	c. 9	d. 6
9. The RCGM shall not include the following representative			
a. DBT	b. ICMR	c. UGC	d. CSIR
10. GEAC established under			
a. MoEF &	b. UGC	c. DBT	d. DST
11. Trade name is otherwise called as -------			
a. Patent	b. Model	c. Business name	d. Trademark
12 ----------is any information of commercial value concerning production			
a. Trade	b. Trade Secret	c. Patent	d. Industrial Design
13. IPR initially started in North Italy during the ----------			
a. Renaissance era. In	b. Renaissance era. In 1472	c. Renaissance era. In 1473	d. Renaissance era. In 1474
14. Protection of IPR not allow the following			

a. Innovator	b. Brand owner	c. Teacher	d. Copyright holder
15. Intellectual property not refers to creations of the mind			
a. Hard	b. Inventions	c. Literary and artistic works	d. Names
16. Which one is comes under type of intellectual property (IP)?			
a. Copyright	b. Patent	c. Trademark	d. All the above
17. Mathematical algorithms are--------			
a. Patenta	b. Non patentable	c. Both	d. None of the above
18. Software is a -------			
a. Patenta	b. Non patentable	c. Both	d. None of the above
19. Patentable biotechnological inventions is ----------			
a. Prote	b. DNA sequences	c. Both of the (a) and (b)	d. None of the above
20. Early founders of bioethics put forth four principles which form the framework for moral reasoning			
a. 4	b. 3	c. 2	d. 1

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Explain different levels of biosafety. B) explain different types of sterilization methods.	(OR)
22. A) What is institutional committe and their roles? B) Explain RCGM and GEAC?	(OR)
23. A) explain object of Intellectual property law? B) Explain the importance of IPR?	(OR)
24. A) Write a note on benefits of patent. B) explain patentable and non-patentable biotechnological inventions?	(OR)
25. A) define bioethics, explain purpose and scope of bioethics? B) Explain perspectives and methodology of bioethics?	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Explain different types of bio-safety measures in laboratory?
27. Explain Cartagena protocol on biosafety.
28. What is IPR and explain their different types?
29. Patent - Definition, History and Law
30. Explain framework for making ethical decisions.

	NAME	SIGNATURE
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COMPILED BY		
AUTHORISED BY		

NMEC – I

BIOINFORMATICS

Paper	: NMEC I	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U5BTN02	External	: 75

PREAMBLE

To make students on understanding the basic concepts biological soft wares and their applicability in enhancing the need based quality of living systems

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand basic knowledge of nucleic acid sequence databases	**K1, K2 & K3**
CO2	To understand the concepts of specialized databases	**K2, K3 & K4**
CO3	To understand the basic concepts of sequence analysis and sequence Alignment	**K2, K3 & K4**
CO4	To understand the concepts of gene prediction methods through *insilico* approaches	**K4 & K5**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Bioinformatics – Biological Databases- Nucleic acid sequence databases – GenBank/NCBI, EMBL, and DDBJ. Protein sequence databases – UniprotKB and PIR, Structure databases – PDB, CATH and SCOP.	**8**
II	Specialized Databases – BLOCKS, PRINTS and Pfam, Microarrays- Microarray data analysis, Proteomic data Analysis.	**8**
III	Sequence Analysis- sequence alignment, Dot plot, pairwise Sequence Alignment- Local alignment and Global alignments- Dynamic programming algorithm for sequence alignment, Scoring matrices, gap penalties.	**8**
IV	Multiple sequence alignment- scoring methods-clustal W- Phylogenetic	**8**

	Analysis- tree construction methods- Maximum likelihood and maximum parsimony- distance methods- Database similarity search- Basic Local Alignment search tool (BLAST).	
V	Gene prediction methods – ORF finder, Restriction site analysis. Protein secondary structure prediction –Comparative Modeling -Drug Designing– - Molecular Docking	**8**

SUGGESTED READINGS:

1. Bioinformatics: Sequence, Structure and Databanks: A Practical Approach (The Practical Approach Series, 236), Des Higgins (Editor), Willie Taylor. 1st edition, October 2000, Oxford University Press. ISBN: 978-0199637904.
2. Bioinformatics: Sequence and Genome Analysis, David W. Mount. 2nd edition, June 2004, Cold spring harbor laboratory press. ISBN: 978-0879697129
3. David, H. M. 2005. Bioinformatics. Second edn. CBS Publishers, New Delhi.
4. David, R., Westhead, J., Howard, P. and Richard, M., and Twyman. Instant Notes-Bioinformatics Viva Books Private Limted, Chennai.
5. Gribskov, M., Devereux, J. 1989. Sequence analysis primer. Stockton Press.
6. Introduction to Bioinformatics, Teresa Attwood, David Parry-Smith, 1st edition, May 2001, Pearson Education. ISBN: 978-8178085074
7. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition, Andreas D. Baxevanis, B. F. Francis Ouellette. 3nd edition, October 2004, A John Wiley & Sons, Inc., Publication. ISBN: 978-0471478782.
8. Seizberg, S. L., Searls, D. B. and Kasif, S. 1998. Computational methods in Molecular biology now comprehensive Biochemistry. Elsevier.

MODEL QUESTION PAPER (BIOINFORMATICS)

NAME OF THE COURSE: **BIOINFORMATICS**	COURSE CODE: **21U5BTN02**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. A single piece of information in a database is called ----------			
a. File	b. Field	c. Record	d. Data set
2. Which of the following is a nucleotide sequence database?			
a. EMBL	b. SWISPOT	c. PROSITE	d. TREMBL
3. BLAST Programme is used for ----------			
a. DNA Sequence	b. Protein sequence	c. DNA barcoding	d. Sequence analysis
4. The BLAST program was developed on _____			
a. 1992	b. 1995	c. 1990	1991
5. Phylogenetic analysis is a ----------			
a. Dendrogram	b. Genbank	c. Data retrieval Tool	d. Data Searching tool
6. Which of the following is a part of the statistical test of sequences?			
a. An optimal alignment between two chosen sequences is obtained at the end	b. Unrelated sequences of the same length are then generated through a randomization process	c. Unrelated sequences of the different length are then generated through a randomization process	d. Related sequences of the same length are then generated through a randomization process
7. Clustal W is a ----------			
a. Multiple sequence alignment tool	b. Protein secondary structure prediction tool	b. Data retrieval tool	c. ORF finder
8. The procedure to align many sequences simultaneously is called ----------			
a. Multiple sequence alignment	b. Pairwise alignment	c. Global alignment	d. Local alignment
9. Which one is specially made for protein data base?			
a. DDBJ	b. EMBL	c. PIR	d. Genbank
10. Genbank maintained by ----------			
a. DDBJ	b. EMBL	*c.* Swissport	d. NCBI
11. Submission of sequences to genbank through ----------			

a. Bankit	b. Sequin	b. A & b	c. None of the above

12. The final step involves pairwise alignment by extending from the words in both directions while counting the ---------- using the same substitution matrix

a. Dock score	b. Alignment score	c. Both a & b	d. None of the above

13. Which of the following is not a variant of BLAST?

a. BLAST N	b. BLAST P	c. BLAST X	d. TBLAST X

14. Phylogenetics is the study of the evolutionary history of living organisms using treelike diagrams to represent---------- of these organisms

a. Distance matrix	b. Maximum likelihood	c. Pedigree	d. Maximum parsimony

15. When the two domains are located in two different proteins, to preserve the same functionality, their close ----------have to be preserved as well.

a. Solubility and Polarity	b. Proximity and interaction	c. Bond length and Bond energy	d. „N‟ and „C‟ terminals

16. Which of the following is not true regarding the STRING?

a. Search Tool for the Retrieval of Interacting Genes/Proteins	b. Functional associations include only the direct protein-protein interactions	c. It is based on combined evidence of gene linkage, gene fusion and phylogenetic profiles	d. It is a web server that predicts gene and protein functional associations

17. If the two sequences share significant similarity, it is extremely_____that the extensive similarity between the two sequences has been acquired randomly, meaning that the two sequences must have derived from a common evolutionary origin

a. Unlikely	b. Possible	c. Likely	d. Relevant

18. Which of the following is incorrect regarding sequence homology?

a. Two sequences can homologous relationship even if have do not have common origin	b. It is an important concept in sequence analysis	c. When two sequences are descended from a common evolutionary origin, they are said to have a homologous relationship	d. When two sequences are descended from a common evolutionary origin, they are said to share homology

19. Which of the given statements is incorrect about Microarray (or microchip) analysis?

a. It is a new technology in which all of the genes of an organism are represented by oligonucleotide sequences spread out in an 80 x 80 array on microscope slides	b. The oligonucleotide sequences cannot be synthesized directly on the slide	c. The oligonucleotides are collectively hybridized to a labeled cDNA library prepared by reverse-transcribing mRNA from cells	d. The amount of label binding to each oligonucleotide spot reflects the amount of mRNA in the cell

20. Other types of evidence for a relationship between two genes are also given that are not dependent in sequence similarity. These include _____

a. Genes are closely linked on the same chromosomes	b. Genes are transcribed from the same DNA strand	c. Gene fusions are observed between otherwise separate genes	d. Phylogenetic profiles show the genes are not that commonly present in organisms

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Write an short Biological Database (OR) B) Explain the NCBI data base
22. A) Give an account on BLOCKS, PRINTS (OR) B) Explain the application of Pfam
23. A) Write short note on sequence alignment (OR) B) Briefly define Scoring matrices
24. A) Write short notes on Phylogenetic Analysis (OR) B) Write about database similarity search
25. A) Explain ORF finder (OR) B) Explain the steps involved in Restriction site analysis

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give a detailed account on Biological databases
27. Explain elaborately about the types of Biological data bases
28. Give a detailed account on BLAST
29. List out the difference between Local alignment and Global alignments
30. Give a detailed account on Molecular Docking

	NAME	**SIGNATURE**
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NMEC – II

CONCEPTS OF BIOTECHNOLOGY

Paper	: NMEC II	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: **21U3BTN03**	External	: 75

PREAMBLE

To make non major life science students in understanding basic and applied principles of biotechnology and its technical approach in society in generating value added, reliable and reproducible products.

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand the scope and application of biotechnology	**K1, K2 & K4**
CO2	Use of enzymes in generating basic recombinant DNA concepts	**K2, K3 & K4**
CO3	Use of plasmid vectors in experimenting and designing cloning Strategies	**K3, K4 & K5**
CO4	Use molecular techniques of the identification of positive recombinant clones	**K4, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Scope of Biotechnology: History of Biotechnology; Conventional and modern Biotechnology – Biotech industries. Biotechnology tree. Strategies for gene cloning.	**8**
II	Tools used in gene cloning – Restriction endonucleases – Types – Features. Ligases – linkers, adaptors and homopolymer tailing. Modifying Enzymes	**8**
III	Vectors-properties of good vector. Constructed plasmids-pBR 322. Cosmid vectors, Animal vectors-SV40. Plant vectors – Ti derivatives	**8**
IV	Introduction of genes – vector mode – transformation and transfection. Vector less mode – Biolistics, Electroporation, Microinjection	**8**

V	Selection of recombinants, Markers – PCR, RFLP, RAPD and blotting techniques	**8**

SUGGESTED READINGS:

1. Principles of gene manipulations. Old and Primrose (1989), 3rd edition.
2. Biotechnology, Sathyanarayana U (2008), Books and Allied (p) ltd.
3. Biotechnology and genomics, Gupta PK (2004). Rastogi publications.
4. Gene cloning and DNA analysis. Brown TA. (1996). Blackwell science, Osney Mead, Oxford.
5. A text book of Biotechnology, Dubey RC (2007). S.Chand & Company Ltd, New Delhi.
6. Biotechnology, Singh BD (2004). Kalyani Publications. New Delhi.

MODEL QUESTION PAPER (CONCEPTS OF BIOTECHNOLOGY)

NAME OF THE COURSE: **CONCEPTS OF BIOTECHNOLOGY**	COURSE CODE: **21U3BTN03**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. The following is not a branch of Biotechnology ----------			
a. Genetic engineering	b. Tissue culture	c. Physiology	d. Microbiology
2. Cell theory was proposed by_____			
a. Schleiden and Schwann	b. Robert Hooke	c. Leeuwen Hooke	d. Beetle and Tatum
3. DNA recombinant technology is also called as_____			
a. Gene manipulation	b. Totipotency	c. Splicing	d. Gene cloning
4. The PCR technique was developed by_____			
a. Karry mullis	b. Kohler	c. Milstein	d.Altman
5. Gene cloning means _____			
a. Production of mutated genes	b. Production of wild genes	c. Production of dominant genes	d. Production of large population of desired DNA fragment
6. A small circular DNA present in bacterial cells are called as ----------			
a. Enzyme	b. Ribosomes	c. Plasmids	d. Vector
7. For cloning, DNA samples are taken from ----------			
a. Same individual	b. Different individual	c. Different species	d. None of the above
8. The function of Restriction enzyme is to ----------			
a. Cut the DNA	b. Join the DNA	c. Amplify the DNA	d. None of the above
9. Who discovered the restriction enzymes?			
a. Natham & Arber and smith	b. Watson & Crick	c. Boyer & Cohen	d. Paul & Berg
10. Which organism has the highest number of vectors?			
a. Yeast	b. Mammalian cells	*c. E.coli*	d. Fungi
11. Boliver and Rodriguez constructed which vectors ----------			
a. P^{uc8}	b. Y^{ip7}	c. P^{BR322}	d. M^{13}
12. How many set of antibiotics resistance does the plasmids PBR322 carry?			
a. 1	b. 2	c.3	c. Nothing
13. Cosmids vectors are used for ----------			

a. Cloning a small fragments	b. Cloning a large fragments	c. Cloning prokaryotes	d. Cloning eukaryotes
14. Single stranded vectors are useful ----------			
a. For sequencing of cloned DNA	b. For oligo nucleotide directed mutagenesis	c. For probe preparation	d. All the above
15. Chemicals used for gene transfer method ----------			
a. Polyethylene	b. Dextran	c. Calcium chloride	d. All the above
16. Polymerase used for PCR is extracted from?			
a. E.coli	*b. Bacillus sp*	*c. Thermos aquaticus*	*d. Saccharomyces cerevisiae*
17. At which temperature does the DNA is denatured during PCR?			
a. 60^oC	b. 54^oC	c.74^oC	d.94^oC
18. Molecular markers include _____			
RAPD	b.AFLP	c.AFLP	d. All of these
19. Western blotting is the techniques for the detection of ----------			
a. Specific RNA in a sample	b. Specific DNA in a sample	c. Specific protein in a sample	d. Specific glycolipids in a sample
20. What is probe?			
a. Chemically synthesized DNA	b. Purified DNA	c. Fragmented DNA duplex	d. Either purified or synthesized single single stranded DNA

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS
21. A) Write history of biotechnology B) Write a short note on biotechnology tree
22. A) Explain ligases enzymes B) Notes on homopolymer tailing
23. A) Explain the properties of good vectors B) Explain cosmid vectors
24. A) Write notes on bio plastics B) Explain microinjection methods
25. A) Write notes on RFLP B) Application on RAPD

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Write the essay strategies of gene cloning
27. Explain the types and functions restriction enzymes
28. Write the essay P^{BR322} and uses of this vector
29. Write a essay on gene transfer methods
30. Explain PCR principle methodology and applications

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NMEC – II

BIOTECHNOLOGY FOR SOCIETY

Paper	: NMEC II	Total Hours	: 40
Hours/Week	: 2	Exam Hours	: 03
Credit	: 2	Internal	: 25
Paper Code	: 21U3BTN04	External	: 75

PREAMBLE

To make students on understanding the applied part of biotechnology to non-major and non-life science back ground students

COURSE OUTCOMES

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

COs	Outcome	CPD
CO1	To understand basic knowledge of silk worm, earth worm cultivation and its applications	**K3, K5 & K6**
CO2	To understand the concepts of bio fertilizers, bio plastics and Bioweapons	**K3, K5 & K6**
CO3	To understand the basic concepts of biodegradation of xenobiotic Compounds	**K3, K5 & K6**
CO4	To understand the concepts of generating genetically modified/transgenic organisms	**K3, K5 & K6**

MAPPING WITH PROGRAMME OUTCOMES

COs	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S: Strong; **M**: Medium; **L**: Low

UNIT	CONTENT	HOURS
I	Seri culture, Aquaculture, Apiculture, Vermi culture and Mushroom Technology	**8**
II	Biofertilizers, Biopesticides, Bio repellents, Pest control and management, Biomass (SCP), Bioplastics, Bioweapons.	**8**
III	Bio dyes, Bio fuels – Biodiesel & Biogas, Bio indicators, Biodegradation – Role of genetically modifies organisms	**8**
IV	Production of penicillin, Recombinant Vaccines (HBV), Recombinant Insulin, Plantibodies, Vaccines in animal cells, Gene therapy.	**8**
V	Transgenic animals and their applications. Mice, Sheep and Fish. Transgenic plants and their applications – BT cotton, Flavr-Savr tomato and golden rice	**8**

SUGGESTED READINGS:

1. Animal Biotechnology, Ranga MM (2000). Agrobios
2. Introduction to Plant Biotechnology. Chawla (2003).2nd edition. Oxford and IBH publications.
3. Biotechnology, Sathyanarayana U (2008), Books and Allied (p) ltd.
4. Industrial Microbiology Patel AH (2005). Mac Millan Publishers.
5. A text book of Biotechnology, Dubey RC (2007). S.Chand & Company Ltd, New Delhi.
6. Environmental Biotechnology, Chatterji AK, 3rd edition, PHI Learning Pvt Ltd, Newdelhi.

MODEL QUESTION PAPER (BIOTECHNOLOGY FOR SOCIETY)

NAME OF THE COURSE: **BIOTECHNOLOGY FOR SOCIETY**	COURSE CODE: **21U3BTN04**	DURATION: **3 Hrs**
MAX MARKS: 75		

SECTION – A (1 X 20 = 20 MARKS) ANSWER ALL THE QUESTIONS			
1. Sericulture is a rearing of ----------			
a. Silk worm	b. Lac insect	c. Honey bee	d. Fish
2. Aquaculture is a rearing of ----------			
a. Silk worm	b. Lac insect	c. Honey bee	d. Fish
3. Which of the following is used as food to feed *Bombyx mori*?			
a. Hibiscus leaves	b. Mulberry leaves	c. Palm leaves	d. Nome of the above
4. The seeds used for mushroom cultivation is called as ----------			
a. Callus	b. Bed	c. Spawn	d. Altman
5. Which of the following can be used as bioweapons?			
a. *Bacillus*	b. *Escherichia*	c. *Streptococcus*	d. *Clostridium*
6. Which of the following is used as SCP to feed cattle?			
a. Azolla	b. Spirullina	c. Mushroom	d. Yeast
7. Which of th following is an example for bioplastic?			
a. PBH	b. PVC	c. PCC	d. PCV
8. *Bacillus thuringiensis* is used as ----------			
a. Biofertilizer	b. Biopesticide	c. Bioplastic	d. Biorepellent
9. The chemical functional group that gives color to the substance is called as ----------			
a. Iodophore	b. Basophore	c. Chromophore	d. None of the above
10. Which organism produces biodiesel?			
a. *Chrococcus*	b. *Botrycoccus*	*c. Scenedesmus*	d. Both b & c
11. Biogas is produced by certain bacteria by the process of ----------			
a. Acetogenesis	b. Chlorogensis	c. Methanogenesis	d. Nitrification
12. Petroleum hydrocarbons are greatly degraded by ----------			
a. *Serratia*	b. *Bacillus*	c. *Proteus*	d. *Pseudomonas*
13. Recombinant vaccines are produced by ----------			
a. Cutting	b. Grafting	c. Harvesting	d. Cloning
14. Hepatitis is commonly caused by ----------			
a. Bacteria	b. Fungi	c. Virus	d. Protozoa
15. Penicillin is produced by ----------			
a. Bacteria	b. Fungi	c. Virus	d. Protozoa
16. Insulin is pancreatic hormone composed of ---------- peptide chains			
a. 1	b. 2	c. 3	d. 4
17. Which of the following product is produced from animals systems through transgenic technology?			

a. Fibrin	b. Antithrombin	c. Insulin	d. Interferon
18. Recombinant proteins (RPs) are extensively produced by using one of the following cell line			
a. MCF	b. CHO	c. HeLa	d. MG-63
19. BT cotton is generated for the purpose of ----------			
a. Controlling cotton production	b. Controlling Honey bee population	c. Controlling butterfly propagation	d. Controlling cotton pests
20. Transgenic tomato was produced by recombinant DNA technology for the purpose of ----------			
a. Increasing CHO content	b. Increasing vitamin content	c. Increasing lipid content	d. Increasing protein content

SECTION – B (5 X 5 = 25 MARKS) ANSWER ALL THE QUESTIONS	
21. A) Write shot notes on the rearing of silkworm B) Write a short note on the applications of vermin compost	(OR)
22. A) Explain the uses of SCP. B) List out the hazardous consequences of bioweapons	(OR)
23. A) List out the composition of biogas B) Write short notes on pest control management	(OR)
24. A) Write short notes on plantibodies B) Write short notes on gene therapy	(OR)
25. A) How will you produce golden rice? B) Briefly write about uses of Flavr-Savr Tomato	(OR)

SECTION – C (3 X 10 = 30 MARKS) ANSWER ALL THE QUESTIONS
26. Give a detailed account on mushroom cultivation technology
27. Give a detailed account on biopesticide production
28. Give a detailed account on bio diesel production
29. Give a detailed account on penicillin production
30. Give a detailed account on the production of transgenic mice

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