

## M.Sc. BIOTECHNOLOGY

SEM	Course Code	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
							CIA	ESE	
<b>I</b>	20PBT1CC1	Core – I	Bioinstrumentation	6	5	3	25	75	100
	20PBT1CC2	Core – II	Advanced Biochemistry	6	5	3	25	75	100
	20PBT1CC3	Core – III	Immunology and Immunotechnology	6	4	3	25	75	100
	20PBT1CC4P	Core – IV	Bioinstrumentation, Advanced Biochemistry, Immunology and Immunotechnology - Practical	6	4	4	25	75	100
	20PBT1DE1	DSE – I <sup>#</sup>		6	4	3	25	75	100
	<b>TOTAL</b>				<b>30</b>	<b>22</b>			
<b>II</b>	20PBT2CC5	Core – V	Enzymology and Enzyme Technology	6	5	3	25	75	100
	20PBT2CC6	Core – VI	Molecular Biology and Genetic Engineering	6	5	3	25	75	100
	20PBT2CC7	Core – VII	Recombinant DNA Technology	6	4	3	25	75	100
	20PBT2CC8	Core – VIII	Enzymology and Enzyme Technology, Genetic Engineering and Molecular Techniques, Recombinant DNA Technology - Practical	6	4	4	25	75	100
	20PBT2DE2	DSE – II <sup>#</sup>		6	4	3	25	75	100
	<b>TOTAL</b>				<b>30</b>	<b>22</b>			
<b>III</b>	20PBT3CC9	Core – IX	Plant Biotechnology	6	5	3	25	75	100
	20PBT3CC10	Core – X	Animal Biotechnology	6	5	3	25	75	100
	20PBT3CC11	Core – XI	Microbial Technology	6	4	3	25	75	100
	20PBT3CC12	Core – XII	Plant Biotechnology, Animal Biotechnology, Microbial Technology - Practical	6	4	4	25	75	100
	20PBT3DE3	DSE – III <sup>#</sup>		6	4	3	25	75	100
	20PBT3EC1	Extra Credit Course – I	Online Course (MOOC)	-	1*	-	-	-	-
	<b>TOTAL</b>				<b>30</b>	<b>22</b>			
<b>IV</b>	20PBT4CC13	Core – XIII	Bioinformatics and Biostatistics	6	5	3	25	75	100
	20PBT4CC14	Core – XIV	Environmental Biotechnology	6	5	3	25	75	100
	20PBT4CC15	Core – XV	Bioinformatics and Biostatistics, Environmental Biotechnology - Practical	6	5	4	25	75	100
	20PBT4PW	Project	Project	12	8	-	-	200	200
	20PCNOC	Online Course (Compulsory)		-	1	-	-	-	-
	20PBT4EC2	Extra Credit Course – II	Biotechnology for career Examinations	-	5*	3	-	100	100*
	<b>TOTAL</b>				<b>30</b>	<b>24</b>			
<b>GRAND TOTAL</b>					<b>90</b>				<b>2000</b>

\*Not considered for grand total and CGPA

### # Discipline Specific Electives

SEMESTER	COURSE CODE	COURSE TITLE
I	20PBT1DE1A	Biodiversity and Bioprospecting
	20PBT1DE1B	Biofertilizer Technology
II	20PBT2DE2A	Genomics and Proteomics
	20PBT2DE2B	Biopharmaceuticals in Nanomedicine
III	20PBT3DE3A	Stem Cell Biology
	20PBT3DE3B	Marine Biotechnology

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBT1CC1	Core – I	BIOINSTRUMENTATION	6	5	100	25	75

**Course outcome:**

1. Integrate spectroscopic techniques in their research projects and utilize them to discover the structure of novel compounds.
2. Gain knowledge on the principles, instrumentation and applications of centrifugation.
3. Understand the working principles, construction and applications of all separation techniques involved in purification.
4. Understand the various Medical instrumentation.
5. Gain knowledge on different scientific research designs and methods in field biology

**UNIT I Microscopy and Spectroscopy:**

**18 hours**

Microscope – Bright field, Dark field, Phase contrast, Microscopy - Fluorescent Microscope, Electron microscopy - Scanning Electron Microscope, Transmission Electron Microscope, Confocal Laser Scanning Microscope, Atomic Force Microscope. General design and components of spectroscopy, UV –Visible, IR- Raman spectroscopy, NMR spectroscopy, Auger electron and Atomic absorption spectroscopy (AAS),

**UNIT II Centrifugation and Analytical bioprocess:**

**18 hours**

Principles of centrifugation, concepts of RCF. Different types of Centrifuges and their uses, differential and density gradient centrifugation, separation methods in Preparative and Analytical Ultra Centrifuges, applications of analytical ultracentrifuge, Analysis of biomass, Gas analysis for O<sub>2</sub> and CO<sub>2</sub>, #Flow injection analysis#.

**UNIT III Separation Techniques:**

**18 hours**

Chromatography – Principles of adsorption and partition chromatography, ion exchange, gel permeation chromatography, affinity chromatography, Gas liquid chromatography and HPLC; Mass spectrometry, Electrophoretic techniques – Principles of Electrophoresis, Continuous, zonal and capillary electrophoresis, Electrophoresis of Proteins-SDS-PAGE, IEF, 2D-PAGE, #Agarose Gel Electrophoresis of DNA#.

**UNIT IV Radio labeling techniques and Medical Instrumentation:**

**18 hours**

Detection and measurement of different types of radioisotopes normally used in biology, molecular imaging of radioactive material, safety guidelines; Medical instrumentation–Single neuron recording, patch-clamp recording, ECG, EEG, Brain activity recording, lesion and stimulation of brain,PET, MRI, fMRI, #computerized axial tomography scan#.

**UNIT V Thermal analysis and methods in field Biology:**

**18 hours**

Thermo gravimetric analysis, Differential thermal analysis, Differential scanning calorimetry (DSC);Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, #sampling methods in the study of behavior#, habitat characterization-ground and remote sensing methods.

#.....#Self –study portion

**Text Books:**

**T.B-1** Chatwal and Anand, Instrumental Methods of Chemical Analysis, 6<sup>th</sup> edition, Himalaya Publishing House, 2006.

**T.B-2** Upadhyay, Upadhyay and Nath, Biophysical Chemistry (Principles & Technology), 9<sup>th</sup> edition, Himalaya Publishing House, 2009.

**T.B-3** Willard, H.H., Merrit, J.A., Dean, L.L. and Settle, F.A., Instrumental Methods of Analysis, 7<sup>th</sup> edition, CBS Publishers and Distributors, 2004

Unit I Chapter I, II, III, T.B-1

Unit II Chapter V, T.B-2

Unit III Chapter 7, T.B-2

Unit IV Chapter 3 T.B-3

Unit V Chapter 4 T.B-3

**Books for Reference:**

1. Wilson and Walker, Principles and techniques of Biochemistry and Molecular Biology, 6<sup>th</sup> edition Cambridge University Press, 2005.
2. Skoog, D., Instrumental Methods of Analysis, 5<sup>th</sup> Edition, David Hariss Publishers, 2000

**Web reference:**

<https://www.epictraining.ca/course/15958/mississauga/bioinstrumentation-distance>  
<https://bioinstrumentation.mit.edu/>  
[https://www.egr.msu.edu/classes/ece445/mason/Files/ECE445\\_1-Intro.pdf](https://www.egr.msu.edu/classes/ece445/mason/Files/ECE445_1-Intro.pdf)  
<https://nptel.ac.in/courses/102/108/102108082/>

**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
I	20PBT1CC1	BIOINSTRUMENTATION					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓		✓	✓	✓	
CO4	✓	✓	✓	✓		✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Number of Matches = 42, Relationship : High											

**Prepared by:**

Dr.B.Nazeema Banu

**Checked by:**

1. K.Gobalan
2. Dr. A. Khaleel Ahamed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBT1CC2	Core – II	ADVANCED BIOCHEMISTRY	6	5	100	25	75

### Course outcomes

1. Acquire the knowledge about bioenergetics and its principles.
2. Describe the metabolic pathways of carbohydrate and its regulatory mechanisms.
3. Illustrate the structure, biological functions and metabolism of lipids.
4. Intellectual about the structures of amino acids, their chemical properties and their metabolism.
5. Assess the synthesis of purines and pyrimidines along with their regulation and explain and provide the inter-relationships of biomolecules and their consequences for interpreting & solving clinical problems.

### Unit I Bioenergetics:

**18 hours**

Free energy and entropy. Phosphoryl group transfers and ATP. Enzymes involved in redox reactions. The electron transport chain—organization and role in electron capture. Electron transfer reactions in mitochondria. Oxidative phosphorylation- F<sub>1</sub>/F<sub>0</sub> ATPase- structure and mechanism of action. #The chemiosmotic theory#. Inhibitors of respiratory chain and Oxidative phosphorylation – uncouplers, ionophores. Regulation of oxidative phosphorylation. Mitochondrial transport systems- ATP/ADP exchange, malate /glycerophosphate shuttle.

### Unit II Carbohydrate metabolism:

**18 hours**

Classification, Structure and Isomerism. Monosaccharides, Oligosaccharides, Polysaccharides— Structure and Properties. Metabolism of Carbohydrates- Glycolysis, Mechanism of pyruvate Dehydrogenase, Citric acid cycle, HMP shunt, Glucuronic acid Gluconeogenesis, Glycogenesis, Glycogenolysis, Glyoxylate cycle. #Metabolic disorders associated with carbohydrate metabolism#. CSDB (Carbohydrate Structure Database, GlycomeDB, Calvin cycle.

### Unit III Lipid metabolism:

**18 hours**

Biosynthesis of fatty acid and its regulation, biosynthesis of triacylglycerol, phospholipids and cholesterol. Metabolism of triacylglycerol during stress.  $\alpha$ ,  $\beta$ ,  $\gamma$ , Oxidation of fatty acids— Role of carnitine cycle in the regulation of  $\beta$  -oxidation. #Ketogenesis and its control. Lipoprotein types and its functions#. Metabolic disorders associated with lipid metabolism, LMSD (Lipid Maps Structure Database), Lipid Bank.

### UNIT IV Metabolism of amino acids, proteins:

**18 hours**

Overview of biosynthesis of nonessential amino acids. Catabolism of amino acid- transamination, deamination, ammonia formation, urea cycle and its significance. Catabolism of carbon skeletons of amino acids. Protein – classification, types, characteristics and structures, PDB (Protein Data Bank), Ramachandran plot, PROCHECK Solid state synthesis of peptides, Sequence determination. #metabolic disorders associated with amino acid metabolism#.

### UNIT V Metabolism of purines and pyrimidines:

**18 hours**

Digestion and absorption of nucleoproteins, Fractionation, sequencing and chemical synthesis of oligonucleotides. Metabolism of purines - *de novo* and salvage pathways for purine biosynthesis, regulation of biosynthesis of nucleotides. #Purine catabolic pathway#. Metabolism of pyrimidines - biosynthesis and catabolism. Disorders of purine and pyrimidine metabolism, intermediary metabolism and KEGG pathway.

#.....# Self-study portion

### Text Books:

T.B.1. Voet, D. and Voet, JG. Biochemistry, 3<sup>rd</sup> Edition, John Wiley & Son. 2004.

Unit-I Chapter 17 – Page no 581-618 and Chapter 18 - Page no 626-651. T.B.1.

Unit-II Chapter 26 –Page no 985-1044. T.B.1.

Unit-III Chapter 25- Page no 909-969. T.B.1.

Unit-IV Chapter 28 - Page no 1069-1098. T.B.1.

Unit-V Chapter 12 - Page no 324-380. T.B.1.

### Books for References:

1. Stryer, Biochemistry- Freeman. 5th ed, 2002.

2. Lehninger's, McMillan, Worth, Principles of Biochemistry. 7th ed, Nelson Cox., 2013.

**Web References:**

<https://csdb.glycoscience.ru/database/>  
<http://www.glycome-db.org/>  
<https://www.lipidmaps.org/data/structure/index.php>  
<https://www.rcsb.org/>  
<https://www.ebi.ac.uk/thornton-srv/software/PROCHECK/>

**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
I	20PBT1CC2	ADVANCED BIOCHEMISTRY					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓		✓	✓	✓	✓	
CO2	✓		✓	✓	✓			✓	✓	✓	
CO3	✓		✓	✓	✓			✓	✓	✓	
CO4	✓		✓	✓	✓			✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Number of Matches = 38, Relationship : High											

**Prepared by:**

1. Dr. T. Nargis Begum

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**Checked by:**

1. Dr. J. Sebastin Raj  
2. Dr. A. Khaleel Ahamed

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Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBT1CC3	Core – III	IMMUNOLOGY AND IMMUNOTECHNOLOGY	6	4	100	25	75

### Course Outcomes:

1. Describe the function of the major components and mechanism of the immune system to protect the body from the pathogens
2. Familiar with the immunologic responses involved in preventing, combating infections and the concepts of nonspecific and specific immunity.
3. Resourceful in the structure, function and characteristics of immunoglobulins.
4. Intellectual literacy in the common immune diseases in terms of the underlying basic principles and preventive measures.
5. Familiar in the modern techniques that aids human protection.

### UNIT I Components of Immune system:

**18 hours**

Immunity: innate immunity-factors, acquired immunity-types, comparison of active and passive acquired immunity. # Haematopoiesis #, Cells of the immune system and their role - lymphoid cells (T and B lymphocytes, NK cells), Macrophages, Dendritic cells, Eosinophils, Basophils, Neutrophils, Mast cells, Antigen presenting cells and Platelets, Organs of the immune system - Primary and secondary lymphoid organs.

### UNIT II Antigens, and Antibodies:

**18 hours**

Antigens- structure, Types of antigens – factors of antigenicity. T cell and B cell epitopes, haptens, #adjuvants and super antigens#. T dependent and independent antigens. antigenic determinants. Immunogens and chemical nature. Antibodies: Ultra structure of immunoglobulin, types and functions. Monoclonal and polyclonal antibodies and its application. Antibody receptors- T cell receptors (TCR), B cell receptor (BCR).

### UNIT III Immune response of B cells and T cells:

**18 hours**

B cell - Activation, humoral immune response, T cell - Activation and Cell mediated response, Antigen processing and presentation pathway, Induction of immune response- Cytokines, lymphokines and chemokines, # Clonal selection Theory and process #, Complement activation – classical and alternative pathways.

### UNIT IV Immunity to infectious diseases:

**18 hours**

Bacterial, viral Auto immunity: Classification and mechanisms of autoimmune diseases. Structure and functions of class I and class II MHC molecules. Transplantation immunology: types, allograft rejection, Graft versus host reactions, application of transplantation immunology, Principles of tumour immunology: Tumour antigens, immune response to tumour, and immunotherapy of malignancy. Vaccines: classification - inactivated, live attenuated, subunit, #synthetic and DNA vaccine and its importance #.

### UNIT V Immunology based techniques and technology:

**18 hours**

Clinical methods for detection of antigens and antibodies: Immunodiffusion: Ouchterlony analysis (Single radial diffusion), Double immunodiffusion. Immunoelectrophoresis: Immunocontraception. Binder- Ligand assays: RIA, ELISA, Western blot. Histocompatibility testing: HLA typing. Hepatitis – B virus test. # Immune complex detection: Rosettes Forming Array, Plaque Forming Array #.

#.....# **Self - study portion**

### Text Books:

- T.B.1. R. A. Goldsby, T. J. Kindt, B. A. Osborne, J. Kuby. Immunology, 5th Edition, W.H. Freeman and Company, New York, 2003.
- T.B.2. A. K. Abbas, A. H. Lichtman, S. Pillai. Cellular and Molecular Immunology, 7th Edition, Elsevier Health Sciences., 2011
- T.B.3. P. M. Latha. A Text Book of Immunology, 1st Edition, S.Chand & Company Ltd, New Delhi, 2003.

### Books for References:

1. I. Roitt. Essential Immunology, 10th Edition. Blackwell Scientific Publication, 2002.
2. M. R. Pandian and B. S. Kumar. Immunology and Immunotechnology, Panima Publishing Corporation, New Delhi, 2007.
2. D. M. Weir and J. Stewart. Immunology, 10th Edition. Churchill Livingstone, New York, 2000.
3. Janis Kuby, Immunology, W.H. Freeman & company, New York. 1997
4. Ivan M. Roitt et al., Essential Immunology, XII Edition, Wiley- Blackwell Publishers, UK.
5. N. Shetty. Immunology. New Age International (P) Limited Publishers. New Delhi. 2006.

**Web Reference:**<https://www.immunology.org/public-information/what-is-immunology><https://en.wikipedia.org/wiki/Immunology><https://www.nature.com/subjects/immunology><https://www.immunology.org/public-information/bitesized-immunology>**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
I	20PBT1CC3	IMMUNOLOGY AND IMMUNOTECHNOLOGY					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓		✓	✓		✓	
CO2	✓			✓	✓		✓	✓	✓	✓	
CO3	✓		✓	✓	✓		✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓			✓	✓	✓	✓	✓	✓	
Number of Matches = 40, Relationship : High											

**Prepared by:**

1.H.F.SyedMafiyaHaniff

**Checked by:**

1.Dr.A.Nishanthini

2.Dr.A.Khaleel Ahamed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBT1CC4P	Core – IV	BIOINSTRUMENTATION, ADVANCED BIOCHEMISTRY, IMMUNOLOGY AND IMMUNOTECHNOLOGY - PRACTICAL	6	4	100	25	75

**Course outcome:**

1. Describe how scientific methods and instruments are used to explain natural phenomena.
2. Generate hypotheses, evaluate data, and design experiments to investigate a scientific problem.
3. Gain expertise in handling equipment for electrophoresis, spectrophotometer and chromatography.
4. Gain skill-based knowledge on techniques associated with Biochemistry
5. Develop their skills in the understanding of immunological reactions.

1. Validating Lambert – Beer’s law using KMnO<sub>4</sub>. Demonstration
2. Absorption spectra of proteins/pigment.
3. Paper chromatography.
4. column chromatography
5. Thin layer chromatography.
6. Extraction and Estimation of sugar from natural sources – glucose.
7. Extraction and Estimation of protein by Lowry’s method.
8. Estimation of amino acid by Ninhydrin method
9. Estimation of serum cholesterol by Zak’s method.
10. Quantitative analysis of blood urea/ creatinine
11. Quantitative analysis of sugar in urine by Benedict’s reagent
12. Blood Grouping and agglutination.
13. Total count, Differential count (RBC & WBC)
14. Ouchterlony double diffusion.
15. Immunoelectrophoresis.
16. ELISA

**Text Books:**

**T.B-1** Keith Wilson and John Walker, Biochemistry - Practical Approach, 5<sup>TH</sup> edition, 2000.

**T.B-2** Collins and Lyne's Microbiological methods, 3<sup>rd</sup> edition, Butterworth-Heinemann Ltd, 1995.

**T.B-3R.** A. Goldsby, T. J. Kindt, B. A. Osborne, J. Kuby. Immunology, 5<sup>th</sup> Edition. W.H. Freeman and Company, 2003.

**Books for References:**

1. J. Jayaraman, Laboratory manual in Biochemistry, 2<sup>nd</sup> edition, New Age International Publishers, 2011.
2. L. Robert, Switzer and Liam Garrity. Experimental Biochemistry, 2<sup>nd</sup> edition, W.H. Freeman and Company, New York. 2001.

**Web reference:**

<https://link.springer.com/chapter/10.1007/978-981-10-8186->

<https://www.youtube.com/watch?v=BST5GRsAnPk>



**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
I	20PBT1CC4P	BIOINSTRUMENTATION, ADVANCED BIOCHEMISTRY, IMMUNOLOGY AND IMMUNOTECHNOLOGY - PRACTICAL					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓			✓	✓	✓	
CO2	✓	✓	✓	✓			✓	✓	✓	✓	
CO3	✓	✓	✓			✓		✓	✓	✓	
CO4	✓	✓	✓					✓	✓	✓	
CO5	✓	✓	✓	✓	✓			✓	✓	✓	
Number of Matches = 37, Relationship : High											

**Prepared by:**

Dr.B.Nazeema Banu

**Checked by:**

1. Dr. J. Sebastin Raj
2. Dr. A. Khaleel Ahamed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBT1DE1A	DSE - I	BIODIVERSITY AND BIOPROSPECTING	6	4	100	25	75

### Course Outcomes:

1. Ensure imparting the knowledge on a concept of biodiversity and its advantages.
2. Identify the application of micro and macro algae in different sectors.
3. Determine the category and potentialities of biological products.
4. Improve the new discovery and commercialization of new products based on biological resources.
5. Appraise the resources or compounds can be important for and useful in many fields, including pharmaceuticals, agriculture.

### Unit I: Components of Biodiversity:

**18 hours**

Biodiversity crisis and biodiversity loss. Importance of biodiversity in daily life. Biodiversity and climate change. Types of Ecosystems: India as mega biodiversity Nation. Hot spots and biodiversity in India. Biodiversity and Ecosystem functioning. Biotechnology and Conservation; IUCN red list of threatened species; Germplasm, #National Parks, Botanical Gardens, Wildlife Sanctuaries#.

### Unit II: Bioprospecting of micro-algae:

**18 hours**

Phyco-remediation, Animal feed, feedstock for anaerobic processes, algal vaccines, algal biofuels, biological hydrogen production from algae, biofertilizer, Lipid identification and extraction techniques, other value added products from microalgae (Pigments, vitamins, food supplements, fatty acids), cosmetics, applications of spent biomass, diatomaceous earth in industries. #Antimicrobial and anticancer compounds from microalgae#.

### Unit III: Bioprospecting of macro-algae:

**18 hours**

Bioprospecting of marine algae, Present and future prospects of seaweeds in developing functional foods, bioactive metabolites from seaweeds, *In-vivo* and *in-vitro* studies of seaweed compounds, chemical ecology of seaweeds, anticoagulant effect. Conventional and alternative technologies for the extraction of algal polysaccharides, (alginates, agar, carrageenan), #Phlorotannins#.

### Unit IV: Bioprospecting of Fungi:

**18 hours**

An arbuscular mycorrhiza fungi and their application in forestry, agroforestry and restoration/reclamation of wasteland. Therapeutic proteins from fungi, bioactive compound from endophytic fungi. Medicinal fungi: antibiotics from fungi, Product of pharmaceutical importance of fungi, #Fungi as biosensors#, industrially important fungal enzymes.

### Unit V: Bioprospecting of plants:

**18 hours**

Cellulose, lignin, starch, waxes, suberins, rubber – Their chemical diversity, localisation and uses. Other useful plant products – Oils, pigments, phenolics, terpenoids, alkaloids, enzymes, antibiotics, antiviral agents; Immunosuppressive agents and other therapeutic agents. #Biopharmaceuticals#, Anticancer compounds from plants, Green synthesis of nanoparticles and its uses.

### Text Books:

- T.B.1 R. A. Andersen, Algal Culturing Techniques. Elsevier Academic Press, 2005.  
 T.B.2 L. Barsanti and P. Gualtieri, Algae: Anatomy, Biochemistry and Biotechnology. CRC Press, 2006.  
 T.B.3 E. E Benson. Plant Conservation Biotechnology. Taylor & Francis, 2012.  
 T.B.4 D. Bhattacharya. Origin of Algae and Their Plastids. Springer-Verlag, New York, 2013.

### Books for Reference:

1. E.D. and U. Sommer, Seaweeds biology- Novel insights into ecophysiology, ecology and utilization. Springer-Verlag, 2012.
2. H. Dominguez, Functional ingredients from algae for foods and nutraceuticals. Woodhead Publishing Ltd., U K., 2013.
3. V. Evangelista, L. Barsanti, A. M. Frassanito, V. Passarelli, and P. Gualtieri, Algal toxins: nature, occurrence, effect and detection. Springer, 2008.
4. R. K. Gupta and V. D. Pandey . Advances in Applied Phycology. Daya Publishing House, Delhi, 2007.

**Web Reference:**

1. <https://nptel.ac.in/courses/102104068/>

**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
I	20PBT1DE1A	BIODIVERSITY AND BIOPROSPECTING					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓		✓	✓	✓		
CO3			✓	✓	✓	✓	✓	✓	✓	✓	
CO4				✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓			✓	✓	✓	✓	✓	✓	
Number of Matches = 41, Relationship : High											

**Prepared by:**

1. Dr. J. Sebastin Raj

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**Checked by:**

1. Dr. Y. ArsiaTarnam

2. Dr. A. Khaleel Ahamed

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Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBT1DE1B	DSE - I	BIOFERTILIZER TECHNOLOGY	6	4	100	25	75

**Course outcome:**

1. Ensure imparting the knowledge of chemical based agriculture.
2. Identify the application of biofertilizer and organic farming.
3. Determine the category of chemical fertilizers and organic manures.
4. Improve the new live products (or latent cells of microbes) and require care in storage, transport, application and maintaining field conditions
5. Develop skills management for best results uses both nitrogenous and phosphate bio fertilizers.

**UNIT I: Introduction to Biofertilizers**

**18 hours**

Structure and characteristic features of the following biofertilizer organisms: Bacteria: Azospirillum, Azotobacter, Bacillus, Pseudomonas, Rhizobium and Frankia. Cyanobacteria: Anabaena, Nostoc, Hapalosiphon. Fungi: Glomus, Gigaspora, Sclerocystis, Amanita, Laccaria.

**UNIT II: Biofertilization processes**

**18 hours**

Decomposition of organic matter and soil fertility and vermicomposting. Mechanism of phosphate solubilization and phosphate mobilization. Nitrogen fixation - Free living and symbiotic nitrogen fixation. Biotechnological application in nitrogen fixation.

**UNIT III: Nitrogenous Biofertilizers**

**18 hours**

Bacteria - Isolation and purification of Azospirillum and Azotobacter, mass multiplication of Azospirillum and Azotobacter, formulation of inoculum of Azospirillum and Azotobacter, application of inoculants of Azospirillum and Azotobacter. Isolation and purification of Rhizobium, mass multiplication and inoculum production of Rhizobium, Methods of application of Rhizobium inoculants.

**UNIT IV: Mycorrhizae Biofertilizers:**

**18 hours**

Mycorrhizae - Ecto and endomycorrhizae and their importance in agriculture. Isolation of AM fungi - Wet sieving method and sucrose gradient method. Mass production of AM inoculants and field applications. Isolation and Purification of phosphate solubilizers. Mass multiplication and field applications of phosphate solubilizer (*Pseudomonas striata*). Biofertilizers -<sup>#</sup> Storage, shelf life, quality control and marketing<sup>#</sup>.

**UNIT V: Organic farming:**

**18 hours**

Management of organic waste and green manure-Farm manures, composts . Organic manures-organic residue, chemical nature of organic manure, <sup>#</sup>green manure, importance of green manure<sup>#</sup>. Animal based organic manure - cow dung, poultry waste, Production of vermicompost and Panchakavya, production and commercialization of Organic products.

#-----# Self-study portion

**Text Books:**

- T.B.1** L.L. Somani, S.C. Bhandari, K.K. Vyas and S.N. Saxena. Biofertilizers, Scientific Publishers – Jodhpur, 1990.
- T.B.2** N.S.Subba Rao, G.S. Venkataraman and S. Kannaiyan. Biological nitrogen fixation, ICAR Pub., New Delhi,1993.

Unit I: Chapter I Section 1, 8-11. T.B - 1

Unit II: Chapter II Section 6- 9. T.B - 1

Unit III: Chapter I Section 1.2, 1.1, 3.2. T.B -2

Unit IV: Chapter VIII Section 180-191 T.B -2

Unit V: Chapter V Section 1-23. T.B - 2

**Books for Reference**

1. D.J. Bagyaraj and A. Manjunath. Mycorrhizal symbiosis and plant growth, Univ. of Agricultural Sciences, Bangalore, India, 1990.

2. S.S. Purohit, P.R. Kothari and S.K. Mathur. Basic and Agricultural Biotechnology, Agro Botanical Pub. India,1993.
3. N. S.Subba Rao, Biological nitrogen fixation: recent developments, Mohan Pramlani for Oxford and IBH Pub. Co. (P) Ltd., India, 1988.

**Web Reference:**

1. [https://elearninguoa.org/course/biofertilizer technology/agricultural-biotechnology](https://elearninguoa.org/course/biofertilizer%20technology/agricultural-biotechnology)
2. [www.sintef.no/en/nitrogen fixation](http://www.sintef.no/en/nitrogen%20fixation)
3. [www.edx.org/learn/mycorrhizal.org](http://www.edx.org/learn/mycorrhizal.org)

**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
I	20PBT1DE1B	BIOFERTILIZER TECHNOLOGY					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓		✓	✓	✓	✓	
CO2	✓		✓	✓	✓			✓	✓	✓	
CO3	✓		✓	✓	✓			✓	✓	✓	
CO4	✓		✓	✓	✓			✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Number of Matches = 38, Relationship : High											

**Prepared by:**

1.Mr.K.Gobalan

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**Checked by:**

1. Dr. J. Sebastin Raj
2. Dr. A. Khaleel Ahamed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBT2CC5	Core - V	ENZYMOLGY AND ENZYME TECHNOLOGY	6	5	100	25	75

### Course Outcomes:

1. Acquire the knowledge about history, classification, purification and separation of enzymes
2. Intellectual about enzyme kinetics.
3. Describe the mechanism of enzyme action.
4. Construct the knowledge on enzyme regulation.
5. Appraise about the techniques of immobilization and application in enzymes in industries.

### Unit I: Historical aspects of enzymology:

**18 hours**

History, nomenclature and classification of enzymes, according to IUB-EC-1964. Intracellular localization of enzymes, isolation and fractionation of enzymes - classical methods of purification and crystallization, criteria of purity, units of enzyme activity. Turn over number, specific activity. Active site definition, organization and determination of active site residues.

### Unit II: Kinetics of catalyzed reaction:

**18 hours**

Single substrate reactions, bisubstrate reactions, Concept and derivation of Michaelis – Menten equation, Lineweaver burk plot, Briggs Haldane relationship. Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics. Inhibition kinetics - competitive, non-competitive and uncompetitive. Allosteric inhibition, cooperative, cumulative, feedback inhibition.

### Unit III: Mechanism of enzyme catalysis:

**18 hours**

Collision & transition state theories, specificity of enzymes. Proximity and orientation effects, general acid-base catalysis, covalent and electrostatic catalysis - nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Theories on mechanism of catalysis. Coenzymes - structure and function, Mechanism of enzymes action: mechanism of action of lysozyme and chymotrypsin. Isoenzymes.

### Unit-IV: Enzyme Regulation:

**18 hours**

General mechanisms of enzyme regulation, Reversible (glutamine synthase & phosphorylase) and irreversible (proteases) covalent modifications of enzymes. Mono cyclic and multicyclic cascade systems with specific examples. Allosteric enzymes, qualitative description of “concerted” & “sequential” models for allosteric enzymes. Proteinligand binding measurement, analysis of binding isotherms.

### Unit V: Applications of enzymes in Industry:

**18 hours**

Immobilization and Immobilized enzymes. Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Applications of immobilized enzymes. Biosensors – glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors. Abzymes and Ribozymes. Enzymes of clinical importance - diagnostic significance and therapeutic effects. Enzyme Engineering.

### Text Books:

- T.B.1. Zubay, Principles of Biochemistry –4th ed, William C. Brown Publication 1998.  
T.B.2. Palmer. Understanding enzymes. Prentice Hall. 2004.

UNIT1: T.B.1-Chapter 6, T.B.2-Chapter 1.  
UNIT 2: T.B.1-Chapter 6.  
UNIT 3: T.B.1-Chapter 6.  
UNIT 4: T.B.1-Chapter 6.  
UNIT 5: T.B.2Chapter 20, T.B.2-Chapter 5.

### Books for References:

1. Donald Voet and Judith G. Voet.. Biochemistry. 3rd Edition. John Wiley, New York, 2004
2. Allan Fershi, Enzyme structure and mechanism. 2nd Edition. W.H. Freeman & Co. Ltd., USA, 1984.

### Web References:

[https://nptel.ac.in/content/storage2/nptel\\_data3/html/mhrd/ict/text/104105076/lec8.pdf](https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/104105076/lec8.pdf)

**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
II	20PBT2CC5	ENZYMOLGY AND ENZYME TECHNOLOGY					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓		✓	✓	✓	✓	
CO2	✓		✓	✓	✓			✓	✓	✓	
CO3	✓		✓	✓	✓			✓	✓	✓	
CO4	✓		✓	✓	✓			✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Number of Matches = 38, Relationship : High											

**Prepared by:**

1. Dr. T. Nargis Begum

-

**Checked by:**

1. Dr. J. Sebastin Raj

2. Dr. A. Khaleel Ahamed

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Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBT2CC6	Core - VI	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	6	5	100	25	75

**Course outcome:**

1. Outline and examine the mechanism of DNA replication and translation.
2. Critically assess and predict the mechanism of gene expression and gene regulation
3. Examine the appropriate selection and screening technique for a specific recombined DNA.
4. Describe the applications of genetic engineering in microbial and animal improvement along with the ethical guidelines
5. Demonstrate the specific techniques for developing transgenic plants and its Biosafety.

**UNIT I Basics of cell and molecular Biology:**

**18 hours**

cell structure and function, Cell cycle and control, DNA structure and chromosome, Role of genes within cells, genetic code, genetic elements that control gene expression, Nucleic acids and DNA replication: DNA - structure, different forms, denaturation, renaturation, #circular and superhelical structures#. RNA - structure, classes and functions. Replication - Process, Semiconservative and Discontinuous replication.

**UNIT II: Transcription and Translation:**

**18 hours**

Transcription - Initiation, Elongation and Termination, Transcriptional factors, Transcription in Eukaryotes, alternative splicing, mRNA transport. Translation - Protein synthesis - Initiation, Elongation and Termination. Post-transcriptional and translational modification of proteins, #Translational control#, genetic code.

**UNIT III**

**18 hours**

**Regulation of gene expression and Transposable elements:** Operon systems: Lactose operon - induction & repression. Tryptophan operon - Repression & attenuation, #Arabinose operon#. Mutations - biochemical basis, Spontaneous mutations, Isolation of mutants, Mutagenesis, Reversion and Suppression. Transposons and Transposable elements.

**UNIT IV Protein Localization and DNA repair:**

**18 hours**

Export of secretory proteins – chaperons (HSP) - signal hypothesis, transport and localization of proteins to mitochondria, chloroplast, peroxisomes and membrane, #Nuclear localization signals#. DNA Repair - DNA damage and repair mechanisms - Photoreactivation, excision repair, recombination repair and SOS repair.

**UNIT V Genetically engineered Microorganism, plants and animals:**

**18 hours**

Aim and scope of genetic engineering (GE), methodology and tools of Genetic engineering, Inocula for agricultural uses and pollution control, GMO for production of antibiotics, enzymes, insulin, growth hormones, monoclonal antibodies and single cell protein, Genetic engineering for plant and animal improvement, #Ethical committee regulations and guidelines for the use of Genetically engineered microbes, plants and animals#.

# .....# Self-study Portion

**Text Books:**

**T,B-1D.** Freifelder. Molecular Biology, 2<sup>nd</sup> Edition, Jones and Barlett Publishers, 2004.

**T.B-2** Nicholl, Introduction to Genetic Engineering, 3<sup>rd</sup> edition, Cambridge University Press, 2008.

**T.B-3S.** B. Primrose and R. M. Twyman. Principles of gene manipulation and Genomics, 7<sup>th</sup> edition, Blackwell Scientific Publications, 2006.

Unit 1, Chapter - 9, Page No. 223-273, TB.1.

Unit 2, Chapter - 12, 13, 14, Page No. 315-450, TB.1

Unit 3, Chapter - 2, Page No. 106-114. TB.1, Chapter - 10, Page No. 277-292, TB.3

Unit 4: TB.1, Chapter - 19, Page No. 619-639. TB.3, Chapter - 5,6,7,8, Page No. 243- 375.

Unit 5: TB.1, Chapter - 15, Page No. 453-497. TB.2, Chapter - 10, Page No. 179-206.

**Books for References:**

1. J. D. Watson, T. A. Baker, S. P. Bell, A. Gann, M. Levine, R. Losick. Molecular Biology of the gene, 5<sup>th</sup> Edition, Pearson Education, Inc. 2004.
2. G. Karp Cell and Molecular Biology: Concepts and Experiments, John Wiley and Sons Inc. 2009.
3. Genes IX - Benjamin Lewis. Oxford University & Cell Press, 2008. Unit 1: TB.1, Chapter - 4, Page No. 79-112, Chapter - 12 & 13, Page No. 333-337, 379.



**Web reference:**

1. <https://geneticscertificate.stanford.edu/courses/genetic-engineering-and-biotechnology>
2. [https://study.com/articles/Genetic\\_Engineering\\_Courses\\_and\\_Classes\\_Overview.html](https://study.com/articles/Genetic_Engineering_Courses_and_Classes_Overview.html)
3. <https://www.edx.org/learn/genetic-engineering>
4. [https://nptel.ac.in/content/syllabus\\_pdf/102103013.pdf](https://nptel.ac.in/content/syllabus_pdf/102103013.pdf)

**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
II	20PBT2CC6	GENETIC ENGINEERING AND MOLECULAR TECHNIQUES					6	5			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓		✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Number of Matches = 43, Relationship : High											

**Prepared by:**

1. Dr.B.Nazeema Banu

**Checked by:**

1. Dr. J. Sebastin Raj
2. Dr. A. Khaleel Ahmed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBT2CC7	Core - VII	RECOMBINATION DNA TECHNOLOGY	6	4	100	25	75

### Course Outcomes:

1. Explain the principles of enzymes and vector which serves indispensable tools in recombinant DNA technology.
2. Demonstrate the principle and the concept of cloning strategies.
3. Develop skills associated with constructing cDNA libraries and finding right clone.
4. Discuss the mechanism associated with PCR and sequence analysis.
5. Understand the genome editing and societal concerns of recombinant DNA technology.

### UNIT I Basic techniques involved in rDNA technology:

**18 hours**

Enzymes used in cloning: Restriction enzymes - specificity, sticky and blunt ends, isoschizomers, processing of restriction fragments; DNA ligase – optimizing ligating conditions; alkaline phosphatase; double digest; modification of restriction fragment ends - trimming and filling, linkers and adapters, homopolymer tailing; #other ways of joining DNA molecules – TA cloning of PCR products and DNA topoisomerase#.

### UNIT II Vectors:

**18 hours**

Plasmid vectors – properties of plasmid vectors, plasmid replication and transformation; Lambda vectors – biology of lambda phage; invitro packaging, insertion vectors – gt10, replacement vectors – EMBL4; cosmids; M13 vectors; expression vectors - pGEM; YEp; YCp; YIp and mammalian cell vectors; #YAC and BAC#.

### UNIT III Genomic and cDNA Libraries:

**18 hours**

Genomic library – partial digest, choice of vectors, construction and evaluation of genomic library; growing and storing of libraries; #cDNA library – isolation of mRNA, cDNA synthesis#, bacterial cDNA; #random, ordered and arrayed libraries#.

### UNIT IV Finding the right clone:

**18 hours**

screening libraries with gene probes – hybridization, labeling probes, steps in hybridization, screening procedure, probe selection; screening expression libraries with antibodies; rescreening; subcloning; characterization of plasmid clones – restriction digest and #agarose gel electrophoresis, southern blot#, PCR and its types.

### UNIT V Genome Editing:

**18 hours**

Definition, process - zinc finger nucleases, transcription activator – like effector nuclease, CRISPR/Cas9 mechanism and its applications. Overview on rDNA Biosafety guidelines – IPR, recombinant DNA advisory committee, institutional Biosafety committee, review committee on genetic manipulation and genetic engineering approval committee.

#.....# **Self Study portion**

### Text Books:

**T.B 1** Jeremy W Dale and Malcom von Schantz, From Genes to Genomes: Concepts and Applications of DNA Technology, John Wiley & Sons, Ltd. 2002.

**T.B 2** Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten, Molecular Biotechnology-principles and applications of Recombinant DNA, 4<sup>th</sup> edition, ASM press, Washington DC, 2010.

**UNIT I** Chapter 5 Section 5.1 – 5.6 T.B. 1 and Chapter 3 T.B. 2

**UNIT II** Chapter 6 Section 6.1 – 6.7 T.B. 1 and Chapter 3 T.B. 2

**UNIT III** Chapter 7 Section 7.1 – 7.4 T.B. 1

**UNIT IV** Chapter Section 8.1 – 8.5 T.B. 1 and Chapter 4 T.B. 2

**UNIT V** Chapter 11 Section 11.1 – 11.3 T.B. 1 and Chapter 10 T.B. 2; Chapter 22 & 23 T.B. 2

**Books for Reference:**

1. T.A. Brown, Gene cloning and DNA analysis: anIntroduction. John Wiley & Sons, 2016.
2. S.B. Primrose and R. Twyman, Principles of Gene Manipulation and Genomics.John Wiley & Sons, 2013.
3. J.W. Dale, M. Von Schantz and N. Plant, From genes to Genomes: Concepts and Applications of DNA Technology. John Wiley & Sons, 2012.
4. V.A. Saunders, Microbial Genetics Applied to Biotechnology: Principles and Techniques of Gene Transfer and Manipulation. Springer Science & Business Media, 2012.

**Web References:**

<https://nptel.ac.in/courses/102103013/>

<https://genomebiology.biomedcentral.com/articles/10.1186/s13059-018-1586-y>

**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
II	20PBT2CC7	RECOMBINATION DNA TECHNOLOGY					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓		✓		✓	✓		
CO2	✓		✓	✓	✓	✓		✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓		✓	
CO4	✓	✓				✓	✓				
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches = 36, Relationship : High											

**Prepared by:**

1. Dr. Y. Arsia Tarnam

**Checked by:**

1. Dr. J. Sebastin Raj
2. Dr. A. Khaleel Ahmed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBT2CC8P	Core - VIII	ENZYMOLOGY AND ENZYME TECHNOLOGY, MOLECULAR BIOLOGY AND GENETIC ENGINEERING & RECOMBINANT DNA TECHNOLOGY – PRACTICAL	6	4	100	25	75

### Course Outcomes:

1. Discuss the basic knowledge of enzymes, its components and their functional properties.
2. Exposure of wide applications of enzymes and their future potential.
3. Technical know-how on versatile techniques in recombinant DNA technology.
4. Describe the mechanism of action and the use of restriction enzymes in biotechnology research
5. Proficiency in designing and conducting experiments involving genetic manipulation.

1. Extraction and estimation of enzymes (peroxidase and catalases) from either plant or microbial source
2. Determination of effect of pH on the activity of enzyme.
3. Determination of effect of temperature on the activity of enzyme.
4. Determination of effect of substrate concentration on the activity of enzyme.
5. Determination of effect of enzyme concentration on the activity of enzyme.
6. Isolation and Quantification of genomic DNA from bacteria.
7. Isolation and Quantification of plasmid DNA from bacteria.
8. Agarose gel electrophoresis.
9. Restriction digestion and ligation.
10. Preparation of *E.coli* competent cells and Transformation.
11. SDS– PAGE/Native PAGE.
12. Western blot – Demonstration.
13. Polymerase chain reaction (PCR).

### Text Books:

- T.B.1. James G. Cappuccino and Natalie Sherman. Microbiology: A laboratory Manual. 10th Edition, Benjamin Cummings. 2013.
- T.B.2. J. Sambrook and D.W. Russel, Molecular Cloning: A Laboratory Manual, Vols (1-3), CSHL, 2001.

### Book for Reference:

1. Hans Bisswanger, Practical Enzymology, Second Edition, Wiley-VCH Verlag GmbH & Co.2012.

### Web Reference:

1. <https://www.kau.edu.sa/Files/0016333/Subjects/Enzymology%20BIOC231.pdf>.
2. <https://www.youtube.com/watch?v=S-6177IEUMo>.

### Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code	Title of the Paper					Hours	Credits				
II	20PBT2CC8P	ENZYMOLOGY AND ENZYME TECHNOLOGY, MOLECULAR BIOLOGY AND GENETIC ENGINEERING & RECOMBINANT DNA TECHNOLOGY – PRACTICAL					6	4				
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓	✓	✓	✓	✓			✓	✓	✓		
CO2	✓	✓		✓				✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓	✓	✓		
CO4	✓	✓	✓			✓	✓	✓	✓	✓		
CO5	✓	✓		✓	✓	✓	✓		✓	✓		
Number of Matches = 36, Relationship : High												

### Prepared by:

1.H.F.SeyedMafiyaHaniff

### Checked by:

1.Dr.A.Nishanthini  
2.Dr.A.KhaleelAhamed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBT2DE2A	DSE - II	GENOMICS AND PROTEOMICS	6	4	100	25	75

### Course Outcomes:

1. Understand the advanced level of genomes and their expressions from structure to functional level.
2. Explain the principle of genome through the process of plant and animal technology and computational analysis.
3. Develop skill proteomics and the different approaches to analyses the proteomics.
4. Determine the different concepts of microarray and their analysis.
5. Assess the pharmacogenomics and Pharmacogenetics, drug design.

### UNIT- I Genome Structure:

**18 hours**

Genome sizes- microbial and organelle genomes - Centromeres and telomeres, tandem repeats- dispersed repeats (transposons). Basic Sanger sequencing - automated sequencing- sequencing simple genomes - Sequencing large genomes - finalizing sequences – resequencing and Next generation sequencing (NGS).

### UNIT- II Microarray:

**18 hours**

DNA Micro array, Protein Micro array Transcriptomics, Applications and advantages of Micro arrays- DNA chips and SAGE technology- Organization of genome projects- human, plant, animal and microbial genome. Microarray-design- analysis visualization of data-Tools for microarray analysis- MADAM-Gene. Applications of Microarrays.

### UNIT- III Human Genome:

**18 hours**

Characteristics of human-genome sequence important genes associated with each chromosome - Mendelian and sex-linked traits in human inheritance. Genetic diseases due to defects in autosomal and sex linked genes. Whole genome sequencing – Human Genome Project.

### UNIT- IV Proteomics:

**18 hours**

Identifying proteins in complex mixtures: Protein profiling, quantitative 2D GE, multidimensional chromatography, quantitative mass spectrometry, MALDI – TOF, TOF analysis and analytical protein chips. Protein structure databanks- protein databank.

### UNIT- V Pharmacogenomics and New Drug Design:

**18 hours**

Introduction to drug design and developing new drugs: Procedure followed in drug design; Molecular modification of lead compounds; Prodrug and soft drugs; Physico-chemical parameters in drug design; # QSAR. Protein-protein interaction.

#-----# Self-study portion

### Text Books:

- T.B.1.** Nacia Grant Cooper; (Ed.). The Human Genome Project; Deciphering the blueprint of heredity University Science books, CA, USA.1994.
- T.B.2.** Gary Zweiger. Transducing the Genome; Information, Anarchy and Revolution in Biomedical Sciences. Tata McGraw-Hill Publishers, New Delhi.2003.
- T.B.3.** C.Branden, and J.Troze. Introduction to Protein Structure. Second Edition. Garland Publishing, New Delhi.1999.
- T.B.4.** W.E. Evans and M.V. Relling. Pharmacogenomics: translating functional genomics into rational therapeutics. *Science* 286:487.1999.

### Books for References:

1. A.D.Baxevanis, and B.F.F. Ouellette. Eds. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley Interscience. New York.2001.
2. D Higgins, and W.Taylor (Eds). Bioinformatics: Sequence, Structure and Databnks. Oxford University Press, Oxford.2000.

**Web Reference:**1. [https://www.kau.edu.sa/Files/0016333/Subjects/Genomics and proteomics%20BIOC231.pdf](https://www.kau.edu.sa/Files/0016333/Subjects/Genomics%20and%20proteomics%20BIOC231.pdf).2. <https://www.youtube.com/watch?v=S-6177IEUMo>**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
II	20PBT2DE2A	GENOMICS AND PROTEOMICS					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓		✓	✓	✓	
CO3	✓	✓	✓	✓		✓		✓	✓	✓	
CO4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Number of Matches = 43, Relationship : High											

**Prepared by:**

1. Mr.K.Gobalan

**Checked by:**1. Dr.B.Nazeema Banu  
2. Dr. A. Khaleel Ahmed

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBT2DE2B	DSE - II	BIOPHARMACEUTICALS IN NANOMEDICINE	6	4	100	25	75

**Course outcome:**

1. Provide a comprehensive introduction to biopharmaceuticals in nanomedicine
2. Gain an understanding of producing novel nano biologics and Nanopharmaceuticals
3. Categorize and explain the role of Regenerative medicine and tissue engineering
4. Develop their understanding of biological therapies.
5. Expand their knowledge on Ethical, Safety and regulatory issues of Nanomedicine

**UNIT I Pharmaceuticals, Biologics and Biopharmaceuticals: 18 hours**

Pharmaceutical products, biopharmaceuticals and pharmaceutical Biotechnology, history of pharmaceutical industry, the age of Biopharmaceuticals, Biopharmaceuticals: current status and future prospects, traditional pharmaceuticals of biological origin, distinction between chemical drugs versus biopharmaceuticals, #sources and delivery of biopharmaceuticals#.

**UNIT II Nanopharmaceuticals: 18 hours**

Nanobiotechnology for drug discovery - gold nanoparticles and nanolasers for drug discovery. Nanobiotechnology based drug development – Dendrimers as drugs, fullerenes as drug candidates and nanobodies. Nanobiotechnology and drug delivery devices - coating of implants by ultrafine layers of polymers, #nanochips for drug delivery#.

**UNIT III Regenerative medicine and tissue engineering: 18 hours**

Targeted drug delivery, Nanobiotechnology in tissue engineering - three dimensional nanofilament based scaffolds. Nanobiotechnology for organ replacement and assisted function - Exosomes for drug free organ transplants, Nanotechnology based human nephron filter for renal failure and #Blood-compatible membranes for renal dialysis#.

**UNIT IV 18 Hours**

**Role of Nanotechnology in biological therapies** – Nanobiotechnology for vaccine delivery, nanobiotechnology and cell transplantation, nanobiotechnology in stem cell based therapies, Nanoparticle mediated gene therapy and nanorod gene therapy, nanocarriers for simultaneous delivery of anticancer drugs, #dendrimers for antisense drug delivery#.

**UNIT V Ethical, Safety and regulatory issues of Nanomedicine: 18 hours**

Ethical, legal and social implications of Nanomedicine (Nanoethics), safety concerns about nanobiotechnology – toxicity of Nanoparticles, fate of Nanoparticle in the human body, measures to reduce toxicity of Nanoparticles, #public perception of safety and future potentials of Nanomedicine#.

**# Self-study Portion**

**Text Books:**

- T.B.1. Gary Walsh. Biopharmaceuticals – Biochemistry & Biotechnology. 2<sup>nd</sup> Edition, John Wiley & Sons. 2003.  
T.B.2. Kewal K. Jain. The Handbook of Nanomedicine. 3<sup>rd</sup> edition, Humana Press, 2008.

Unit I: Chapter 1, Page no: 1-40. T.B.1.

Unit II: Page no: 119-160. T.B.2

Unit III: Page no: 303-327. T.B.2

Unit IV: Page no: 161-181. T.B.2

Unit V: Page no: 329-352. T.B.2

**Books for References:**

1. Christof M. Niemeyand Chad A. Mirkin, Nanobiotechnology: Concepts, Applications and Perspectives. 1st edition. Wiley-VCH. 2004.

**Web reference:**

1. <https://elearninguoa.org/course/health-nanotechnology-nanomedicine/nanotechnology-and-nanomedicine>
2. [www.sintef.no/en/biopharmaceuticals-medical](http://www.sintef.no/en/biopharmaceuticals-medical)
3. [www.edx.org/learn/nanotechnology](http://www.edx.org/learn/nanotechnology)

**Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:**

Semester	Code	Title of the Paper					Hours	Credits			
II	20PBT2DE2B	BIOPHARMACEUTICALS IN NANOMEDICINE					6	4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓				✓	✓	✓	
CO2	✓	✓	✓	✓			✓	✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓				✓	✓	✓	
CO5	✓	✓	✓	✓	✓			✓	✓	✓	
Number of Matches = 39, Relationship : High											

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