M.Sc Biotechnology

Core Course - 1

BIOCHEMISTRY

SEMESTER – I	
Title of The Course: BIOCHEMISTRY	**Category of The Course:** CORE COURSE
Course Code: P1R3BTCC1	**Nature of The Skill :** Skill Development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week :** 7
Credits : 5	**Total Inst. Hrs : 105**

Course Objectives:

1. The paper imparts a thorough knowledge on the basics of all the Biochemical concepts,
2. The students will understand the metabolic reactions and its regulation.
3. To understand the core concepts of metabolism
4. To teach the basics about the physiological processes of the body
5. The Students get idea about healthy and disease state.

SYLLABUS | Core Course-1 | BIOCHEMISTRY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	pH, pK . acid, base .Buffers- Henderson- Haselbach equation, biological buffer system –Phosphate buffer system, protein buffer system, bicarbonate buffer system, amino acid buffer system and Hb buffer system. Water, Carbohydrates: Nomenclature, classification, structure,chemical and physical properties of carbohydrates. Metabolisms: glycogenesis, glycogenolysis, gluconeogenesis, pentose phosphate pathway	20	CO1	K1&k2
II	Lipids: Nomenclature, classification, structure, chemical and physical properties of fatty acids. Metabolisms: biosynthesis of fatty acids, triglycerols, phospholipids, glycol lipids. Cholesterol biosynthesis, bile acids and salt formation. Eicosanoids, sphingolipids and steroid hormones.	15	CO2	K1,K2 & K3

III	Bioenergetics – Concept of energy, Principle of thermodynamics, Relationship between standard free energy and Equilibrium constant, ATP ads universal unit of free energy in Biological systems. Biological oxidation: Electron transport chain, oxidative phosphorylation, glycolysis, citric acid cycle, cori.s cycle, glyoxalate pathway. Oxidation of fatty acids- mitochondrial and peroxisomal ß-oxidation, alpha and beta oxidation, oxidation of unsaturated and odd chain fatty acids, ketone bodies. Photosynthesis, urea cycle, hormonal regulation of fatty acids and carbohydrates metabolisms, Mineral metabolism	30	CO3	K1,K2 & K3
IV	Amino acids and Protein: Nomenclature, Classification, structure, chemical and physical properties of amino acids and proteins. Metabolisms: Biosynthesis of amino acids. Degradation of proteins, nitrogen metabolisms and carbon skeleton of amino acids. Over all in born error metabolisms	20	CO4	K1,K2 & K3
V	Nucleic acids: Nomenclature, Classification, structure, chemical and physical properties of purine and pyrimidines. In de novo and salvage synthesis of purines, pyrimidine bases, nucleosides and nucleotides. Catabolisms of purines and pyrimidines bases. Synthetic analogues of nitrogenous bases	20	CO5	K1,K2 & K3
Total Hours		**105**		

Reference books:

- Philip Kuchel, Simon Easterbrook-Smith, Vanessa Gysbers, Jacqui M. Matthews, 2011. Schaum.s Outline of Biochemistry, Third Edition (Schaum.s Outline Series), McGraw-Hill.
- Sathyanarayana.U and U.Chakrapani., 2011. Biochemistry. Books and Allied private limited, Kolkata.
- Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, 2010. Biochemistry, Seventh Edition, W. H. Freeman.
- Albert Lehninger, David L. NelsonVoet Donald, Judith G.Voet and Charlotte W.Pratt., 2008. Principles of Biochemistry. John Wiley and sons, Inc., New Jersey.

- Michael M. Cox, 2008. Lehninger Principles of Biochemistry, Fifth Edition, W. H. Freeman publishers.

Useful web sites:

- mcdb-webarchive.mcdb.ucsb.edu/.../biochemistry/.../website-tourf.htm
- www.biochemweb.org/
- http://golgi.harvard.edu/biopages.html

webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-

BIOCHEMISTRY		**Course Code: P1R3BTCC1**
S.No	**Course Outcomes:**	**Knowledge Level**
At the end of the Course, the Student will be able to:		
CO-1	To understand the basics of pH and related principles and carbohydrate metabolism.	**K1**
CO-2	To provide basic knowledge about lipid metabolism and related significance.	**K2 & K3**
CO-3	To enlighten the students on Bio-energetics and Biological oxidation pathways.	**K4 & K5**
CO-4	To update the knowledge on Amino acids and Protein.	**K2**
CO-5	To assess and appraise the role of Nucleic acids.	**K6**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	S	S	S	M	M	M
CO4	S	S	S	M	M	M	S	S	M	S
CO5	M	M	M	S	M	S	M	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Core Course – 2

MICROBIOLOGY

SEMESTER – I	
Title of The Course: MICROBIOLOGY	**Category of The Course:** CORE COURSE
Course Code: P1R3BTCC2	**Nature of The Skill :** Skill Development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week :** 7
Credits : 5	**Total Inst. Hrs : 105**

Course Objectives:

1. To provide a comprehensive knowledge on taxonomy of microorganisms
2. To understand the various microbial diversity
3. To know the growth of microbes & their harmful effects
4. To get a knowledge of microorganism's beneficial role in agriculture
5. To get an idea about the microbes impact in the environment.

SYLLABUS | Core Course - 2 | MICROBIOLOGY				
Unit	**Content**	**Hours**	**Cos**	**Cognitive level**
I	History and microbial taxonomy: Major discoveries related to the field of microbiology: Antony Von Leeuwenhoek, Louis Pasteur, Robert Koch and Edward Jenner. Microbial taxonomy: Bacteria, viruses, fungi, algae and protozoa, Microbial diversity: Biovars, Serovars and Prions, Microbial growth and metabolism: Microbial growth: Growth curve, factors affecting growth, Microbial metabolism- Methanogenesis, acetogenesis and auxotrophs.	22	CO1 CO2	K1,K2 &K3

II	Microbial culture, identification, and control: Nutritional requirements for growth - Growth media and types, Pure culture techniques: Serial dilution and plating methods, Staining methods - Principles and types of staining (simple and differential), Identification of bacteria – Biochemical – IMViC, 16s rRNA sequencing. Microscopy: principles and applications of Bright field, florescent and Scanning electron microscopes, Microbial growth control: Physical Methods – Heat, Filtration, Low Temperatures, High Pressure, Desiccation, Osmotic Pressure, Radiation; Chemical Methods	25	CO2 CO3 CO5	K2,K3,K5
III	Host microbe interaction and Epidemiology: Human microbiome; Skin, Gastrointestinal tract, Oral cavity, Lung. Symbiotic relationship of microbes: Symbiosis, Mutualism, Parasitism, Commensalism and endophyte. Epidemiology of microbes: causes, types and transmission of epidemic, endemic and pandemic diseases	16	CO1 CO3 CO4	K1,K2,K3
IV	Microbial Diseases: Microbial diseases - General characteristics, pathogenesis, laboratory diagnosis and control measures of Pandemic and Epidemic diseases: Tuberculosis, Leprosy, Cholera, Typhoid, COVID-19, Yellow Fever, Flu, AIDS, Ebola, Zika Virus, Small Pox, Dengue, Chickungunya, Malaria, filariasis, Candidiasis, superficial mycosis	20	CO4 CO5	K4 &K5
V	Agricultural and Environmental Microbiology: Biological nitrogen fixation, free living, symbiotic nitrogen fixation, mechanism of Nitrogen, Biofertilizers- types and applications; Rhizosphere effect. Biogeochemical cycles-Carbon, Nitrogen, Sulphur and Phosphorous; Methanogenic bacteria Extremphiles- Thermophiles Acidophiles, Halophiles and alkalophiles; Biotechnological application of extremophiles	22	CO1 CO2 CO3	K4 & K5
Total Hours		**105**		

References

- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, (2017). Prescott's Microbiology, (10th edition), McGraw-Hill Education, ISBN: 978-1259281594.
- Maheshwari D K, Dubey R C 2013. A Textbook of Microbiology.4th Edn S Chand Publishing India.
- Ananthanarayan and Paniker's (2017) Textbook of Microbiology, (10th edition), The Orient Blackswan, ISBN: 978-9386235251.
- Benson HJ. (1999). Microbiological Applications: A Laboratory manual in General Microbiology, 7th Edition, McGraw Hill. 5
- Managing epidemics- Key facts about major deadly diseases, World Health Organization (WHO) 2018. 9. O'Flaherty, Vincent & Collins, Gavin & Mahony, Thérèse. (2010). Environmental Microbiology, Second Edition. 10.1002/9780470495117.ch11.
- Agriculture Microbiology, 2016. E-Course Developed By TNAU (ICAR)

Web Sources

- https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdf ISBN 978-92-4-156553-0. https://doi.org/10.3389/fmicb.2020.631736

https://www.agrimoon.com/wp-content/uploads/AGRICULTURAL-Microbiology.pdf.

MICROBIOLOGY		**Course Code:** P1R3BTCC2
S.No	**Course Outcomes:**	**Knowledge Level**
At the end of the Course, the Student will be able to:		
CO-1	To understand the major discoveries of microbiology and describe microbial diversity, Microbial growth and metabolism.	**K1**
CO-2	To provide basic knowledge about microbial culture, identification of microbes, principle and working of microscopes and sterilization techniques	**K2**
CO-3	To enlighten the students on host microbe interaction and Epidemiology of microbial disease	**K4**
CO-4	To update the knowledge on epidemic and pandemic diseases.	**K5**
CO-5	To assess and appraise the role of novel microbes in environment and integrate them in specific innovative approaches.	**K6**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	M	S	S	M	M	M
CO4	S	M	S	M	M	S	S	S	M	S
CO5	M	M	M	S	M	S	M	M	S	M

PO – Programme Outcome, CO – Course outcome S – Strong, M – Medium, L – Low (may be avoided)

Core Course - 3

PRACTICAL -I

(Biochemistry & Microbiology)

SEMESTER – I	
Title of The Course: PRACTICAL - I (Biochemistry, Microbiology)	**Category of The Course:** CORE COURSE
Course Code: P1R3BTCC3P	**Nature of The Skill :** Employability
Marks : CIA : 40 + Ext: 60 = 100	**Hrs / Week : 6**
Credits : 4	**Total Inst. Hrs : 90**

Course Objectives:

1. The practical will establish a basic study skills of Microbes.
2. To improve the student's ability to calculate the cell's count
3. To get an idea about the basic biochemistry analysis.
4. To get an knowledge about the isolation strategy of micro organisms.
5. To improve the micro organisms handling skill

SYLLABUS | Core Paper -3 | PRACTICAL - I				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
	(A) Biochemistry – Practical 1. Basic calculations in Biochemistry - Normality, Molarity, Molality percent solutions (v/v, w/v). 2. Calibration of pH meter 3. Transition interval of commonly used pH indicators 4. Preparation of biological buffer - phosphate buffer 5a. Extraction of Proteins from biological materials 5b Protein separation methods:-Ammonium sulphate Precipitation, 5c. Membrane Dialysis, 5d. SDS PAGE 6. Urea -SDS PAGE for separation of low molecular weight proteins 7. Estimation of Proteins by Lowry's method	50	CO1 CO2 CO3 CO4 CO5	K3 & K4

	8. Estimation of Proteins by Biuret method 9. Estimation of Proteins by Bradford method 10. Estimation of RNA by orcinol method 11. Estimation of DNA by diphenylamine method 12. Estimation of Carbohydrate by Anthrone method 13 Purity check of DNA & RNA by UV Spectrophotometry - A260/280 14. Separation of amino acids by Paper Chromatography 15. Separation of sugars by Paper Chromatography 16. Separation of amino acids by Thin layer chromatography 17. Separation of sugars by Thin layer chromatography 18. Thermal Denaturation of DNA and UV absorption studies **Demo Experiments** 1. Gel permeation chromatography, 2. Affinity chromatography, 3. Ion.exchange chromatography 4. Western blotting 5. PCR			
	(B) Microbiology -Practicals 1. Sterilization of glassware using dry heat- hot air oven 2. Sterilization of media using moist heat - autoclave 3. Filter sterilization 4. Liquid media preparation- nutrient broth 5. Solid media preparation- SDA plates 6. Preparation of Agar slants 7. Streak plate method 8. Pour plate method 9. Spread plate method 10. Enumeration of total count of the bacteria	40	CO1 CO2 CO3 CO4 CO5	K1, K2, K3, K4, K5 & K6

	11. Isolation of microbes from soil 12. Isolation of microbes from water 13. Isolation of microbes from air 14. Isolation of microbes from plant surface. 15. Isolation of pure culture of *E.coli,* 16. Isolation of pure culture of *Aspergillus niger,* 17. Isolation of pure culture of *Streptomyces*. 18. Gram staining and morphological characterization of microbes. 19. Negative staining of bacteria 20. Determination of growth curve of bacteria – *E.coli* 21. IMViC test of enteric bacteria **Demonstration** 16srRNA sequencing			

Reference

1. Introduction to Practical Biochemistry, E.F Plummer Mu, Plummer Tata McGraw-HillEducation,1998.
2. Principles and techniques of biochemistry and molecular biology (7^{th} ed). keithWilson(editor),john walker (editor),Cambridge universitypress,2010.
3. Microbiology- A Laboratory manual P. Gunasekaran . New age publications, New delhi,1995.
4. Laboratory exercise of Microbiology, J.P. Harley and L.M. Prescott, 5^{th} Edition, the McGraw-Hill companies,2002.
5. Microbiology: A Laboratory Manual, J.G. Cappuccino and N. Sherman, Addison-Wesley,2002.
6. Laboratory Manual of Experimental Microbiology ,R.M.Atlas, A.E.Brown and L.C.Parks, 1995. Mosby,St.Louis,2002.
7. Laboratory manual in General Microbiology, N.Kannan, Panimapublishers.
8. Bergey"s Manual of Determinative Bacteriology. Ninth Edition J.G.Holt, N.R.Krieg.,Lippincott Williams, Wilkin publishers, 2000.

PRACTICAL -I (Biochemistry and Microbiology)		Course Code: P1R3BTCC3P
S. No	**Course outcomes**	**Knowledge Level**
On successful completion of the course the students will be able to		
CO 1	Illustrate the basic biochemistry procedures	**K1**
CO 2	Study the methods of estimation of biomolecules	**K2**
CO 3	Isolate and identify microbes from various sources	**K3**
CO 4	Critically analyze the isolated biomolecules	**K5**
CO 5	Characterize microbes	**K6**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, = 3, M – Medium, L – Low (may be avoided)

Discipline Specific Elective -1:1

BIOINSTRUMENTATION

SEMESTER – I	
Title of The Course: BIOINSTRUMENTATION	**Category of The Course:** DISCIPLINE SPECIFIC ELECTIVE COURSE
Course Code: P1R3BTDSE1:1	**Nature of The Skill :** Employability
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 5**
Credits : 3	**Total Inst. Hrs : 75**

Course Objectives:

1. To get an idea about the basic instruments in the laboratory
2. To understand about the cell culture separation techniques
3. To get an knowledge of chromatographic techniques
4. To improve their skill in handling microscopes
5. To observe the basic concepts of radioisotopes.

SYLLABUS | Discipline Specific Elective 1:1 | BIOINSTRUMENTATION				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Microscopic Techniques: Principles and Applications: Compound, Light, Stereo, Phase Contrast, Fluorescent Microscopy, Scanning and Transmission Electron Microscopy, Scanning Electron Microscopy, Atomic Force Microscopy, Confocal Microscopy, FRET and Flow Cytometry.	14	CO1	K1 & K2
II	Centrifugation: pH meter, Principle and Applications of various types of centrifugation, Sedimentation Coefficient, Svedberg unit, RCF, Density Gradient Centrifugation. Chromatography Techniques: Principle and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GC & HPLC.	16	CO2	K1, K2,K3

III	Electrophoretic Techniques: Principle and Application of Agarose Gel Electrophoresis, 2D-gel Electrophoresis, PAGE- NATIVE & SDS PAGE, Iso-electric Focusing, High resolution Electrophoresis, Immuno Electrophoresis (Immunofixation EP,), ELISA, RIA, Southern, Northern and Western Blotting. Electro blotting, PCR and RT-PCR, Microarray (DNA, Proteins)	17	CO3	K1, K2 & K3
IV	Spectroscopic Techniques: Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, Mass Spectroscopy, IR Spectroscopy NMR, ESR, Atomic Absorption Spectroscopy, X- ray Spectroscopy, Laser Spectroscopy and Raman Spectroscopy	15	CO4	K1,K2 & K3
V	Radio-isotopic Techniques: Introduction to Radioisotopes, Uses and their Biological Applications, Radioactive Decay – Types and Measurement , Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, Autoradiography, RIA, Radiation Dosimetry, Health effects of Radiations.	13	CO5	K1,K2 & K3
Total Hours		**75**		

Reference books

- M.H. Fulekar and Bhawana Pandey Bioinstrumentation, Wiley
- Keith Wilson, John Walker, 2010. Principles and Techniques of Biochemistry and Molecular Biology (7th Edition), Cambridge University Press •
- David L. Nelson, Michael M. Cox. Menninger (2008). Principles of Biochemistry, Fifth edition W. H. Freeman, New York. •
- Experiments in Biochemistry: A Hands-On Approach by Shawn O. Farrell, Ryan T. Ranallo, Paperback: 324 pages, Publisher: Brooks Cole. 20 •
- Metzler D.E. 2001, the chemical reactions of living cells –Academic Press. 2nd edition.
- Stryer L,1999, Biochemistry-W.H. Freeman & Company, New York. 1. • 4th edition
- L.Veerakumari (2006) Bioinstrumentation MJP Publisher Kindle edition

- Jefrey. M., Backer el al., 1996. Biotechnology- A Laboratory Course. Academic Press, New York.
- Holcapek, M., Byrdwell, Wm. C. 2017. Handbook of Advanced Chromatography /Mass Spectrometry Techniques, Elsevier

BIOINSTRUMENTATION		**Course Code: P1R3BTDSE1:1**
S.No	**Course Outcomes**	**Knowledge Level**
At the end of the Course, the Students will be able to		
CO-1	Know the various types of Microscopic techniques	**K2**
CO-2	Impart understanding on centrifugal instruments and techniques	**K3**
CO -3	Separation of Biomolecules	**K4**
CO -4	Analytical methods on Spectroscopic Analysis	**K5**
CO -5	Understand the application and Detection on Bioinstrumentation	**K6**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	S	S	S	M	M	M
CO4	S	S	S	M	M	M	S	S	M	S
CO5	M	M	M	S	M	S	M	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Discipline Specific Elective - 1:2

Cell Signaling

SEMESTER – I	
Title of The Course: CELL SIGNALING	**Category of The Course:** DISCIPLINE SPECIFIC ELECTIVE COURSE
Course Code: P1R3BTDSE1:2	**Nature of The Skill :** Skill Development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 5**
Credits : 3	**Total Inst. Hrs : 75**

Course Objectives:

1. To give a thorough knowledge on the basics of all the cell to cell contacts
2. To know about the cellular receptors and their importance.
3. The student will get an idea about host & parasite communication.
4. To understand the core concepts of cell signaling
5. To get a detailed knowledge in the mechanism of cell signaling.

SYLLABUS | Discipline Specific Elective 1:2 | CELL SIGNALING				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Extra Cellular Matrix (ECM) and Cell Surface: Molecules in the ECM in plant and animals. Transport across cell membrane, Ficks Law. Types of transport - simple, passive, facilitated. Active transport, primary and secondary active transport system. Ionophores, gated channels (Voltage and Ligand). Cell communication and type of signaling molecules.	15	CO1	K1 & K2
II	Cell signaling: Various types cell signaling. Cell signaling molecules: Hormones and growth factors, neurotransmitters, peptide hormones, steroid hormones, eicosanoids, vitamins and gases. Cell signaling: Cell signaling in neurons - Cell signaling in immune system. Cross talk between signaling pathways. Signal transduction pathways, regulation of	17	CO2	K1, K2,K3

II	signaling pathways. Plant signaling system an over view, Stress signaling in plants (biotic), Stress signaling in plants (abiotic). Plant hormones and their mechanism of action.			
III	Types of receptors and their structure. GPCR, inhibitory and stimulatory and type of wn-stream effectors and signal termination. Monomeric G-proteins their role. Drugs targeting signaling molecules Concept of transducers, effectors, GTP binding proteins - Gi, Gs, Gp, Gq, ras; adenylate cyclase, guanylate cyclase, phosphodiesterases, Protein kinase (PK) (PKs associated with cell survival and death processes)	16	CO3	K1, K2 & K3
IV	Cancer Cell Communication : Discovery of oncogenes, proto-oncogenes. Modes of action of oncogenes – G proteins – Ras. Growth factors – Erb, Sis. Transcription factors – Fos, Jun, AP1, V-erbA. Discovery of tumor suppressor genes. RB and retinoblastoma, APC and colon cancer. Modes of action of TS genes – p110, p16, p21, Phosphatase and tensin homolog (pTEN). p53 and cancer risk. Selected examples – c-Myc and leukemia. BRCA and breast cancer.	15	CO4	K1,K2 & K3
V	**Host parasite interaction** Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells. Signaling in yeast: STAT pathway in yeast	12	CO5	K1,K2 & K3
Total Hours		**75**		

TEXT BOOKS

1. Michel Friedman and Brett Friedman. 2004. Cell communication: Understanding how information is stored and used in cells. Ingram International Inc.

2. John T Hancock. 2005. Cell signaling. Oxford University press.

REFERENCE BOOKS

1. Geoffery M Cooper and Robert E Hausman. 2009. The Cell and Molecular Approach. (Ed: 5). ASM Press and Sinauer Associates Inc.

2. Gomperts, Basten D, Ijbrand M Kramer and Peter ER Tatham. 2009. Signal transduction. (Ed:2). Academic Press.

3. Ernst JM Helmreich. 2001. The Biochemistry of cell signaling. Oxford Universiy Press.35

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NET REFERENCES

- http://www.landesbioscience.com/journals/BioArchitecture/about/
- *http://expmed.bwh.harvard.edu/main/labs.html*
- *http://www.unc.edu/depts/salmlab/mafia/mafia.html*

CELL SIGNALING		**Course Code: P1R3BTDSE1:2**
S.No	**Course outcomes**	**Knowledge Level**
At the end of the Course, the Student will be able to		
CO-1	To impart basic knowledge about cells & their matrix Systems	**K1**
CO-2	To understand the importance of proteins in signaling	**K2**
CO-3	To be effective in hormones and growth factors in signaling system of plants & animals	**K2**
CO-4	To acquire knowledge on cancer cell communication & their genes.	**K3**
CO-5	To gain the knowledge of interaction between host and parasites.	**K4**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	S	S	S	M	M	M
CO4	S	S	S	M	M	M	S	S	M	S
CO5	M	M	M	S	M	S	M	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Discipline Specific Elective - 2:1

ENZYMOLOGY

SEMESTER – I	
Title of The Course: ENZYMOLOGY	**Category of The Course:** DISCIPLINE SPECIFIC ELECTIVE COURSE
Course Code: P1R3BTDSE2:1	**Nature of The Skill :** Skill development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 5**
Credits : 3	**Total Inst. Hrs : 75**

Course Objectives:

1. The subject imparts knowledge on the fundamentals of enzyme structure and its kinetics
2. To obtain a basic knowledge about the proximity of enzymes
3. The students will understand about the functions of enzymes
4. The students get an idea about the co-enzymes in detail.
5. To impart knowledge on industrial application of enzymes

SYLLABUS | Discipline Specific Elective 2:1 | ENZYMOLOGY				
Unit	**Content**	**Hours**	**Cos**	**Cognitive level**
I	Introduction to enzymes, Classification, nomenclature and general properties like effects of pH, substrate and temperature on enzyme catalysed reactions. Extraction Isolation and purification of enzymes by precipitation, centrifugation, chromatography and electrophoresis and liquid-liquid extraction methods	14	CO1 & CO5	K3 & K5
II	Kinetics of catalysed reaction : Single substrate reactions, bisubstrate reactions, concept of Michaelis - Menten, Briggs Haldane relationship, Determination and significance of kinetic constants, Limitations of Michaelis-Menten Kinetics, line weaver burk plot, Hanes wolf equation, Eadie hoofstee equation ,Inhibition of enzyme activity	15	CO1 CO2 CO5	K3 & K5

III	Enzyme catalysis: enzyme specificity and the concept of active site, determination of active site. Stereospecificity of enzymes. Mechanism of catalysis: Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis	16	CO1 CO3	K3 & K4
IV	Theories on mechanism of catalysis.-Mechanism of enzymes action: mechanism of action of lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Multienzymes system, Mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex	13	CO1 CO4	K3, K4 & K6
V	Coenzyme action. Enzyme regulation: General mechanisms of enzyme regulation, Allosteric enzymes, sigmoidal kinetics and their physiological significance, Symmetric and sequential modes for action of allosteric enzymes. Reversible and irreversible covalent modification of enzymes, Immobilized enzymes and their industrial applications.Clinical and industrial applications of enzymes, Enzyme Engineering	17	CO1 CO5	K3,K4, K5 & K6
Total Hours		**75**		

Reference Books

- Nicholas C.Price and Lewis Stevens., 2010. Fundamentals of Enzymology. Oxford University Press, New Delhi
- Lehninger, Nelson and Cox, 2005, Principles of Biochemistry - 4th edition, WH Freeman and Company, New York, USA
- Principles of Biochemistry with human focus - Garrett and Grisham, 2002, Harcourt College Publishers, Orlando, Florida, USA.
- Geoffrey L, Zubay, Biochemistry -, 1998, 4th edition. 23
- Donald Voet, Judith Voet and Pratt, 1995, Fundamentals of Biochemistry, 2nd edition.

- Harper.s Biochemistry - Murray et al, 2000, 25th edition, Appleton and Lange Publishers.
- Enzymes – Trevor Palmer 2002.

Useful Websites

- www.lsbu.ac.uk/biology/enztech/
- www. lsbu.ac.uk/biology/enzyme/

http://www.aetlted.com/tech/applications.html

Course outcomes:

ENZYMOLOGY		**Course Code:** P1R3BTDSE2:1
S.No	**Course outcomes**	**Knowledge Level**
At the end of the Course, the Student will be able to		
CO-1	Explain the basics of enzyme nomenclature and properties	**K1 & K2**
CO-2	Classify and Recognize the native and immobilized enzyme	**K4**
CO-3	Examine the equations of steady state kinetics	**K5**
CO-4	Assess extraction and downstream processing of enzymes	**K6**
CO-5	Compile the uses of enzymes and design enzymes for Industrial and Clinical application	**K6**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	M	S	S	S
CO2	M	M	M	S	S	M	S	S	M	M
CO3	M	M	M	S	S	S	S	M	M	M
CO4	S	S	S	M	M	M	S	S	M	S
CO5	M	M	M	S	M	S	M	M	S	S

PO – Programme Outcome, CO – Course outcome, S – Strong, M – Medium, L – Low

Discipline Specific Elective - 2:2

DIAGNOSTIC BIOTECHNOLOGY

SEMESTER – I	
Title of The Course: DIAGNOSTIC BIOTECHNOLOGY	**Category of The Course:** DISCIPLINE SPECIFIC ELECTIVE COURSE
Course Code: P1R3BTDSE2:2	**Nature of The Skill :** Employability
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 5**
Credits : 3	**Total Inst. Hrs : 75**

Course Objectives:

- The subject will understand the concept of chemical usage and its first aid practices.
- To imparts knowledge on the fundamentals of Clinical Laboratory and its importance
- The student will be provided with a basic knowledge of Anatomy
- The student will get an knowledge about the hematopoietic system of human body.
- To understand about the functions of human body

SYLLABUS | Discipline Specific Elective 2:2 | DIAGNOSTIC BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**Cos**	**Cognitive level**
I	Introduction-Organization of Clinical laboratory-basic needs, functional components – Basic laboratory safety, Carcinogens, Chemicals and radioactive substances, Corrosive chemicals, Explosive chemicals, Firefighting equipment, First aid in laboratory accidents, Flammable chemicals-First Aid in laboratory accidents.	15	CO1 CO5	K3 & K5
II	Introduction to Body organs and system, Physiology of Organs and system-Cardiovascular system, Respiratory system, excretory system. Units of measurement: The Metric system Preparation of reagent Solutions (Molar, Percentage)-Laboratory calculations.	13	CO1 CO2 CO5	K3 & K5

III	Introduction- Components of Blood and their functions-Human Blood group systems - Rh Blood group-Collection of Blood-transportation of Blood-storage of Blood-Haematopoietic system of the body-Determination of Haemoglobin concentration. Clinical haematology, Anticoagulants, Blood cell counts, Blood film examination.	14	CO1 CO3	K3 & K4
IV	Microbiology: Laboratory Identification of infectious bacterial agents-Mycotic infections. Human parasites. Media used for culturing of Pathogens-Pathological features of Salomonella typhi, Vibrio cholerae and Mycobacterium tuberculosis. Emerging viruses and diseases.	15	CO1 CO4	K3, K4 & K6
V	Urine analysis-Abnormal porphyrin metabolism, Blood in urine, Calcium in urine, Casts in urine, Chemical examination of urine, Semen analysis-Semen examination, Evaluation of infertility, Expensive examination of the female, Pregnancy test-Advantages of serum testing, Dipstick ICT pregnancy test, ELISA pregnancy test, ICT techniques for urine, Interpretation of test results, Material provided with the kit, Performance characteristics, Slide test for pregnancy.	18	CO1 CO5	K3,K4, K5 & K6
Total Hours		**75**		

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1. Kanai L.Mukherjee Medical laboratory technology vol I,II,and III
2. Basic and Practical Microbiology-Ronald M. Atlas, Mac.Milleen Company, New york.
3. Harper's illustrated biochemistry, David A. Bender et al., Mc Graw Hill, 27th edition 2006, New Delhi.

Course outcomes:

DIAGNOSTIC BIOTECHNOLOGY		Course Code: P1R3BTDSE2:2
S.No	**Course outcomes**	**Knowledge Level**
At the end of the Course, the Student will be able to		
CO-1	To understand the basic principles and procedure followed in medical laboratory	**K1**
CO-2	To develop a skill in that field for initiating the laboratory	**K3**
CO-3	To understand the principles of hematology	**K2**
CO-4	To get knowledge about clinical microbiology	**K4**
CO-5	To know the detail knowledge about clinical diagnosis	**K5**

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	M	S	S	S	S	M	S	M
CO3	S	S	S	S	S	M	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

PO – Programme Outcome, CO – Course outcome S – Strong, = 3, M – Medium, L – Low (may be avoided)

M. Sc Biotechnology

Core Course - 4 MOLECULAR GENETICS

SEMESTER – II	
Title of The Course: MOLECULAR GENETICS	**Category of The Course:** CORE COURSE
Course Code: P2R3BTCC4	**Nature of The Skill :** Skill Development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 6**
Credits : 5	**Total Inst. Hrs : 90**

COURSE OBJECTIVES

- To know the fundamental aspects of human heredity.
- To make them understand the factors which influence the inheritance
- To make them familiar with the tools available to test the inheritance of congenital diseases and gene therapy.
- To play a key role in the diagnosis, prognosis and selection and monitoring of treatment.
- To know the outline of the development steps in sex determination.

SYLLABUS | Core Paper - 4 | MOLECULAR GENETICS				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Genes and chromosomes, Colinearity of Genes and Proteins, Genetic code, Identification of DNA as the genetic material. The complexity of eukaryotic genome (introns, exons, repetitive DNA sequence, gene duplication and pseudogenes). DNA markers - VNTR, STR, microsatellite, SNP and their detection techniques	15	CO1	K1,K2 & K3

II	Replication of DNA, Gene expression and regulation in prokaryotes and eukaryotes. Mutation: Spontaneous and virus induced mutation, Radiation induced mutation. Ionizing radiation, UV radiation. Chromosomal Abnormalities and associated genetic diseases, Techniques in the study of chromosomes and their applications, Recombination – models	15	CO2	K1,K2 &K3
III	DNA Damage and Repair-Internal and external agents causing DNA damages 3.2. DNA damages (Oxidative damages, Depurinations, Depyrimidinations, O6-methylguanines, Cytosine deamination, single and double strand breaks) 3.3. Mechanisms of DNA damage (transition, transversion, frameshift, nonsense mutations) 3.4. Repair mechanisms (Photo reactivation, excision repair, mismatch repair, post replication repair, SOS repair) 3.5. Discovery: Early experiments of McClintock in maize. Insertion sequences in prokaryotes. Complex transposons (ex. Tn3, Tn5, Tn9 and Tn10). Mechanisms, control consequences and application of transposition by simple and complex elements	20	CO3	K1,K2 &K3
IV	Allele frequencies and genotype frequencies, Random mating population, Hardy-Weinberg principle, complications of dominance, special cases of random mating – multiple alleles, different frequencies between sexes (autosomal and X-linked) inbreeding, genetics and evolution, random genetic drift, Karyotyping and usefulness of chromosomes in understanding Genetic variation, Genetics of eukaryotes gene linkage and chromosome mapping.	20	CO4	K1 &K2

V	Extra chromosomal heredity: Biology of Plasmids, their discovery, types and structure of F.RTH. *col* factors and Ti – Replication and partitioning, Incompatibility and copy number control-natural and artificial plasmid transfer and their applications- Human Genome Project, Genomics and Modern methodologies in understanding genome.	20	CO5	K1,K2 & K3

References:

- Principles of Genetics- 8th Edition, Gardner, Simmons and Snustad, 2002.
- The Cell- A Molecular Approach. 3rd Edition. Geoffrey M. Cooper, Robert E. Hausman, 2003.
- Genetics- Kavitha B. Ahluwalia, New Age International Pvt Ltd and Publishers, New Delhi, 2010
- Genetics – P.S Verma and A.K Agarwal (Rack 3, Central Library)
- Robert Brooker.2011. Genetics- Analysis and Principles. 4th edition. McGraw Hill.
- Leland Hartwell,Leroy Hood, Michael Goldberg, Ann Reynolds, Lee Silver,2010.Genetics: From Genes to Genomes, 4th Edition, McGraw Hill.
- Rastogi Smita and Neelam Pathak.,2010. Genetic Engineering, Oxford University Press, New Delhi. (Rack 3, Central Library)
- Watson, Hopkins, Roberts, Steitz, Weiner, 2004. Molecular Biology of Genes, 4th Edition.
- DNA markers Protocols, applications and overviews Anolles G. C. & Gresshoff P. M. Wiley-Liss
- Molecular markers in Plant Genetics and Biotechnology Vienne De. D. Science Publishers
- Genetics of Population Hedrick P.W. Jones & Bartlett 4 Principle of Population Genetics Hartl D. L. and Clark A. G. Sinauer Associates

Course outcomes:

MOLECULAR GENETICS		**Course Code :** P2R3BTCC4
S.No	**Course Outcome**	**Knowledge Level**
Upon completion of course, the students will be able to		
CO-1	To acquire good knowledge about the molecular mechanisms of gene expression and understand the theories behind the organization and functions of genetic material in the living world.	**K1,K2 & K3**
CO -2	Identify and distinguish genetic regulatory mechanisms at different levels and explain the processes behind mutations and other genetic changes and study various chromosomal abnormalities.	**K1,K2 & K3**

CO -3	Make the students understand different range of DNA damage and range of their tools for their detection an.	**K1,K2 & K3**
CO -4	Learn the concepts of the transposons and their applications.	**K1 & K2**
CO -5	Detects the Allele frequencies and genotype frequencies in populations and describe the concepts behind the theory of evolution	**K1,K2 & K3**

Relationship Matrix for CO, PO, PSO

Course Outcome (CO)	**Programme Outcome (PO)**					**Programme Specific Outcome (PSO)**					
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PSO-1**	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**	**Mean**
CO-1	3	2	2	2	2	3	3	2	2	3	2.4
CO-2	2	2	3	1	2	2	2	2	2	2	2
CO-3	2	3	3	2	3	2	3	3	3	3	2.7
CO-4	3	2	3	3	2	2	2	2	2	2	2.3
CO-5	2	2	2	2	3	2	2	3	3	2	2.3
Mean Overall Score											**2.34**
Result											**High**

Core Course - 5

PLANT AND ANIMAL BIOTECHNOLOGY

SEMESTER - II	
Title of The Course: PLANT AND ANIMAL BIOTECHNOLOGY	**Category of The Course:** CORE COURSE
Course Code: P2R3BTCC5	**Nature of The Skill :** Skill Development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 6**
Credits : 5	**Total Inst. Hrs : 90**

COURSE OBJECTIVES

- To study the details of plant cells, organ and tissue culture.
- To learn and gain the knowledge about the plant tissue culture for transgenic plant production
- To educate the theoretical knowledge on secondary metabolite production
- To get knowledge on secondary metabolite production to meet the global competence.
- To understand the principles of Animal cell culture and its applications.
- To understand and develop new technologies using molecular biology, manipulation and cell culture.

SYLLABUS | Core Paper-5 | PLANT AND ANIMAL BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Introduction of plant tissue culture, composition of media, Micropropagation, organogenesis, somatic embryogenesis, haploid and triploid production, protoplast isolation and fusion, hybrid and cybrid, synthetic seed production. Secondary metabolites in plants - Phytochemicals- Glycosides and Flavonoids; Anthocyanins and Coumarins - Lignans, Terpenes, Volatile oils and Saponins; Carotenoids and Alkaloids: biogenesis, therapeutic applications	15	CO1 CO5	K1,K2 &K3

II	Plant Transformation Direct transformation by electroporation and particle gun bombardment. Agrobacterium, Ti plasmid vector. Theory and techniques for the development of new genetic traits, conferring resistance to biotic and abiotic. Plant engineering towards the development of enriched food products, plant growth regulators; Molecular Marker aided breeding: RFLP maps, Linkage analysis, RAPD markers, STS Mirco satellite, SCAR, SSCP, QTL, Map based cloning and Molecular marker assisted selection.	15	CO1 CO2 CO5	K1,K2 & K5
III	Animal health disease diagnosis, hybridoma technique, monoclonal antibodies, application of probes for disease diagnosis of existing and emerging animal diseases. Prophylaxis - Vaccines, Oral vaccines DNA Vaccines in animal disease. Cell culture: primary and established culture; organ culture; tissue culture	20	CO1 CO3 CO5	K4 & K5
IV	Disaggregation of tissue and primary culture; cell separation, Slide and coverslip cultures, flask culture, test tube culture techniques, cell synchronization, cryo preservation. Scaling up of animal cell culture, cell line and cloning micromanipulation and cloning, somatic cell cloning. Karyotyping; measuring parameters for growth, measurement of cell death, apoptosis and its determination, cytotoxicity assays	20	CO4 CO5	K2,K3,K4 & K5

V	Nuclear magnetic resonance methods of monitoring cell metabolism culturing animal cells in fluidised bed reactors. Application of animal cell culture for in vitro testing of drugs, in production of human and animal viral vaccines and pharmaceutical proteins. Culture Scale up and mass production of biologically important compounds. Harvesting of products, purification and assays. Transgenic animals: Production and application; transgenic animals in livestock improvement, transgenic animals as model for human diseases; Stem Cells- Properties, Types, Therapy, Prospects and Ethics in stem cell research.	20	CO5	K3,K4 & K6

Reference Books

- Razdan. M. K., 2011. Plant tissue culture. Oxford and IBH publishing Company Pvt. Ltd, New Delhi.
- Chawla. H. S., 2010. Introduction to plant biotechnology. Oxford and IBH publishing company pvt. Ltd, New delhi.
- Ian Freshney, 2010. Culture of animal cells. 6th edition, Wiley-Blackwell publishers.
- Slater, 2008. Plant Biotechnology: The Genetic manipulation of plants, Second Edition, Oxford University Press, USA.
- J.D.Watson, Gillman, J.Witknowski and M.Zoller, 2006. Recombinant DNA. 3rd ed.
- W.H.Freeman. 26 K. Dass. 2005, Text book of Biotechnology, Second Edition, Wiley Dreamtech, India (P) Ltd.
- H.Kreuzer & A.Massey. 2001. Recombinant DNA and Biotechnology: A guide for teachers Second Edition. ASM press, Washington.
- M.Sudhir. 2000. Applied Biotechnology & Plant Genetics. Dominant publishers & Distributors.
- Genetic Engineering of Animals by (Ed) A.Puhler, VCH Publishers, Weinheim, FRG, 1993.
- Animal Cell culture Practical approach. Ed. John R.W.Masters, Oxford.2004.
- Concepts in Biotechnology D. Balasubramaniam, Bryce, Dharmalingam, Green, Jayaraman Univ. Press, 1996

Course outcomes:

PLANT AND ANIMAL BIOTECHNOLOGY		**Course Code :** P2R3BTCC5
S.No	**Course Outcome**	**Knowledge Level**

Upon completion of course, the students will be able to		
CO-1	To impart theoretical knowledge on various techniques of plant biotechnology like tissue culture, plant genetic transformation and their application in industries.	**K1,K2 & K3**
CO-2	Importance of secondary metabolites and production in plants.	**K1,K2 & K5**
CO-3	To develop concepts, principles and processes in animal biotechnology.	**K4 & K5**
CO-4	Concept and different types in Animal Cell Culture and animal cell lines.	**K2,K3,K4 & K5**
CO-5	Use of molecular biology techniques genetically engineer the animals to improve sustainability, productivity and suitability for pharmaceutical and industrial applications.	**K3,K4 & K6**

Relationship Matrix for CO, PO, PSO

Course Outcome (CO)	**Programme Outcome (PO)**					**Programme Specific Outcome (PSO)**					
	PO-1	**PO2**	**PO-3**	**PO-4**	**PO-5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean**
CO-1	3	2	3	2	2	3	3	2	2	3	2.5
CO-2	2	2	2	1	2	2	3	3	2	3	2.2
CO-3	2	3	2	2	2	2	2	2	3	2	2.2
CO-4	2	2	3	3	2	2	2	2	2	2	2.2
CO-5	2	2	2	2	3	2	2	3	3	2	2.3
Mean Overall Score											**2.28**
Result											**High**

Core Course - 6

PRACTICAL - II (Covering CC4 & CC5)

Molecular Genetics & Plant and Animal Biotechnology

SEMESTER - II	
Title of The Course: PRACTICAL - II **(Molecular Genetics & Plant and Animal Biotechnology)**	**Category of The Course:** CORE COURSE
Course Code: P2R3BTCC6P	**Nature of The Skill :** Employability
Marks : CIA : 40 + Ext: 60 = 100	**Hrs / Week : 6**
Credits : 4	**Total Inst. Hrs : 90**

COURSE OBJECTIVES

- To know the fundamental aspects of human heredity.
- To make them understand the factors which influence the inheritance.
- To understand the basic techniques of plant tissue culture
- To gain knowledge on separation and estimation of secondary metabolites
- To know in outline the development steps in sex determination.

SYLLABUS | Core Paper-6 | PRACTICAL-II				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**

A	**(A) Molecular Genetics - Practical** 1. Isolation of DNA from bacteria 2. Isolation of DNA from plants 3. Isolation of DNA from animal tissue 4. Isolation of DNA from blood 5. Plasmid DNA isolation. 6. Agarose gel electrophoresis of DNA 7. Transfer of DNA from gel – Southern Blotting 8. Isolation of RNA 9. Glyoxal denatured Agarose gel electrophoresis of RNA 10. Formaldehyde denatured Agarose gel electrophoresis of RNA 11. Urea denatured Agarose gel electrophoresis of RNA 12. Transfer of RNA from gel – Northern Blotting 13. Restriction digestion of DNA 14. Radiation induced genetic damage assessment 15. Chemical induced genetic damage assessment. 16. Preparation of metaphase chromosomes form blood	40	CO1 CO2 CO3 CO4 CO5	K3,K4 &K5

B	**(B) Plant and Animal Biotechnology - Practicals:** 1. Plant tissue culture media preparation 2. Plant tissue culture sterilization techniques. 3. Generation of Callus from leaf 4. Generation of Callus from root 5. Generation of Callus from bud 6. Generation of Callus from shoot apex 7. Maintenance of callus culture. 8. Cell suspension culture 9. Anther culture 10. Pollen culture 11. Embryo culture. 12. Isolation of plant protoplast 13. Culture of plant protoplast. 14. Protoplast viability test. 15. Localization of nucleus using nuclear stain. 16. Agrobacterium culture maintenance and isolation of plasmid DNA. 17. Mass culture of Chlorella /Spirulina 18. Introduction to Animal Cell culture: Procedure for handling cells and medium. 19. Cleaning and sterilization of glassware and plastic tissue culture flasks 20. Preparation of tissue culture media 21. Preparation of sera for animal cell culture 22. Preparation of single cell suspension from chicken liver (Primary cell culture). 23. Trypsinization of established cell culture. 24. Cell counting and viability - staining of cells (a) Vital Staining (Trypan blue, Erythrosin (b) Giemsa staining. 25. MTT Assay	50	CO1 CO2 CO3 CO4 CO5	K3,K4 & K5

REFERENCES:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI

Edition.JohnWiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology.VIIIEdition. Lippincott Williams and Wilkins, Philadelphia.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of theCell.VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
4. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., (2008) MolecularBiology of the Gene (VI Edition.). Cold Spring Harbour Lab. Press, PearsonPub.
5. Animal Cell Culture: A practical approach, Freshney, E.D., 2000, John Wiley Pub., NewYork.
6. Plant Tissue culture theory & practical, Bhojwani and Razdan, M.K, 2004.
7. Tissue culture, methods and application, Hurse P.I. and Patterson.
8. Handbook of cell and Organ culture M.K Marchan, D, J. (2ndEd). Burgess Pub. Co.,Minneapolis, USA. (1964).
9. Plant cell culture – A Practical Approach, Dixon, L.A. and R.A. Gonzales. , Revan Press,New York.

Course outcomes:

PRACTICAL-II **(Molecular Genetics & Plant and Animal Biotechnology)** **Course Code :** U5R2BTSEC2:1		
S.No	**Course Outcome**	**Knowledge Level**
Upon completion of course, the students will be able to		
CO-1	Isolate and identify microbes from various sources.	**K3,K4 &K5**
CO-2	Characterize microbes.	**K3,K4 & K5**
CO-3	Examine Plant and Animal cells and their functions	**K3,K4 &K5**
CO-4	Assess extracted DNA, RNA and protein for rDNA technology	**K3,K4 & K5**
CO-5	to study cloning tools	**K3,K4 &K5**

Relationship Matrix for CO, PO, PSO

Course Outcome	**Programme Outcome (PO)**					**Programme Specific Outcome (PSO)**					
	PO-1	**PO2**	**PO-3**	**PO-4**	**PO-5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean**

(CO)											
CO-1	3	2	3	2	2	3	3	2	2	3	2.5
CO-2	2	2	2	1	2	2	3	3	2	3	2.2
CO-3	2	3	2	2	2	2	2	2	3	2	2.2
CO-4	2	2	3	3	2	2	2	2	2	2	2.2
CO-5	2	2	2	2	3	2	2	3	3	2	2.3
										Mean Overall Score	**2.28**
										Result	**High**

Discipline Specific Elective - 3:1

VIROLOGY

SEMESTER - II	
Title of the Course: VIROLOGY	**Category of The Course:** DISCIPLINE SPECIFIC ELECTIVE COURSE
Course Code: P2R3BTDSE3:1	**Nature of The Skill :** Skill Development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 4**
Credits : 3	**Total Inst. Hrs : 60**

Course Objectives:

- Contrast differences in virus architecture and classification.
- To understand the viral diagnostic and detection methods.
- Distinguish characteristics of normal cells and virus-infected cells.
- Explain and apply methods used in research and diagnosis of viral diseases.
- Describe cellular and therapeutic antiviral strategies and social stigmas against infectedindividuals.

SYLLABUS | DISCIPLINE SPECIFIC ELECTIVE -3:1 | VIROLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	General Virology: Structure of viruses: Enveloped and non-enveloped viruses, Capsid symmetries- icosahedral, polyhedral and helical, structural proteins- matrix proteins and lipoproteins, viral genomic organization and replication- types of nucleic acids, protein-nucleic-acid interactions and genome packaging, Virus related structures-viroids and prions. Cultivation of viruses: Inovo, In vivo, Ex vivo/In vitro. Cytopathic effect-pock forming unit.	10	CO1 CO5	K1,K2 &K3
II	Viral diagnostic and detection methods: Sample processing-enrichment and concentration, Direct methods of detection-light microscopy (inclusion bodies), electron microscopy, Immuno diagnosis, hemagglutination, Complement fixation, neutralization, Western blot, Radioactive Immuno precipitation Assay (RIPA), Flow Cytometry and Immuno histochemistry. Nucleic acid-based diagnosis: Nucleic acid hybridization, PCR, microarray and nucleotide sequencing, LINE probe assay.	10	CO1 CO2 CO5	K1,K2 & K5

III	Bacterio phages and plant viruses: Bacterio phage: Morphology, genome organization, classification-Lifecycle-Lytic and Lysogenic Cycle, Head and tailphages- T4phage-phage- Filamentous Bacteriophages-174-M13,phage therapy for control of bacterial poultrydiseases. Viral Disease in Plants: Histological, physiological andcytological changes in infected plants, Behavior of viruses in plants,Methods for detection of plant viruses, Transmission of plant viruses through vectors-insects, nematodes and fungi.	10	CO1 CO3 CO5	K4 & K5
IV	Clinical virology: Pathogenesis, clinical symptoms, epidemiology and prophylaxis of DNA Viruses - pox virus, Herpes Virus, Adenovirus, Hepatitis Virus. RNA Viruses- Picorna Virus, Orthomyxo Virus, RabiesVirus, HIV. Oncogenic viruses; Virus-induced cell transformation and oncogenesis, Mechanism of cell transformation by tumor viruses,	15	CO4 CO5	K2,K3,K4 & K5
V	Viral vaccines and anti-viral drugs: Viral vaccines, conventional vaccines-killed and attenuated, Modern vaccines-DNA vaccines, recombinant DNA/protein vaccines, subunits vaccines, peptide vaccines, anti-idio type vaccines, edible vaccines, immuno modulators (cytokines), adjuvants to increase immunogenicity of vaccines. Antivirals: Interferons, 21 designing and screening for antivirals, mechanisms of action, anti retrovirals-mechanism of action anddrug resistance.	15	CO5	K3,K4 & K6

Reference Books

- Virology principles and application John Carter and Venetia Saunders (2007) John Wiley andSons publishers.
- Principles of Virology 4th edition Jane Flint.
- Real –Time PCR: Current technology and applications 1st edition (2009) edited by Julie Logan *et al.*,
- Analytical techniques in DNA sequencing edited by Brian K. Nunnally
- Medical Microbiology: with student consult by Patrick R. Murray Ph.D. (Author), Ken S. Rosenthal PhD Saunders; 7th edition.
- Antiviral Agents, Vaccines and Immunotherapies. Stephen K. Trying. October 2004. Marcel Dekker.

VIROLOGY		**Course Code :** P2R3BTDSE3:1
S. No.	**Course Outcome**	**Knowledge Level**
Upon completion of the course, the students will be able to		

CO - 1	describe and review the General Virologyand cultivation of viruses	**K1,K2 &K3**
CO - 2	know the Viral diagnostic and detectionmethods	**K1,K2 & K5**
CO - 3	explain viral replication strategies; andcompare and contrast replication mechanisms used by viruses relevant to human disease	**K4 & K5**
CO - 4	discuss principles of virus pathogenesis	**K2,K3,K4 & K5**
CO - 5	explain host antiviral immune mechanisms at a cellular and molecular level and vaccine strategies and mechanisms of antiviral drugs	**K3,K4 & K6**

Relationship Matrix for CO, PO, PSO

Course Outcome (CO)	**Programme Outcome (PO)**					**Programme Specific Outcome (PSO)**					
	PO-1	**PO2**	**PO-3**	**PO-4**	**PO-5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean**
CO-1	3	2	2	2	2	3	3	2	2	3	2.4
CO-2	2	2	3	1	2	2	2	2	2	2	2
CO-3	2	3	3	2	3	2	3	3	3	3	2.7
CO-4	3	2	3	3	2	2	2	2	2	2	2.3
CO-5	2	2	2	2	3	2	2	3	3	2	2.3
Mean Overall Score											**2.34**
Result											**High**

Discipline Specific Elective - 3:2

MEDICAL BACTERIOLOGY

SEMESTER- II	
Title of the Course: MEDICAL BACTERIOLOGY	**Category of The Course:** DISCIPLINE SPECIFIC ELECTIVE COURSE
Course Code: P2R3BTDSE3:2	**Nature of The Skill :** Skill Development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 4**
Credits : 3	**Total Inst. Hrs : 60**

Course Objectives

- Acquire Knowledge on collection, transportation and processing of various kinds of clinical specimens.
- Explain morphology, characteristics and pathogenesis of bacteria.
- Discuss various factors leading to pathogenesis of bacteria.
- To understand the handling and maintenance of laboratory animals.
- To know the significance of Nosocomial, infections and Zoonotic diseases

SYLLABUS | DISCIPLINE SPECIFIC ELECTIVE -3:2 | **MEDICAL BACTERIOLOGY**				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Classification of medically important bacteria, Normal flora of human body, Collection, transport, storage and processing of clinical specimens, Microbiological examination of clinical specimens, antimicrobial susceptibility testing. Handling and maintenance of laboratory animals - Rabbits, guinea pigs and mice.	10	CO1 CO5	K1,K2 &K3
II	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of *Staphylococci, Streptococci, Pneumococci, and Neisseriae*.	10	CO1 CO2 CO5	K1 & K5

III	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by species of *Bacillus*, *Corynebacteria*, *Mycobacteria* and *Clostridium.*	10	CO1 CO3 CO5	K4 & K5
IV	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by Enterobacteriaceae members, *Yersinia*, *Pseudomonas*, *Vibrio*, *Mycoplasma*, *Helicobacter*, *Rickettsiae*, *Chlamydiae* and *Bordetella.*	15	CO4 CO5	K2,K3,K4 & K5
V	Morphology, classification, characteristics, pathogenesis, laboratory diagnosis and treatment of diseases caused by *Francisella.*, *Spirochaetes*-*Leptospira*, *Treponema* and *Borrelia*. Nosocomial, zoonotic and opportunistic infections - prevention and control.	15	CO5	K3,K4 & K6

Reference Books

1. (2017).Orient Longman, Hyderabad.
2. Greenwood, D., Slack, R. B. and Peutherer, J. F. (2012) Medical Microbiology, (18th Edition). Churchill Livingstone, London.
3. Finegold, S. M. (2000) Diagnostic Microbiology, (10th Edition). C.V. Mosby Company, St. Louis.

Text Book

1. Salle A. J. (2007). Fundamental Principles of Bacteriology. (4th Edition). Tata McGraw-Hill Publications.
2. Collee J.C. Duguid J.P. Foraser, A.C, Marimon B.P, (1996). Mackie & McCartney Practical Medical Microbiology. 14thedn, Churchill Livingston.
3. Cheesbrough M. (2006). District Laboratory Practice in Tropical countries.- Part 22ndedn.Cambridge University Press.
4. Topley and Wilson's. (1998). Principles of Bacteriology.9th edn. Edward Arnold, London.

MEDICAL BACTERIOLOGY		**Course Code :** P2R3BTDSE3:2
S. No.	**Course Outcome**	**Knowledge Level**
Upon completion of the course, the students will be able to		
CO - 1	Collect, transport and process of various kinds of clinical specimens.	**K1,K2 &K3**
CO - 2	Analyze various bacteria based on morphology and pathogenesis.	**K1 & K5**
CO - 3	Discuss various treatment methods for bacterial disease.	**K4 & K5**
CO - 4	Acquiring theoretical knowledge for handling and maintenance of laboratory animals.	**K2,K3,K4 & K5**
CO - 5	Employ various methods detect Nosocomial and Zoonotic diseases	**K3,K4 & K6**

Relationship Matrix for CO, PO, PSO

Course Outcome (CO)	**Programme Outcome (PO)**					**Programme Specific Outcome (PSO)**					
	PO-1	**PO2**	**PO-3**	**PO-4**	**PO-5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean**
CO-1	3	2	2	2	2	3	3	2	2	3	2.4
CO-2	2	2	3	1	2	2	2	2	2	2	2
CO-3	2	3	3	2	3	2	3	3	3	3	2.7
CO-4	3	2	3	2	3	2	2	2	2	2	2.3
CO-5	2	2	2	2	2	2	3	3	3	2	2.3
										Mean Overall Score	**2.34**
										Result	**High**

Discipline Specific Elective - 4:1

ENVIRONMENTAL BIOTECHNOLOGY

SEMESTER - II	
Title of The Course: **ENVIRONMENTAL BIOTECHNOLOGY**	**Category of The Course:** DISCIPLINE SPECIFIC ELECTIVE COURSE
Course Code: P2R3BTDSE4:1	**Nature of The Skill :** Employability
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 4**
Credits : 3	**Total Inst. Hrs : 60**

COURSE OBJECTIVES

- The course explains the application of biotechnology in environment and to understand the energy sources, and remediation using biotechnology and its control.
- Students will get an idea about the hazards to our environment, solutions to protect and for sustainable development.
- This course is important in the era of industrialization leading to environmental hazards.
- Students to take up a career in tackling industrial pollution and also who is willing to take up the research in areas like development of biological systems.
- To learn the remediation of contaminated environments and for environment-friendly processes such as green manufacturing technologies and sustainable development.

SYLLABUS/ DISCIPLINE SPECIFIC ELECTIVE - 4:1| ENVIRONMENTAL BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Environment: Basic concepts and issues; Environmental management and Conservation, Environmental Laws & Agencies involved in conservation. Environmental Pollution: Types of pollution & its control strategies -Air pollution, Soil pollution, Water pollution, Oil pollution & Radioactive pollution	10	CO1 CO5	K2

II	Biofilm Kinetics: Completely mixed biofilm reactor- Soluble microbial products and inert biomass-Special-case biofilm solution. Reactor types:- batch reactor - continuous-flow stirred-tank reactor- Plug-flow reactor. Engineering design of reactors- Reactors in series	10	CO1 CO2 CO5	K3
III	Waste water management, source of waste water, Waste water treatment- physical, chemical and biological treatment. Microbiology of Waste water; Aerobic and anaerobic process, BOD and COD.	10	CO3	K4
IV	Toxicity: Types and Test for evaluating Toxicity. Biosensors, Biomonitoring of toxic materials .Biomagnification, Biomining and Biofuels	15	CO4	K5
V	Bioremediation; *In-situ and Ex-situ* Bioremediation of contaminated soils and waste land; Microbiology of degradation of Xenobiotics in environment; Pesticides, Surfactants, Degradative plasmids. Solid waste: Composting, Vermiculture and methane production.	15	CO5	K6

Reference Books:

- Gareth M. Evans, Gareth G. Evans, Judy Furlong 2011
- Environmental biotechnology: theory and application John Wiley & Sons, Ltd. West Sussex, UK
- M. Moo-Young, W.A. Anderson, A.M. Chakrabarty, 2010. Environmental Biotechnology: Principles and Applications. Springer.
- M. H. Fulekar, 2010 Environmental Biotechnology, by Science Publishers Department of Life Sciences, University of Mumbai, India,
- Stanley E. Manahan, 2009. Environmental Chemistry, Ninth Edition, CRC Press.
- Environmental chemistry 5th edition by A.K.De. 1997.
- Bruce E. Rittmann and Perry L. McCarty. 2001. Environmental Biotechnology :Principles and applications. McGraw Hill, Newyork.
- Ahmed N, Qureshi, F.M. and Khan, O.Y. 2001.Industrial and Environmental Biotechnology. Horizon Press.
- Ahmed N, Qureshi, F.M. and Khan, O.Y. 2001.Industrial and Environmental Biotechnology. Horizon Press.

Useful Websites:

- lbewww.epfl.ch/LBE/Default_E.htm
- http://lbe.epfl.ch

Course outcomes:

ENVIRONMENTAL BIOTECHNOLOGY		**Course Code :** P2R3BTDSE4:1
S.No	**Course Outcome**	**Knowledge Level**
Upon completion of course, the students will be able to		
CO-1	Explain various waste management methods	**K2**
CO-2	Classify potential methods of biodegrading organic pollutants.	**K3**
CO-3	Examine the techniques involved in remediation of polluted environments	**K4**
CO-4	Assess types of pollution & its control	**K5**
CO-5	Compile biotechnological approaches to degrade xenobiotic compounds	**K6**

Relationship Matrix for CO, PO, PSO

Course	**Programme Outcome (PO)**	**Programme Specific Outcome (PSO)**

Outcome (CO)	PO-1	PO2	PO-3	PO-4	PO-5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean
CO-1	3	2	2	2	2	3	3	2	2	3	2.4
CO-2	2	2	3	1	2	2	2	2	2	2	2
CO-3	2	3	3	2	3	2	3	3	3	3	2.7
CO-4	3	2	3	3	2	2	2	2	2	2	2.3
CO-5	2	2	2	2	3	2	2	3	3	2	2.3
Mean Overall Score											**2.34**
Result											**High**

Discipline Specific Elective - 4:2

PHARMACEUTICAL BIOTECHNOLOGY

SEMESTER – II	
Title of The Course: **PHARMACEUTICAL BIOTECHNOLOGY**	**Category of The Course:** DISCIPLINE SPECIFIC ELECTIVE COURSE
Course Code: P2R3BTDSE4:2	**Nature of The Skill :** Employability
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 4**
Credits : 3	**Total Inst. Hrs : 60**

COURSE OBJECTIVES:

- To understand the basic steps in the drug research, toxicological, pre-clinical and clinical studies.
- To update newer developments in pharmaceutical Biotechnology/emerging trends/ novel mechanisms of drug action etc.
- To study of inherited variation in drug response.
- Student's comprehensive information and insights in pharmaceutical biotechnology and the development of biopharmaceuticals in pharmaceutical industry.
- To gain an understanding in both scientific knowledge of designing and producing navel biologics, and business challenges in biopharmaceutical companies.

SYLLABUS | DISCIPLINE SPECIFIC ELECTIVE - 4:2 | PHARMACEUTICAL BIOTECHNOLOGY				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Introduction to concepts and technologies in pharmaceutical biotechnology and industrial applications, Biosensors- Working and applications of biosensors in pharmaceutical Industries; Pharmacology and Ethnopharmacology: Scope, applications and Importance.	10	CO1	K1

II	Scientific, technical and economic aspects of vaccine research and development, Preparation of bacterial vaccines, toxoids, viral vaccine and antitoxins, Storage conditions and stability of vaccines, Recombinant DNA technology, Application of rDNA technology and genetic engineering in the production of: (i) Interferon (ii) Vaccines - hepatitis- B (iii) Hormones – Insulin, Brief introduction to Protein Engineering, Therapeutic proteins, Production of Enzymes- General consideration – Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase, Methods of enzyme immobilization and applications	10	CO2	K3 & K4
III	Hybridoma technology - Production, Purification and Applications, Formulation of biotech products - Rituximab, Introduction to Microbial biotransformation and applications, Study of the production of – penicillins, citric acid, Vitamin B12, Glutamic acid and Griseofulvin Somatic gene therapy, Xenotransplantation in pharmaceutical biotechnology, Large scale production fermenter design and its various controls, Bio safety in pharmaceutical industry	10	CO3	K2
IV	Pharmacological activity of Plant drugs, Plant Chemicals in modern pharmacology; biochemistry and pharmacology of atropine, caffeine, ephedrine, opioids, taxol, vinca alkaloids, synthetic substitutes for therapeutically active plant constituents; drug improvement by structure modification and bio-transformation. Criteria for pharmacological evaluation of drugs.	15	CO4	K2 & K4

V	Clinical Pharmacology, Drug therapy, therapeutic situation, benefits and risk of use of drugs, Mechanism of drug action, Therapeutic efficacy, Therapeutic index, tolerance, dosage forms and routes of drug action , factors affecting drug action; Adverse Drug reactions and drug poisoning-classification and causes of ADR; principle clinical manifestations and treatment of ADR, General principles of management of drug poiosoning; antidotes, classisfication of drugs.	15	CO5	K1,K2 &K5

Reference Books:

- Harbans lal, 2011. Pharmaceuticals biochemistry. CBS Publishers and distributors Pvt. Ltd, Chennai.
- Carlos A. Guzmán and Giora Z. Feuerstein, 2009. Pharmaceutical Biotechnology, 1st edition, Springer.
- Daniel Figeys (Ed.). 2005. Industrial Proteomics: Applications for Biotechnology and Pharmaceuticals. Wiley, John & Sons, Incorporated.
- Kayser, O and Muller R.H.. 2004. Pharmaceutical Biotechnology Drug Discovery and Clinical Applications. WILEY-VCH
- Leon Shargel, Andrew B. C. Yu, Susanna Wu-Pong, and Yu Andrew B. C. 2004. Applied Biopharmaceutics & Pharmacokinetics. McGraw-Hill Companies
- Stefania Spada, Garywalsh. 2004. Directory of approved biopharmaceutical
- Gary Walsh. 2003. Biopharmaceutical, Biochemistry & Biotechnology.
- Heinrich Klefenz. 2002. Industrial pharmaceutical biotechnology.
- Thomas Lengauer (Ed.). 2002. Bioinformatics – from Genomes to Drugs. Volume I& II. Wiley-VCH.
- John F. Corpenter (editor), Mark C. Manning. 2002. Rational Design of stable formulation Theory and Practice (Pharmaceutical Biotechnology). Plenum, US. Ist edition.
- D.I.A. Crommelin, et al., 2002. Pharmaceutical Biology. Amazon prime publications.
- Werner Kalow, Urs A Meyer and Rachel F. Tyndale. 2001.
- Pharmacogenomics. CPL press.

Useful Websites:

- https://tugasakhirsttifbogor.files.wordpress.com/2018/08/pharmaceutical-biotechnology.pdf
- http://library.nuft.edu.ua/ebook/file/Gad2007.pdf
- https://oasis.iik.ac.id:9443/library/repository/a932eb462c49885a2c72755977036b81.pdf

Course outcomes:

PHARMACEUTICAL BIOTECHNOLOGY		**Course Code :** P2R3BTDSE4:2
S.No	**Course Outcome**	**Knowledge Level**
Upon completion of course, the students will be able to		
CO-1	Explain the basic components of pharmaceutical and biotechnology industry and methods and applications of biosensor	**K1**
CO-2	Describe the Scientific, technical and economic aspects of vaccine & rDNA technology	**K3 & K4**
CO-3	Describe the basic concepts of protein Engineering, therapeutic proteins and enzyme immobilization techniques	**K2**
CO-4	Describe the concepts of hybridoma technology, microbial biotransformation and microbial bio-transformed products	**K2 & K4**
CO-5	Explain the basic components of somatic gene therapy, Xeno-transplantation and fermenter and bio safety methods	**K1,K2 &K5**

Relationship Matrix for CO, PO, PSO

Course Outcome (CO)	**Programme Outcome (PO)**					**Programme Specific Outcome (PSO)**					
	PO-1	**PO2**	**PO-3**	**PO-4**	**PO-5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**Mean**
CO-1	2	2	2	1	2	3	3	2	2	3	2.2
CO-2	3	2	2	1	2	2	2	2	2	2	2.15
CO-3	2	3	2	2	2	2	3	2	3	2	2.3
CO-4	2	2	2	3	2	2	2	2	3	2	2.2
CO-5	2	2	2	2	3	2	2	3	3	2	2.3
										Mean Overall Score	**2.24**
										Result	**High**

Skill Enhancement Course - 1:1 GENETIC ENGINEERING

SEMESTER – II	
Title of The Course: **GENETIC ENGINEERING**	**Category of The Course: SKILL ENHANCEMENT COURSE**
Course Code: P2R3BTSEC1:1	**Nature of The Skill :** Skill Development
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 4**
Credits : 2	**Total Inst. Hrs : 60**

COURSE OBJECTIVES:

- To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
- To expose students to application of recombinant DNA technology in biotechnological research.
- To train students in strategizing research methodologies employing genetic engineering techniques.
- Understand the concepts, introduction of genetic engineering, introduction about restriction enzymes, ligases, polymerases, vectors, their types, sources and their roles in genetic engineering.
- Knowledgeable in basic techniques of molecular biology and their applications in various aspects.

SYLLABUS | Skill Enhancement Course - 1:1 | GENETIC ENGINEERING				
Unit	**Content**	**Hours**	**COs**	**Cognitive level**
I	Gene cloning. Genetic engineering tools. Nucleic acid manipulating enzymes. Promoters, Selectable markers and reporters used in r DNA technology. Restriction digestion, Ligation, Transformation, Selection of Recombinants. Construction of gene libraries	10	CO1	K1,K2, K5
II	*E.Coli* vectors - pBR322 and its derivatives; Cloning vectors for gram negative bacteria - ColE1, p15A, R1, IncPa, pSC101; Lambda bacteriophage vectors, filamentous phages, Cosmids, Phasmids, Phagemids. Cloning in gram positive bacteria (*Bacillus subtilis*)	10	CO2	K2,K3, K4

III	Cloning in yeast *Saccharomyces cerevisae*. Life cycle and types of vectors; Eukaryotic vectors. SV40 (molecular genetics and expression); Specialized cloning vector for cDNA; Synthesis of specific RNA in vitro; Vectors for cloning promoters and terminators; vectors with adjustable copy number	10	CO4	K3,K4 &K6
IV	Nucleic acid hybridization techniques; Molecular probes (Types of probes and its construction); probe labeling. Nick translation, End labeling and Random primer labeling. Polymerase chain reaction and its variants; DNA fingerprinting; DNA sequencing first generation sequencing methods (Maxam and Gilbert sequencing, Sangers Dideoxy sequencing, Pyrosequencing, PCR based sequencing and hybridization sequencing).Second generation sequencing methods	15	CO4	K3,K4,K5 & K6
V	Site directed mutagenesis; DNA microarray; chromosome walking and jumping. Molecular techniques in prenatal diagnosis gene therapy, Transgenic animals (knockout mice) and plants (Flavr savr tomato), Pharmaceutical products (Vaccine, Humulin, etc), Crop improvement. Pesticide resistance, herbicide resistance, transgenic animals and GM foods; Modern Concepts in Genetic Analysis.	15	CO5	K3,K4,K5 & K6

Reference Books:

- T.A. Brown, 2010. Gene cloning and DNA analysis: An introduction, 6th edition, Wiley-Blackwell.
- Sandy B.Primrose and Richard Twyman, 2006. Principles of Gene Manipulation and genomics, 7th edition, Wiley-Blackwell.
- Lewin, 2009. Genes X, 10th edition, Jones & Barlett Publishers
- Raymond Rodriguez and David T.Denhart 2003.Vectors, A survey of molecular cloning vectors and their uses
- Errst-L. Winnacker 1987.From genes to clones. Introduction to Gene Technology,
- Ed. David V. Geoddel 2002.Gene Expression technologies. Methods in enzymology (Vol.185)
- William Wu, Michael J.Welsh, Peter B.Kaufrmar, Helen H.Zhang 2001. Methods in Gene Biotechnology

Course outcomes:

GENETIC ENGINEERING	**Course Code :** P2R3BT SEC1:1	
S.No	**Course Outcome**	**Knowledge Level**
Upon completion of course, the students will be able to		
CO-1	Understanding the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering.	**K1,K2, K5**
CO-2	Getting detailed knowledge of gene transfer methods and identifying suitable hosts for cloning.	**K2,K3, K4**
CO-3	Acquiring theoretical knowledge in the techniques, tools, and application and safety measures of genetic engineering.	**K3,K4 &K6**
CO-4	Describes the genome mapping and sequencing and methods for gene therapy.	**K3,K4,K5 & K6**
CO-5	Elucidate different techniques involved in genetic engineering	**K3,K4,K5 & K6**

Relationship Matrix for CO, PO, PSO

Course Outcome (CO)	**Programme Outcome (PO)**					**Programme Specific Outcome (PSO)**					
	PO-1	**PO2**	**PO-3**	**PO-4**	**PO-5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO 5**	**Mean**
CO-1	3	2	3	2	2	3	3	2	2	3	2.5
CO-2	2	2	2	1	2	2	3	3	2	3	2.2
CO-3	2	3	2	2	2	2	2	2	3	2	2.2
CO-4	2	2	3	3	2	2	2	2	2	2	2.2

CO-5	2	2	2	2	3	2	2	3	3	2	2.3
										Mean Overall Score	**2.28**
										Result	**High**

Skill Enhancement Course - 1:2 FOOD TECHNOLOGY

SEMESTER – II	
Title of The Course: **FOOD TECHNOLOGY**	**Category of The Course: SKILL ENHANCEMENT COURSE**
Course Code: P2R3BTSEC1:2	**Nature of The Skill :** Employability
Marks : CIA : 25 + Ext: 75 = 100	**Hrs / Week : 4**
Credits : 2	**Total Inst. Hrs : 60**

COURSE OBJECTIVES:

- To provide knowledge on various processing technologies of food and food products, preservation, long term storage and food safety aspects.
- To know about the structure, principles and applications of Bioreactors.
- To adds information about the role of microorganisms in many food industries both in production and spoilage processes.
- To create awareness among the students about the food quality analysis and the role of government organizations involved in food quality control.
- To encode the importance processing, preservation and packaging of many food products

SYLLABUS | Skill Enhancement Course -1.2 | FOOD TECHNOLOGY				
Unit	**Content**	**Hours**	**Cos**	**Cognitive level**

I	**Planning, Organisation and setting of Food testing laboratory and laboratory safety** Understand the requirements for setting up a laboratory for the legal defensibility of analytical data. The ideal structure design, environment, layout for microbiological testing and Air handling etc., Introduction about accreditation, Different accreditation bodies (NABL, APLAC, ILAC), Requirements for ISO/IEC 17025:2017, documentation, pre-requisites for accreditation, management requirements, technical requirements, measurement of traceability, Laboratory safety: Personnel and laboratory hygiene, emergency planning, general hazards in a food laboratory, safety equipment, storage of chemicals, acids, flammables etc, handling and biological spills and waste disposal.	10	CO1	K2,K3,K4
II	**Principles of Food Preservation technology** Heat: Principles of Heat transfer, Blanching, Pasteurization, Heat sterilization, thermal extrusion, cooking. Water Removal: Forms of Water in Foods, Sorption of water in foods, Water activity, drying and evaporation technology. Temperature reduction: Chilling, Freezing, Radiation: Ionizing Radiation, Microwave, Use of chemicals: Class-I & Class-II preservatives, smoke other chemical additives, New non-thermal methods: High hydrostatic pressure, modified atmosphere, high intensity pulsed electric fields, intense pulsed light, oscillating magnetic fields, hurdle technology, ultrasonic and ohmic heating etc.	10	CO2	K2 & K3

III	**Principles of Food Packaging technology** Effect of environment on food stability: light, oxygen, water, temperature, sensitivity to mechanical damage and attack by biological agents, Different packaging materials used for food packaging and their properties including barrier properties, strength properties, optical properties: Glass, metals, paper, plastics, biodegradable and edible films and coatings aseptic packaging and combinations, Selection of packaging material and design for various food commodities including fresh produce (Fruits and vegetables), milk and milk products (dairy), cereal, pulses, oil, meat, fish, poultry, water and processed foods, Evaluation of quality and safety of packaging materials-different testing procedures, Function of packaging: Protective packaging and active packaging smart and intelligent packaging, Newer packaging technologies-CAP/MAP packaging aseptic processing and packaging, irradiated packaging, retort pouch and microwaveable packaging.	15	CO3	K2,K3 & K4

IV	**Food Microbiology and testing** Introduction of Food microbiology: Classification and nomenclature of microorganisms. Morphology and structure of microorganisms in foods (yeast and Molds, Bacterial cells viruses), Important genera of mold, yeast, bacteria (Gram positive and Gram negative, facultative aerobic and anaerobic, endospore forming bacteria and non-sporulating bacteria), Bacterial groups (lactic acid, acetic acid, butyric acid etc.,), thermophilic, proteolytic, saccharomyticetc, coliforms, faecal coliforms, enteric pathogens and emerging microbes, Sources of microorganisms in food chain (raw materials, water, air, equipment etc) and microbiological quality of foods, Microbial growth characteristics: Reproduction and growth (fission, generation time optimum growth, growth curve etc). Microbial growth in foods: intrinsic (pH, Moisture content, oxidation-reduction potential, nutrient content, antimicrobial constituents and extrinsic parameters (temperature of storage, relative humidity of environment, presence and concentration of gases in the environment, Thermal destruction of microorganisms: Thermal death time, D Value, Z- Value, F-Value, thermal death time curve, 12 D Concept, Microbial food spoilage and food borne diseases, food pathogens, bacillus *cereus and other bacillus species, campylobacter, clostridium species,Enterobacteriaceae,E. coli, listeria monocytogens, salmonella, shigella, staphylococcus aureus, vibrio species, yersinia enterocolitica, fungi, virus etc.,* Methods for the Microbiological examination of foods: Sampling activity and sampling plan, pure culture isolation: streaking, serial dilution and plating, cultivation maintenance and preservation/stocking of pure culture, Observation of Indicator organisms: Direct examination, enumeration methods, plate count, MPN, biochemical test, Rapid methods detection of specific organisms.	10	CO4	K2,K3,K4

V	**HACCP and Food safety management systems:** ISO 22000: Importance of implementing a HACCP system and how it can be applied to various products. Prerequisite programs, HACCP principles, some limitation of HACCP food safety objective (FSO). Food safety audits: Management review, audit certification and importance. Good manufacturing practices (GMP), Good hygienic practices (GHP), Food safety plan, food safety management risk analysis. Traceability food products recall and sanitation.	15	CO5	K2,K3 & K6

References:

- ISO 9001, Quality management systems – Requirements
- ISO 17034 General requirements for the competence of reference material producers
- ISO/IEC 17043 Conformity assessment – General requirements for proficiency testing.
- Food safety standards authority regulation 2011.

Course outcomes:

FOOD TECHNOLOGY		**Course Code :** P2R3BTSEC1:2
S.No	**Course Outcome**	**Knowledge Level**
Upon completion of course, the students will be able to		
CO-1	Elucidate the basic requirements of establish laboratory for testing samples as per the regulatory body's requirements	**K2,K3,K4**
CO-2	Describe the Scientific, technical knowledge about various food preservation techniques	**K2 & K3**
CO-3	Describe the basic concepts of packing of food materials, various parameters observed during packaging	**K2,K3 & K4**
CO-4	Describe the testing of food materials and identifying of microbial food contaminant	**K2,K3,K4**
CO-5	Explain the basic of food safety management system, good manufacturing practice and good hygienic practices	**K2,K3 & K6**

Relationship Matrix for CO, PO, PSO

Course	**Programme Outcome (PO)**	**Programme Specific Outcome (PSO)**

Outcome (CO)	PO-1	PO2	PO-3	PO-4	PO-5	PSO1	PSO2	PSO3	PSO4	PSO5	Mean
CO-1	3	2	3	2	2	3	3	2	2	3	2.5
CO-2	2	2	2	1	2	2	3	3	2	3	2.2
CO-3	2	3	2	2	2	2	2	2	3	2	2.2
CO-4	2	2	3	3	2	2	2	2	2	2	2.2
CO-5	2	2	2	2	3	2	2	3	3	2	2.3
Mean Overall Score											**2.28**
Result											**High**