Marudhar Kesari Jain College for Women (Autonomous)

Vaniyambadi – 635 751

PG & Research Department of Biotechnology

For

Undergraduate Programme

Bachelor of Science in Biotechnology

From the Academic Year 2024-25

Semester – I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA11	Tamil – 1	4	1	0	0	3
24UFEN11	English – 1	4	1	0	0	3
24UBTC11	CC – 1 – Cell and molecular Developmental Biology	3	1	2	0	4
24UBTC12P	CC - 2 Practical I – Lab in Cell Biology and Biological Chemistry	0	0	4	0	4
24UBTA11	EC - 1 AL – Biological Chemistry	3	1	0	0	3
24UBTS11	SEC – 1Human Physiology and Disease (NME)	2	0	0	0	2
24UBTS12P	SEC – 2 – Practical – Lab in MS – Office Fundamentals	0	0	2	0	2
24UBTF11	FC – Concepts in Biotechnology	1	1	0	0	2
					30	23

Semester - II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA21	Tamil – 2	4	1	0	0	3
24UFEN21	English – 2	4	1	0	0	3
24UBTC21	CC – 3 – Genetics and Molecular Biology	3	1	2	0	5
24UBTC22P	CC - 4 Practical II – Lab in Genetics and Molecular Biology	0	0	4	0	2
24UBTA21	EC - 2 AL – Fundamentals of Microbiology	3	1	0	0	4
24UBTA22P	EC - 3 AL Practical – Lab in Fundamentals of Microbiology	0	0	2	0	2
24UBTS21	SEC – 3 Good Laboratory Practice	1	0	1	0	2
24UAEC21	AEC – 1 LIFE SKILLS THROUGH YOGA	1	1	0	0	2
					30	23

Semester – III						
24UFTA31	Tamil – 3	4	1	0	0	3
24UFEN31	English – 3	4	1	0	0	3
24UBTC31	CC – 5 – Immunology and Immunotechnology	3	1	2	0	5
24UBTC32P	CC - 6 Practical III – Lab in Immunology and Immunotechnology	0	0	3	0	2
24UBTA31	EC - 4 AL – Bioinstrumentation	3	1	0	0	4
24UBTA32P	EC - 5 AL Practical – Lab in Bioinstrumentation	0	0	3	0	2
24UBTS31	SEC -4 – Medical Lab Technology	1	0	1	0	2
24UAEC31	AEC – 2 HUMAN VALUES AND PROFESSIONAL ETHICS	1	1	0	0	2
					30	23

Semester - IV						
24UFTA41	Tamil - 4	4	1	0	0	3
24UFEN41	English - 4	4	1	0	0	3
24UBTC41	CC – 7 – Genetic Engineering & rDNA Technology	3	1	2	0	5
24UBTC42P	CC - 8 Practical IV – Lab in Genetic Engineering and rDNA Technology	0	0	3	0	2
24UBTA41	EC - 6 AL – Bioinformatics & Biostatistics EC - 6 AL – Botany	3	1	0	0	4
24UBTA41 24UBTA41	EC - 7 AL Practical – Bioinformatics & Biostatistics Practical EC - 7 AL Practical – Botany	0	0	3	0	2
24UBTS41	SEC – 5 – Disease Diagnosis and Prevention	1	0	1	0	2
24UAEC41	AEC – 3 Environmental Studies & Disaster Management	1	1	0	0	2
					30	23

Semester – V						
	CC -9 – Environmental and Industrial Biotechnology	4	1	0	0	5
	CC- 10 Practical V – Lab in Environmental and Industrial Biotechnology	0	0	3	0	2
	CC – 11 – Plant and Animal Biotechnology	4	1	0	0	5
	CC - 12 Practical VI – Lab in Plant and Animal Biotechnology	0	0	3	0	2
	EC – 8 – Nanotechnology / Bioethics & Biosafety/ Research Methodology	4	1	0	0	4
	EC – 9 – Biotechnology in Forensic Science/ Bioentrepreneurship	4	1	0	0	4

Semester - VI						
	CC – 13 - Enzymology	5	1	0	0	5
	CC - 14 Practical VII – Lab in Enzymology	0	0	4	0	2
	CC - 15 – Project (Group/ Individual)	0	0	0	5	4
	EC – 10 –Marine Biotechnology / Food Technology	4	1	0	0	4
	EC – 11 – Vermicompost / Pharmaceutical Biotechnology	4	1	0	0	4
	PEC – 1 – Research Ethics	1	1	0	0	2

	AEC – 4 SOCIAL RESPONSIBILITIES AND UPLIFTMENT	1	1	0	0	2
	Internship				2	2
					30	**26**

	SLC – 1 – General Psychology				3	2
					30	**23**

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

Part – 1 & 2	Tamil & English	4	SEC	Skill Elective Course	5
CC	Core Course	15	FC	Foundation Course	1
EC-AL	Elective Course – Applied	7	AEC	Ability Enhancement Course	4
EC	Elective Course – Major	4	SLC	Self-Learning Course	1

SECOND YEAR THIRD SEMESTER

CC- 5 -IMMUNOLOGY AND IMMUNOTECHNOLOGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks	
									CIA	External
24UBTC31	Immunology and Immunotechnology	CC-5	3	1	2	0	5	6	25	75

Learning Objectives	
LO1	To Understand the role of immune cells and their mechanism in body defense mechanism.
LO2	To study the characteristics of antigen & antibody
LO3	To gain new insights into Antigen - Antibody interactions and to demonstrate immunological techniques.
LO4	To gain knowledge on complement System & production of vaccines.
LO5	To explain hypersensitivity reactions & MHC

Unit	Contents	No. of Hours
I	**Introduction to Immunology**: Cells involved in immune response. Strucutre and function of Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Hematopoiesis – development of B and T lymphocytes. Types of immunity – Innate and acquired.	15
II	**Antigen & Antibody:** Characteristics and types. Antibody – Structure, Types, Properties and their Biological Function. Production of antibodies- Hybridoma technology: Applications of Monoclonal antibodies in biomedical research.	15
III	**Antigen – Antibody Interactions**: Immunodiffusion-Single and double, Immuno electrophoresis. Principle and application of ELISA and RIA and Flourescent antibody technique and Western Blotting. Purification of antibodies.	20
IV	**The complement system - activation and regulation:** Types – Classical, alternative and Lectin pathway. Biological function of C' proteins. Cytokines- Structure and Function. **Vaccines –** Introductory review of Vaccines**,** Types, Production and application. I	20
V	**Hypersensitivity:** Hypersensitivity Reactions and Types. Major Histocompatability Complex – MHC genes, MHC in immune responsiveness, Structure and function of Class I and Class II MHC molecules. HLA tissue typing	20

Course Outcomes **The students will be able to**	
CO1	Explain the mechanism of Immune cells and their defense activity
CO2	Describe the characteristics of antigens and antibodies
CO3	Outline and compare various antigen-antibody interactions
CO4	Describe Complement system and cytokines
CO5	Illustrate Hypersensitivity reactions and MHC
Textbooks	
1	Junith A. Owen, Jenny Punt, Sharon A. Stanford, Patrica P. Jones 2013. Kuby Immunology. 7th edition, W. H . Freeman and Company.
2	Kannan, I., 2010. Immunology. MJP Publishers, Chennai
3	Bharat Singh, 2006. Immunology, Pointer Publishers.
4	Ashim K. Chakravarty, 2015. Immunology and Immunotechnology. Oxford University Press
5	Dulsy Fathima, N Arumugam, 2006. Immunology. Saras Publication.
Reference Books	
1	Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011. Roitt.s Essential Immunology, 13th edition, Wiley- Blackwell. USA.
2	Ian R. Tizard, 2004. Immunology an Introduction, 4th Edition. Saunders College Publishing.
3	David Male, jonathan Brostoff, David B Roth, Ivan Roitt, 2006. Immunoogy 7th Edition. Elsevier.
4	Abbas, A.K., A.H.L. Lichtman and S.Pillai, 2010. Cellular and Molecular Immunology. 6th Edition. Saunders Elsevier Publications, Philadelphia.
5	Charles A. Janeway, Paul Travers, Mark Walport, Mark J Shlomchik. (2005). Immunobiology- the immune system in health and disease. Garland Science Publishing. 6rd Edition.

Web Resources

1	https://www.ncbi.nlm.nih.gov/books/NBK279395/
2	https://med.stanford.edu/immunol/phd-program/ebook.html
3	https://ocw.mit.edu/courses/hst-176-cellular-and-molecular-immunology-fall-2005/pages/lecture-notes/
4	https://www.ncbi.nlm.nih.gov/books/NBK7795/

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SECOND YEAR THIRD SEMESTER

CC – 6 – IMMUNOLOGY AND IMMUNOTECHNOLOGY **PRACTICALS**

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTC32P	Immunology and Immunotechnology Practicals	CC-6	0	0	3	0	2	3	25	75	100

Learning Objectives	
LO1	To learn to Perform blood grouping and determine blood type
LO2	To learn count WBC and RBC
LO3	To conduct serological diagnostic tests such as ASO and Widal test.
LO4	To acquire technical skills required for immunodiffusion and know the principle behind the techniques.
LO5	To demonstrate ELISA & Western blot

Unit	**Contents**	**No.of Hours**
I	Separation of Serum and Plasma. Blood grouping	9
II	WBC counting RBC counting Differential blood count	9
III	WIDAL Slide test ASO test	9
IV	Double Immunodiffusion Single Radial Immunodifusion	9
V	ELISA – Demonstration Western Blotting – Demonstration	9

Course Outcomes **The students will be able to**	
CO1	Perform Blood group and identify Blood groups
CO2	Demonstrate Procedure to count RBC & WBC
CO3	Conduct diagnostic test such as WIDAL and ASO tests
CO4	Demonstrate immunodiffusion technique
CO5	Demonstrate ELISA & Western blotting tests
Textbooks	
1	Talwar. (2006). Hand Book of Practical and Clinical Immunology, Vol. I, 2nd edition, CBS.
2	Asim Kumar Roy. (2019). Immunology Theory and Practical, Kalyani Publications.
3	V H Talib, H R Khurana, 1999. A Handbook of Medical Laboratory Technology, 2nd Edition. CBS Publishers and Distributors Pvt. Ltd
Reference Books	
1	Frank C. Hay, Olwyn M. R. Westwood. (2008).Practical Immunology, 4th Edition, Wiley-Blackwell.
2	Rose. (1992). Manual of Clinical Lab Immunology, ASM.
3	Wilmore Webley. (2016). Immunology Lab Manual, LAD Custom Publishing.
4	Janeway Travers. (1997). Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd Edition.

Web Resources

1	https://www.urmc.rochester.edu/MediaLibraries/URMCMedia/labs/frelinger-lab/documents/Immunology-Lab-Manual.pdf

Mapping Programme Outcomes and Programme Specific Outcsomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	3	3	3	2	1	3	3	3	2
CO2	3	1	3	3	3	2	1	3	3	3	2
CO3	3	1	3	3	3	2	1	3	3	3	3
CO4	3	1	3	3	3	2	1	3	3	3	3
CO5	3	1	3	3	3	2	1	3	3	3	3
Total	15	5	15	15	15	10	5	15	15	15	13
Average	3	1	3	3	3	2	1	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

SECOND YEAR THIRD SEMESTER
EC – 4 AL – BIOINSTRUMENTATION

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTA31	Bioinstrumentation	EC-4	3	1	0	0	4	4	25	75	100

Learning Objectives	
LO1	To Practice, experiment with and apply the basic instruments in the laboratory.
LO2	To Predict the functionality of Beer – Lambert's law in identifying and quantifying a biomolecule.
LO3	To Employ the separation techniques for separating biomolecules based on chromatography and electrophoretic techniques.
LO4	To Understand the clinical important isotopes and detection of isotopes
LO5	To Employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation.

Unit	Contents	No. of Hours
I	pH – Definition – pH meter. Measurement of pH and calibration of pH meter - Buffers – Preparation of Buffers. Microscopy: Principle and applications of Compound, Bright field, Phase contrast and Fluorescence Microscope.	15
II	Centrifugation – Principles - RCF, Sedimentation concept - - Different types of centrifuge – Types of rotors – Centrifugation types: Differential and Density gradient centrifugation – Ultra Centrifuge.	15
III	Chromatography - Principles – Paper Chromatography, TLC, Gel filtration, Ion-Exchange, Affinity Chromatography, Liquid Chromatography and Gas Chromatography. Electrophoresis: Principle, Paper Electrophoresis. Agarose Gel Electrophoresis – SDS- PAGE.	10
IV	Spectra – Absorption and Emission Spectra – Beer Lambert's law – Colorimeter, UV-Visible Spectrophotometer. Mass spectroscopy - Atomic absorption spectrometer (AAS) - Nuclear magnetic resonance Spectrometer (NMR).	10
V	Radioactivity – Isotopes – Clinically important isotopes – Measurement of Radioactivity – GM Counters, Scintillation Counters – Autoradiography – Applications. SOPs for Radioactive materials.	10

Course Outcomes **The Students will able to understand**	
CO1	the principles of pH, buffer preparation, and the operation and calibration of a pH meter, along with gaining knowledge of microscopy techniques and their applications in biological and chemical analysis.
CO2	the principles of centrifugation, including RCF and sedimentation concepts, different types of centrifuges and rotors, and the applications of differential, density gradient, and ultracentrifugation techniques in biological and chemical analysis.
CO3	the principles and applications of chromatography techniques, including paper chromatography, TLC, gel filtration, ion-exchange, affinity, liquid, and gas chromatography, along with electrophoresis methods such as paper electrophoresis, agarose gel electrophoresis, and SDS-PAGE for biomolecular separation and analysis.
CO4	the principles of absorption and emission spectra, Beer-Lambert's law, and the working of colorimeters, UV-Visible spectrophotometers, mass spectrometry, AAS, and NMR. Gain knowledge of their applications in qualitative and quantitative analysis of biological and chemical substances.
CO5	the principles of radioactivity, isotopes, and their clinical significance, along with radioactivity measurement techniques like GM counters, scintillation counters, and autoradiography. Learn the applications of radioisotopes and SOPs for safe handling of radioactive materials.
Textbooks	
1	Keith Wilson, John Walker, (2010).Principles and techniques of Biochemistry and Molecular Biology"(7th edition).Cambridge University Press
2	David L .Nelson, Michael M Cox.Lehninger (2008)."Principles of Biochemistry",Fifth edition W.H.Freeman,Newyork.
3	Khandpur R S, 2014. Handbook of Biomedical Instrumentation, 3rd edition, McGraw Hill Education (India).
Reference Books	
1	L.Veerakumari, (2006) "Bioinstrumentation" MJP publishers , Kindle Edition.
2	Upadhyay and UpadhyayNath. (2009). "Biophysical Chemistry", Principles and Techniques. Himalaya Publishing House.

Web Resources

1	Centrifuge: Principle, Parts, Types, and Applications
2	Chromatography | Definition, Types, C Facts | Britannica

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SECOND YEAR THIRD SEMESTER

EC – 5 AL – PRACTICALS - BIOINSTRUMENTATION

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTA32P	Bioinstrumentation Practicals	EC-4	0	0	3	0	2	3	25	75	100

Learning Objectives	
LO1	To Practice, experiment with and apply the basic instruments in the laboratory such as weighing balance, pH meter, shaker, incubator etc. in various research processes.
LO2	To Employ the separation techniques for separating biomolecules based on Agarose Gel Electrophoresis
LO3	To Employ the separation techniques for separating biomolecules based on paper chromatography.
LO4	To Employ the separation techniques for separating biomolecules based on Thin layer chromatography.
LO5	To Employ the separation techniques for separating biomolecules based on centrifugal force by centrifugation.

Unit	**Contents**	**No. of Hours**
I	Preparation of Buffer (Phosphate Buffer) Calibration of pH Determination of pH of biological samples using pH meter.	9
II	Agarose gel electrophoresis of DNA Verification of Beer's Lamberts law by colorimetry	9
III	Chromatography analysis of sugar, amino acids by paper Chromatography Chromatography analysis of sugar, amino acids by Thin Layer Chromatography	9
IV	Separation of Proteins by SDS-PAGE	9
V	Fractionation of cellular components by differential Centrifugation.	9

Course Outcomes The Students will able to	
CO1	Understand the preparation of phosphate buffer and the principles of pH measurement. Gain hands-on experience in determining the pH of biological samples using a pH meter.
CO2	Understand the principles and techniques of agarose gel electrophoresis for DNA analysis. Verify Beer-Lambert's law using colorimetry for quantitative analysis of absorbance and concentration relationships.
CO3	Perform chromatography analysis of sugars and amino acids using paper chromatography for separation and identification.
CO4	Perform chromatography analysis of sugars and amino acids using thin-layer chromatography for separation and identification.
CO5	Perform chromatography analysis of sugars and amino acids using thin-layer chromatography for separation and identification.
Textbooks	
1	Sharda University Abstract Laboratory Manual for Bio-instrumentation, Biochemistry, Microbiology, Cell Biology and Enzyme Technology.2018
2	Bhomwik (2011),Analytical techniques in Biotechnology – A complete laboratory manual, MGH Publisher, ISBN-13 : 978-0070700130
3	P. Palanivelu (2017), Analytical Biochemistry and Separation techniques – A laboratory manual, (5th Edition), Twentyfirst century publishers, ISBN: 978-81-908489-0-9
Reference Books	
1	L.Veerakumari, (2006) "Bioinstrumentation" MJP publishers , Kindle Edition.
2	Upadhyay and UpadhyayNath. (2009). "Biophysical Chemistry", Principles and Techniques. Himalaya Publishing House.

Web Resources

Mapping Programme Outcomes and Programme Specific Outcomes with Course

1	https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/files/BI501%20Advanced%20Biochemistry%20and%20Immunology.pdf
2	https://egyankosh.ac.in/bitstream/123456789/68525/1/Exercise-3.pdf
3	Agarose Gel Electrophoresis: Principle, Parts, Steps, Uses
4	https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/Chemistry_410%3A_Chemistry_for_Health_Sciences_Laboratory_Manual/15%3A_Paper_Chromatography_of_Amino_Acids/15.01%3A_New_Page

Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SECOND YEAR THIRD SEMESTER
SEC – 4 MEDICAL LAB TECHNOLOGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTS31	Medical Lab Technology	SEC-4	1	0	1	0	2	2	25	75	100

24UAEC31

LO1	To Understand the structural organization of cell and physiological system
LO2	To Understand microbial diseases and its biochemical tests
LO3	To Understand the blood components and evaluation
LO4	To Understand clinical aspects of physiological system.
LO5	To Understand processing of tissue in histopathological tests

Unit	Contents	No. of Hours
I	General Anatomy - Cell-structure & function. Tissue - Epithelium, Connective, Sclerous muscle. Systemic anatomy - Basic features of Cardio vascular system, Respiratory system, Digestive system, Excretory system, Reproductive (Male &Female) system, Nervous system.	7
II	Microbiology- Microbial diseases -Cholera, TB, Leprosy & Typhoid. Biochemical tests, Bacteriological examination of pus, wounds, Abscess, Microbial Parasites, Serological tests	7
III	Blood -Blood cells, Haemoglobin, Blood grouping, Coagulation Factors. Anticoagulation, MCV,MCH & MCHC & its Importance, Haematological Disorders-Classification of Anaemia-Iron Deficiency anaemia, Megaloblastic anaemia, Haemolytic anaemia.	3
IV	Cardio vascular system-Heart rate, cardiac cycle, cardiac output, blood pressure, hypertension, radial pulse. Respiratory System-Ventilation, functions, Lungs- Volumes and capacities. Endocrinology - Endocrine Glands- Description. Hormones-their secretion and functions. Excretory system, Urine formation, Urinary Sediments, Glocose Tolerance test (G.T.T.), Liver Function test	10
V	Histopathology -Introduction. Basic steps for tissue processing- Fixing, Embedding, Microtomy, Staining- PAS & PAP staining principal and uses, Mounting, methods of decalcifications..	3

Course Outcomes **The student will be able to understand the**	
CO1	Funtions of various physiological system
CO2	Mechanism of microbial diseases and their diagnosis
CO3	Concepts in blood profiling and its inference
CO4	Features in clinical examination of physiological responses
CO5	Processing of clinical samples involving tissues
Textbooks	
1	Kanai L Mukharjee, Swarajit Ghosh, Medical Laboratory Technology-Procedure Manual for Routine Diagnostic Test, Vol II, 2nd Edition, Tata McGraw Hill Publishers, 2010, Pages 818.
2	Ramnik Sood, Medical Lab Technology-Method and Interpretation, 5th Edition, JayPee Publications, 1999, Pages 732
Reference Books	
1	V. H. Talib, Handbook Medical Laboratory Technology, CBS Publishers C Distributors, 2019, Pages 246
2	F. J. Baker, R. E. Silverton, Eveline D. Luckcock, An Introduction to Medical Laboratory Technology, Elsevier Science, 2014, Pages 342

Web Resources

1	https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001209/M014177/ET/1526979793P14_M1_ET.pdf
2	https://library.fiveable.me/bioinformatics/unit-3/pairwise-sequence-alignment/study-guide/X75d1KtnnunHWZyJ
3	https://booksite.elsevier.com/9780123749796/Chapter_13.pdf
4	https://pmc.ncbi.nlm.nih.gov/articles/PMC10819513/
5	https://www.e3s-conferences.org/articles/e3sconf/pdf/2023/36/e3sconf_iconnect2023_04042.pdf

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

Second Year Fourth Semester

Core Paper 7 - Genetic Engineering and rDNA Technology

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTC41	**Genetic Engineering and rDNA Technology**	CC - 7	3	1	2	-	5	6	25	75	100

Learning Objectives	
LO1	Demonstrate the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.
LO2	Exhibit knowledge in sequencing technologies and Sequencing method employed in Human Genome Project
LO3	Understand Gene transfer techniques by direct and indirect mechanisms.
LO4	Comprehend the mechanism of Gene Expression, DNA Amplification and Fragmentation.
LO5	Explore the strategies of Recombinant DNA Technology in medicine, Industry and agriculture.

UNIT	**Contents**	**No. of Hours**
1	Genetic Engineering – Introduction. Tools in recombinant DNA technology – recombinant DNA – cloning strategies (Restriction enzymes; Vectors-Expression, cloning, shuttle; host) – Introduction of rDNA into host cells.	15
II	Identification of recombinants, selection and screening for Recombinants. DNA sequencing methods: Sangers (Chain Termination Method), Maxam Gilbert (Chemical Degradation Method), BAC to BAC, Whole Genome Shotgum Method and NGS: Next Generation Sequencing method). Human Genome Project.	20
III	Gene transfer techniques – Direct (Physical & Chemical): Physical methods: Microinjection - Electroporation - Particle Bombardment, Chemical methods: Calcium phosphate - DEAE dextran - Liposomes. Indirect Method: Viral mediated gene transfer, Selectable markers and reporter genes - Non viral mediated gene transfer	20
IV	Gene Expression: Expression system and their applications	20

	Gene Amplification: Polymerase Chain reaction- Methodology and its Types. DNA Fragmentation: RAPD – Randomly Amplified Polymorphic DNA and RFLP – Restriction Fragment Length Polymorphism.	
V	Application of Recombinant DNA technology in Industries: Pharmaceutical, Food, and Agricultural Industries. Merits and Demerits of r-DNA technology.	15
Total		**90**
COURSE OUTCOME		
Students will be able		
CO1	To demonstrate the basic principles of genetic engineering techniques and illustrate the specificity of vectors for cloning and advantages.	
CO2	To exhibit knowledge in sequencing technologies and Sequencing method employed in Human Genome Project	
CO3	To understand Gene transfer techniques by direct and indirect mechanisms.	
CO4	To comprehend the mechanism of Gene Expression, DNA Amplification and Fragmentation.	
CO5	To explore the strategies of Recombinant DNA Technology in medicine, Industry and agriculture.	
Text Books		
1	Brown T.A, 2015. Gene Cloning and DNA Analysis: An Introduction, 7th edition, Wiley - Blackwell.	
2	Desmond S.T. Nicholl, 2008. An Introduction to Genetic Engineering, 3rd edition, Cambridge university press.	
3	R.W. Old & S.B. Primrose, Principles of Gene Manipulation, Fifth Edition, Blackwell Science.	
4	Genetic Engineering Principles and Methods by Setlow, Jane K. (Volume 24).	
5	Keya Chaudhuri, 2012. Recombinant DNA Technology.	
Reference Books		
1	David Clark Nanette Pazdernik Michelle McGehee (2018), *Molecular Biology techniques*,(3rd edition).	
2	Anton Byron (2019), *Introduction to Gene Cloning*, Publisher: Oxford Book Company	
3	Monika Jain (2012), *Recombinant DNA technology*, (I edition), Alpha Science International. ISBN-13 : 978-1842656679.	

4	Primrose.S.B (2014), *Principles of gene manipulation*, (7th edition), Blackwell Scientific limited, Germany. ISBN: 978-1-405-13544-3
Web Resource	
1	https://www.britannica.com/recombinant-DNA-technology
2	https://www.le.ac.uk/recombinant-dna-and-genetic-techniques
3	https://www..ncbi.nlm.nih.gov

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**
TOTAL	**15**	**15**	**15**	**14**	**14**	**14**	**15**	**15**	**14**
AVERAGE	**3**	**3**	**3**	**2.8**	**2.8**	**2.8**	**3**	**3**	**2.8**

3-Strong, 2-Medium, 1-Low

Core Course VIII- PRACTICAL IV - LAB IN GENETIC ENGINEERING & RDNA TECHNOLOGY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTC42P	**Lab in Genetic Engineering & rDNA Technology**	CC - 8	0	0	3	0	2	3	25	75	100

Learning Objectives

LO1	Isolate the Plasmid DNA and Genomic DNA and predict the molecular weight of DNA by Agarose gel electrophoresis.
LO2	Isolate the RNA and predict the molecular weight of RNA by Agarose gel electrophoresis.
LO3	Prepare the competent cells and perform bacterial transformation.
LO4	Demonstrate working principles of PCR and RAPD
LO5	Exhibit the restriction fragment length polymorphism.

UNIT	**Contents**	**No. of Hours**
1	Isolation of genomic DNA- Bacteria Isolation of bacterial plasmid DNA	12
II	Isolation of RNA from bacteria by trizol method Detection of molecular weight by Agarose Gel Electrophoresis	7
III	Production of competent cells for transformation Bacterial transformation	6
IV	PCR – Polymerase Chain Reaction RAPD – Randomly Amplified Polymorphic DNA	14
V	Analyzes the differences in DNA fragment sizes created by cutting DNA with restriction enzymes using RFLP – Restriction Fragment Length Polymorphism	6
	Total	**45**

Course Outcome	
Students will be able	
CO1	To isolate the Plasmid DNA and Genomic DNA and predict the molecular weight of DNA by Agarose gel electrophoresis.
CO2	To isolate the RNA and predict the molecular weight of RNA by Agarose gel electrophoresis.
CO3	To prepare the competent cells and perform bacterial transformation.
CO4	To demonstrate working principles of PCR and RAPD
CO5	To exhibit the restriction fragment length polymorphism.
Text Books	
1	Laboratory Manual for GENETIC ENGINEERING 1st Edition, Kindle Edition by S. JOHN VENNISON (Author) 2009.
2	Understanding Bioinstrumentation, Discovery Publishing House Pvt Limited by M. Prakash(Author) 2009

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOME

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
CLO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CLO3	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**
CLO4	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**
CLO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**
TOTAL	**15**	**15**	**15**	**14**	**14**	**14**	**15**	**14**	**14**
AVERAGE	**3**	**3**	**3**	**2.8**	**2.8**	**2.8**	**3**	**2.8**	**2.8**

3-Strong, 2-Medium, 1-Low

SECOND YEAR FOURTH SEMESTER

EC- 6 AL -BIOINFORMATICS AND BIOSTATISTICS

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBT A41	BIOINFORMATICS AND BIOSTATISTICS	EC-6 AL	3	1	0	0	4	4	25	75	100

Learning Objectives	
LO1	Acquire knowledge about the Developments and Applications of Bioinformatics.
LO2	Gain knowledge about the importance of the bioinformatics, databases, tools and software of bioinformatics and explain different types of Biological Databases.
LO3	Understand the basics of sequence alignment, sequence analysis and Protein structure prediction method.
LO4	Demonstrate the basic methods of data collection, graph construction and sampling techniques and Calculate measures of central tendency
LO5	Correlate and analyze biological data through various statistical methods and interpret biological data via various probabilistic distribution methods.

Unit	Contents	No. of Hours
I	Introduction to Bioinformatics–History,Scope and applications, Biological Databases, Importance of Databases, Nucleic acid sequence databases, Protein Databases and Structure Databases	12
II	Sequence analysis (Proteins and Nucleic acids), Pairwise Sequence alignment– BLAST. Multiple Sequences alignment – method of multiple sequences alignment- clustering methods	12
III	Homology modeling of proteins methods for protein structure prediction - visualization tools (RASMOL), History of Drug Discovery, Steps in Drug design - Chemical libraries –(Pubchem)- Role of molecular docking in drug design.	12
IV	Introduction to Biostatistics, Application of Biostatistics in biotechnology, Statistics – collection, classification, tabulations of Statistical Data – Diagrammatic representation – Graphs – Sampling method and standard error. Measures of central tendency (Mean, Median and Mode) – measures	12

	of dispersion.	

V	Correlations and regression. Probability distribution-Binomial, Negative binomial, multinomial distribution, Poisson distribution. Tests of significance – t tests – F tests – Chi square test. Analysis of variance – Statistical Soft wares (SPSS).	12

Course Outcomes	
CO1	Understand the basic concepts of genome, transcriptome, and proteome, and learn gene prediction methods and tools.
CO2	Gain knowledge of biological databases and perform sequence analysis using tools like BLAST and FASTA.
CO3	Compare protein sequences, predict protein structures, and visualize them using tools such as RasMol
CO4	Understand multiple sequence alignment, phylogenetic tree construction, and the basics of drug discovery and molecular docking.
CO5	Apply statistical methods to analyze biological data, including probability, correlation, regression, and significance tests.
Textbooks	
1	Pennington, S.R. and Punn, M.J. 2002.Proteomics: from protein sequence to function. Viva books Pvt. Ltd.
2	Shuba G.,2010. Bioinformatics., Tata McGraw Hill publishing.India.
3	Rastogi, S.C, Mendiratta, N,Rastogi, P., 2004. Bioinformatics methods and application. Prentice-Hall of India private limited, New Delhi.
4	N.Gurumani (2011) "An Introduction to Biostastistics" MJP Publishers
5	VerbalaRastogi .(2011).”Fundamentals of Biostatistics”, Ane books Pvt Ltd Publishers,Chennai.
Reference Books	
1	Attwood, T.K. and Parry-Smith, D.J.2008. Introduction to Bioinformatics. Pearson Education.
2	David Mount., Bioinformatics: sequence and genome analysis, second edition., Taylor & Francis, UK; 2009.
3	D.R.Westhead. Instant Notes in Bioinformatics., second edition., Taylor & Francis, UK; 2009.
4	Zar,(J.H.2010).”Biostatistical Analysis” Fifth Edition, Pearson Education Pvt Ltd, Indian Branch,NewDelhi.
5	P.N.Arora and P.K. Malhan.(2013)"Biostatistics"Himalaya publishing House.

Web Resources

1	https://www.lkouniv.ac.in/site/writereaddata/siteContent/202003291612341467kuaum_yadav_Bioinformatics.pdf
2	https://www.slideshare.net/6263234147/protein-and-nucleic-acid-sequencing
3	https://www.slideshare.net/slideshow/multiple-sequence-alignment-81493182/81493182
4	https://microbenotes.com/phylogenetic-tree/
5	https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200424121624037 0priyamka_SDS_COLLECTION_OF_DATA.pdf

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SECOND YEAR FOURTH SEMESTER

EC - 7 AL (Practical) – Lab in Bioinformatics and Biostatistics

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTA42P	**Lab in Bioinformatics and Biostatistics**	**EC-7 (AL)**	0	0	3	0	2	3	25	75	100

Learning Objectives	
LO1	Analyse the Biological databases
LO2	Able to perform BLAST and FASTA
LO3	Represent data in to graphical form
LO4	Test the level of significance of biological data and interpret the results.
LO5	Determine Correlation Coefficient

Unit	**Contents**	**No.of Hours**
I	Retrieval of Nucleotide, Protein sequence from Database (GenBank, etc.,)	9
II	Sequence similarity search using BLAST & FASTA	9
III	Molecular Visualization using RasMol Measurement of bond length, angle in protein Structure using RasMol	9
IV	Preparation of bar diagram, line diagram and pie diagram using MS EXCEL. Calculation of Central tendency- mean, geometric mean, median using MS EXCEL Calculation of dispersion – Mean deviation, quartile deviation and standard deviation using MS EXCEL	9
V	Calculation of r value using Correlation Coefficient Calculation of student's t test using MS EXCEL	9

Course Outcomes **The students will be able to**	
CO1	Use biological databases such as **NCBI, Swiss-Prot, and PDB** to retrieve and interpret sequence and structure data.
CO2	Perform sequence similarity searches using **BLAST** and **FASTA** tools for functional analysis of biomolecules.
CO3	Identify functional domains in proteins using domain analysis tools like **SMART**.
CO4	Create and interpret **bar diagrams, line diagrams, and pie charts** using **MS Excel** for data visualization.

CO5	Calculate correlation coefficient **and t-tests** using **MS Excel**.
Textbooks	
1	Pennington, S.R. and Punn, M.J. 2002.Proteomics: from protein sequence to function. Viva books Pri. Ltd.
2	Maleolm and Goosfship. J. 2001. Genotype to phenotype, 2ndedition. Bios Scientific Publishers Ltd
3	Misener, S. and Krawetz. S.A. 2000. Bioinformatics: Methods and Protocols. Humana press.
4	Attwood, T.K. and Parry-Smith, D.J.1999. Introduction to Bioinformatics. Pearson Education Asia.
5	Primrose, S.B. 1998. Principle of genome analysis. 2ndedition. Blackwell Science.
Reference Books	
1	Durbin, R., Eddy, S., Krogh, A. and Mitchison, G. 1998. Biological sequence analysis. Cambridge University Press.
2	Friedman, C.P. and Wyatt. J.C. 1997. Computers and Machine: Evaluation methods in medicinal information. Springer-verlag, New York.

Web Resources

1	Bishop, M.J. and Rawhings. C.J. 1997. DNA and protein sequence analysis: A practical approach. Oxford University press. New press. Kolodne
2	Kolodner, R.M. 1997. Computer in Health care: Computerizing large integrated health networks. Springer – Verlag, New York

Mapping Programme Outcomes and Programme Specific Outcsomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3	3	3	2	1	3	3	3	2
CO2	3	1	3	3	3	2	1	3	3	3	2
CO3	3	1	3	3	3	2	1	3	3	3	3
CO4	3	1	3	3	3	2	1	3	3	3	3
CO5	3	1	3	3	3	2	1	3	3	3	3
Total	15	5	15	15	15	10	5	15	15	15	13
Average	3	1	3	3	3	2	1	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

SEC – 5 - Disease diagnosis and prevention

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTS41	**Disease diagnosis and prevention**	**SEC – 5**	2	-	-	-	2	2	25	75	100

Learning Objectives

LO1	To acquire a bacis knowledge on human health and diseases
LO2	To understand the pathogenesis of infectious diseases
LO3	To understand the mechanism of development non-infectious diseases
LO4	To obtain knowledge on the various dignostics procedures
LO5	To perceive the methods of prevention and control of diseases

Unit	Contents	No. of Hours
I	**Human Health and Disease** Introduction to human health and diseases. Infectious and Non-infectious diseases. Modes of transmission- direct and indirect; Epidemic, pandemic and endemic diseases	5
II	**Pathogenesis of infectious diseases** Bacterial diseases- signs and symptoms-typhoid, tuberculosis, syphillis; steps in bacterial pathogenesis; Steps in viral pathogenesis; viral diseases- signs and symptoms-Influenza, covid, dengue; Steps in fungal infection, signs and symptoms-yeast infection, ringworm; Parasitic infections -malaria, lymphatic filariasis, steps in pathogenesis	7
III	**Non-infectious diseases** Causes, symptoms and mechanism-Cancer, diabetes, cardiovascular diseases, Cystic fibrosis, alzheimer's disease, anxiety disorders, autoimmune diseases	5
IV	**Diagnosis and treatment** Sample types, collection and preparation; Diagnostic tests- Biochemical tests, Antibiotic sensitivity test, Widal test, Serological tests- CBC, ELISA, Immunoassays, CSF analysis, Molecular tests, Histopathological assay	10
V	**Prevention and control of diseases** Immunity; Vaccination; Healthy lifestyle, Exercise, Yoga and Meditation, Rehablitation, Screening tests-markers, Social distancing., Antibiotics	3

Course Outcomes	
The student will be able to	
CO1	Understand the various types of diseases and its transmission
CO2	Obtain knowledge on the mode of pathogenesis of infectious diseases
CO3	Gain knowledge on the development of non-infectious diseases
CO4	Comprehend deeper insights into the different diagnostics methods of infectious and non-infectious diseases
CO5	Understand the various preventive measures in controlling diseases
Textbooks	
1	Roy M. Anderson, Robert M. May, Infectious Diseases of Humans Dynamics and Control, 2003, OUP Oxford, 757 pages
2	Molecular Diagnostics: Promises and Possibilities, Mousumi Debnath, Godavarthi B.K.S. Prasad, Prakash S. Bisen, Springer Netherlands, 520 pages
3	Andrej Spec, Bethany Davies, Courtney Chrisler, Gerome Escota, Comprehensive Review of Infectious Diseases, Elsevier publishers, 2025, 831 pages
Reference Books	
1	John H. Dirckx, Human Diseases, Health Professions Institute Publishers, 1997, 370 pages
2	Neelam Sharma, Sandeep Arora, Saurabh Gupta, Sukhbir Singh, Tapan Behl, Metastatic Diseases, Apple Academic Press, 2021, 294 pages
3	Jean-Luc Benoit, Michael David, The Infectious Disease Diagnosis, 2017, 272 pages, Springer International Publishing
4	J. S. Thakur, Public Health Approaches to Non-Communicable Diseases, Lippincott Williams & Wilkins, 2015, pages 448
Web Resources	
1	https://pmc.ncbi.nlm.nih.gov/articles/PMC7150340/
2	https://www.msdmanuals.com/professional/infectious-diseases/laboratory-diagnosis-of-infectious-disease/susceptibility-testing
3	https://accessmedicine.mhmedical.com/content.aspx?bookid=2129&sectionid=192510478
4	https://libguides.mskcc.org/infectiousdiseases/Transmission
5	https://egyankosh.ac.in/bitstream/123456789/101249/1/Unit-4.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	2	1	2	2	2
CO2	3	3	3	3	2	3	2	2	3	1	2
CO3	3	3	3	3	2	3	2	2	3	1	2
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3	3	3	3	3
Total	15	14	15	15	12	15	12	11	14	10	12
Average	3	2.8	3	3	2.4	3	2.4	2.2	2.8	2	2.4

3-Strong, 2-Medium, 1-Low

SECOND YEAR FOURTH SEMESTER
EC- 6 AL - BOTANY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UB TA41	BOTANY	EC-6 AL	3	1	0	0	4	4	25	75	100

Learning Objectives	
LO1	To be familiar with the basic concepts and principles of plant systematics.
LO2	Learn the importance of plant anatomy in plant production systems
LO3	Understand the mechanism underling the shift from vegetative to reproductive phase
LO4	To learn about the physiological processes that underlie plant metabolism
LO5	To know the application of plant growth hormones

Unit	Contents	No. of Hours
I	MORPHOLOGY Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.	12
II	TAXONOMY: Study of the range of characters and plants of economic importance in the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae	12
III	ANATOMY Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot stem and leaves	12
IV	EMBRYOLOGY Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization, structure of dicotyledonous and monocotyledonous seeds.	12
V	PLANT PHYSIOLOGY Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.	12

Course Outcomes	
CO1	Classify plant systematics and recognize the importance of herbarium and virtual herbarium
CO2	Understand the fundamental concepts of plant anatomy and embryology.
CO3	Analyze and recognize the different organs of plants and secondar y growth.
CO4	Understand water relation of plants with respect to various physiological processes
CO5	Classify aerobic and anaerobic respiration.
Textbooks	
1	Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.

2	Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi

3	Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
4	Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont
5	Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.
Reference Books	
1	Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad
2	Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3	Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing.
4	Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd.
5	Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.

Web Resources

1	https://archive.org/EXPERIMENTS/plantanatomy031773mbp_4.
2	https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi 0lwSXFnUC&redir_esc=y 3.
3	https://www.crcpress.com/Plant-Physiology/StewartGlobig/p/book/9781926692692
4	https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagarebook/dp/B00UN5KPQG

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	1	1	3	3	1	1
CO2	3	1	2	2	2	2	2	3	3	2	3
CO3	3	1	2	2	2	3	2	3	3	3	3
CO4	3	1	2	2	2	3	1	3	3	3	3
CO5	3	2	1	2	2	1	1	3	3	2	2
Total	15	6	8	10	10	10	7	15	15	11	12
Average	3	1.2	1.6	2	2	2	1.4	3	3	2.2	2.4

3 – Strong, 2- Medium, 1- Low

SECOND YEAR FOURTH SEMESTER
EC - 7 AL (Practical) – BOTANY

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UBTA42P	**BOTANY**	**EC-7 (AL)**	0	0	3	0	2	3	25	75	100

Learning Objectives	
LO1	To be familiar with the basic concepts and principles of plant systematics
LO2	To understand the basic structure and functions of cell organells
LO3	To learn about the physiological processes that underlie plant metabolism
LO4	To study the development embryology
LO5	To study the primary and secondary structure of stem and root

Unit	**Contents**	**No.of Hours**
I	To describe in technical terms, plants belonging to any of the family prescribes and to identify the family. To dissect a flower, construct floral diagram and write floral formula.	9
II	To dissect a flower, construct floral diagram and write floral formula. Demonstration experiments Ganong's Light screen Ganong'srespiro	9
III	Study the Growth hormones - auxins and cytokinins	9
IV	Dissect and display the T.S of (young and mature) anther - Datura or Cassia flower and any one stage of embryo - Tridax	9
V	Study the types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous. (Permanent slides)	9

Course Outcomes **The students will be able to**	
CO1	To study the classical taxonomy with reference to different parameters.
CO2	To study the morphology characters of plants
CO3	Develop critical understanding on Growth Hormones
CO4	Understand the fundamental concepts of Anther
CO5	Understand the fundamental concepts of Ovule
Textbooks	
1	Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi
2	Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi

3	Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi
4	Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691
5	Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi
Reference Books	
1	Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London
2	Steward, F.C. 2012. Plant Physiology Academic Press, US

Web Resources

1	https://www.amazon.in/Practical-Taxonomy-Angiosperms-RSinha/dp/9380578210

Mapping Programme Outcomes and Programme Specific Outcsomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3	3	3	2	1	3	3	3	2
CO2	3	1	3	3	3	2	1	3	3	3	2
CO3	3	1	3	3	3	2	1	3	3	3	3
CO4	3	1	3	3	3	2	1	3	3	3	3
CO5	3	1	3	3	3	2	1	3	3	3	3
Total	15	5	15	15	15	10	5	15	15	15	13
Average	3	1	3	3	3	2	1	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

SECOND YEAR FOURTH SEMESTER

AEC – 3 – ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT

Course Code	Course name	Category	L	T	P	S	Credit	Hours	Marks		
									CIA	External	Total
24UAEC41	ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT	AEC - 3	2	0	0	0	2	2	25	75	100

Learning Objectives	
LO1	To provide basic knowledge of Environmental Science and Sustainability
LO2	To understand the Fundamentals of Disaster Management
LO3	To create awareness about Natural Disaster and Management
LO4	To familiarize students with Manmade Disaster and Management
LO5	To promote community participation and technological applications in disaster risk reduction

Unit	**Contents**	**Hour**
I	**Environmental Science and Sustainability** Ecosystem: structure, types, and functions - Biodiversity: importance and conservation strategies - Environmental pollution: types (Air & Water), causes, effects, and control measures - Climate change and global warming	5
II	**Fundamentals of Disaster Management** Concepts: disaster, hazard, vulnerability, risk, resilience - Types of disasters: natural and man-made - Disaster management cycle: prevention, mitigation, preparedness, response, recovery**.**	5
III	**Natural Disasters and Management** Earthquakes, floods, Oil spill disaster, cyclones, Tsunami, droughts, landslides, Heat wave - Causes, consequences, and case studies - Community and government measures for preparedness and mitigation. Role of Government in Disaster Management – NDMA, SDMA & DDMA. Community Based Disaster Management	8
IV	**Man-Made Disasters and Management** Industrial accidents, fires, chemical and nuclear hazards, Biological hazards, transport accidents - Impacts on society, economy, and environment - Disaster preparedness and management strategies - Case studies: Bhopal Gas Tragedy, Vizag Gas Leak, urban disasters.	7
V	**Sustainable Development and Disaster Risk Reduction** Principles of sustainable development and Sustainable Development Goals (SDGs) -	5

	Climate change and disaster interlinkages - Disaster risk reduction strategies: early warning systems, resilient infrastructure, policy framework. Role of technology, education, and media in environmental sustainability and disaster management	

Course Outcomes **The students will be able to**	
CO1	Describe the importance of ecosystems, biodiversity, and methods of controlling pollution.
CO2	Understand the basic concepts of disaster management, hazards, risks, and resilience.
CO3	Explain the causes, effects, and control measures of major natural disasters.
CO4	Identify different types of man-made disasters and suggest safety and preparedness measures.
CO5	Recognize the role of sustainable development and disaster risk reduction strategies in protecting environment and society.
Textbooks	
1	Government of India – Disaster Management Act, 2005
2	P.C. Mishra – Disaster Management and Mitigation
Reference Book	
1	Erach Bharucha – Textbook of Environmental Studies
2	IGNOU Study Material – Disaster Management

Web Resources:

1	https://ndma.gov.in/

Mapping Programme Outcomes and Programme Specific Outcomes with Course Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	3	2	2	3	3	3	3
CO2	3	3	3	3	3	2	3	3	3	3	2
CO3	3	3	3	3	3	2	3	3	3	3	2
CO4	3	2	3	3	3	2	3	3	3	3	2
CO5	3	2	3	3	3	2	3	3	3	3	2
Total	15	13	15	15	15	10	14	15	15	15	11
Average	3	2.6	3	3	3	2	2.8	3	3	3	2.2

3 – Strong, 2- Medium, 1- Low