ERA UNIVERSITY, LUCKNOW
STUDY & EVALUATION SCHEME (Effective from Session 2025-26)
B.Sc. BIOTECHNOLOGY
YEAR III, SEMESTER – VI

S. No.	Course category	Course code	Course title	Hours/Week			EVALUATION SCHEME				Course Total	C	Attributes						
				L	T	P	Mid Sem Exam	TA	Total	End Sem Exam			Employability	Entrepreneurship	Skill Development	Gender	Environment Sustainability	Human values	Professional Ethics
THEORY																			
1.	Major Own Faculty	BBT0601T	Animal Biotechnology	3	1	0	12	18	30	70	100	4	√	√	√		√		
2.	Major Own Faculty	BBT0602T	Proteomics, Genomics & Metabolomics	3	1	0	12	18	30	70	100	4	√	√	√		√		
3	Major Own Faculty	BBT0603T	Industrial & Pharmaceutical Biotechnology	3	1	0	12	18	30	70	100	4	√	√	√		√		
4.	Major Own Faculty	BBT0604T	IPR Biosafety & Ethical Issues	3	1	0	12	18	30	70	100	4	√	√	√		√		
5	Other Faculty	BBT0605H	Communication skills & personality development	2	0	0	12	18	30	70	100	2	√	√	√		√	√	√
PRACTICALS																			
6.	Major Own Faculty	BBT0606P	Animal Biotech Lab	0	0	4	12	18	30	70	100	2	√	√	√		√		
7.	Major Own Faculty	BBT0607P	Proteomics, Genomics & Metabolomics Lab	0	0	4	12	18	30	70	100	2	√	√	√		√		
8.	Major Own Faculty	BBT0608R	Project/Training	0	0	6	0	0	0	100	100	3	√	√	√		√		
	Total										**800**	**25**							

CREDITS

S. No.	Semester	Total Marks	Total Credit
1.	I	700	19
2.	II	700	21
3.	III	700	21
4.	IV	600	19
5.	V	800	25
6.	VI	800	25
Grand Total	---------	**4300**	**130**

ERA UNIVERSITY
Department of Biotechnology
Course Outline
Academic Year: 2025-26

Course Name: Animal Biotechnology		**Course Code:** BBT0601T	**Year:** III	**Semester:** VI
Co-curricular/Vocational/Core/Elective: Core				
Credits: 4	**Total No. of Lectures:** 60	**Lecture-Tutorial-Practical (in hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	30	**End Term Exam**	70
Subject prerequisites	To study this subject, a student must have had biology in class 12th			
Course Objective	The broad objective of the present core course is to provide an overview of animal biotechnology. In this respect, students will be acquainted with principles and applications of different techniques of animal cell/tissue culture and genetic transformation. In case of cell and tissue culture, the focus shall be on media composition and preparation, methods of in vitro propagation, their applications and limitations.			
Course Outcome	*After the successful course completion, learners will develop following attributes:* CO1: Students will be gaining in-depth knowledge about the principles and applications of plant tissue culture and animal cell culture. CO2: Development of plant transformation vectors specifically designed to facilitate transfer of improved/unique genetic traits to plants, and to provide knowledge on diverse genetic transformation technologies available for the production of transgenic plants in crop improvement programs. CO3: Familiarization with knock-out and transgenic animals to model disease and study gene function.			
Pedagogy	Interactive, discussion-based, student-centred, Presentation			
Internal Evaluation Mode	Sessional Test; Quiz; Assignments; Attendance; Presentations			
UNIT	**Topic**			**No. of Lectures**
I	**Introduction to Animal Tissue Culture:** Animal tissue culture- concept and application, Risks in tissue culture laboratory - safety and biohazards; Minimal requirement for cell culture- infrastructure, equipment, consumable and non-consumable items; Various types of contamination, Aseptic conditions and methods of sterilization. **Cell culture Media:** Natural and synthetic media, physicochemical properties of culture media, balanced salt solutions, complete culture media and its composition, Serum-free media.			**15**
II	**Tissue culture characteristics:** Cell adhesion and cell surface molecules of cultured cells. Growth curve and growth parameters of cultured cells; Various techniques for characterization of cultured cells and the authentication of specific cell lines. **Tissue culture techniques:** Evolution and establishment of			**15**

	cell lines, finite and continuous cell lines, Immortalization of cell lines- methods and application. Cell Synchronization- methods and application	
III	**Primary cell culture-** Various isolation techniques; maintenance of cell culture, passaging and freezing of monolayer and suspension culture. **Stem cell culture-** Embryonic and epithelial stem cell culture. **Transformed cells-** Characteristics and methods. **Cell transfection-** methods and application.	**15**
IV	**Experimental applications-** Cell separation techniques- Centrifugal elutriation and FACS. Cell viability and cytotoxicity assays, Clonogenic survival assays. **Applied animal biotechnology:** Transgenic animals- mice, cattle, sheep, and fish- methods of production and their application;	**15**
	Suggested Readings 1. Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications by Amanda Capes-Davis and R. Ian Freshney: 2. Textbook of Animal Biotechnology by B Singh **3.** Animal Cell Culture and Technology By Michael Butler	

Course created by: Dr. Sahabjada **Approved by:**

UNIT	MAPPED CO
I	CO1
II	CO2
III	CO3
IV	CO4

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	√		√	√	√		√		√		√		√	√		
CO2	√		√	√	√		√		√		√		√	√		
CO3	√		√	√	√		√		√		√		√	√		
CO4	√		√	√	√		√		√		√		√	√		

ERA UNIVERSITY
Department of Biotechnology
Course Outline
Academic Year: 2025-26

Course Name: Proteomics, Genomics and Metabolomics	**Course Code:** BBT0602T	**Year:** III	**Semester:** VI
Co-curricular/Vocational/Core/Elective: Core			

Credits: 4	**Total No. of Lectures:** 60	**Lecture-Tutorial-Practical (in hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	30	**End Term Exam**	70
Subject prerequisites	To study this subject, a student must have had biology in class 12th			
Course Objective	The objective of this course is to develop the understanding of genome, nucleotide sequence, proteomics and technologies in metabolomics.			
Course Outcome	*After the successful course completion, learners will develop following attributes:* CO1: Students will be gaining in-depth knowledge about the basics of genome and techniques used. CO2: Students will be learning the different types of nucleotide sequence determination techniques. CO3: Students will understand the basic proteomics technologies are used in modern era. CO4: Students will learn the applications of technologies of metabolomics in agriculture, human health and industry.			
Pedagogy	Interactive, discussion-based, student-centered, Presentation			
Internal Evaluation Mode	Sessional Test; Quiz; Assignments; Attendance; Presentations			

UNIT	**Topic**	**No. of Lectures**
I	**Studying the Genome:** Biomarker, Genetic Mapping- Markers for Genetic Mapping; RFLP, SSLP – VNTR's, STR's, SNP's, Physical Mapping– In situ hybridization, Sequence Tagged Sites Mapping. DNA data bases.	**15Hrs**
II	**Determination of nucleotide sequence:** Chemical degradation method, Sanger's dideoxynucleotide synthetic method. Direct DNA sequencing using PCR, Sequencing by conventional shotgun method, Whole genome shot gun method, Clone Contig method.	**15Hrs**
III	**Proteomics:** Introduction to basic proteomics technology; Bio-informatics in proteomics; Proteome analysis, Proteomics classification,1D-SDS-PAGE, 2D-SDS PAGE, Detection and quantitation of proteins in gels, Pros and cons of various staining methods; Basics of mass spectrometry, MALDI- TOFF and ESI, and their application in proteomics; Tandem MS/MS spectrometry, Affinity purification of protein.	**15Hrs**
IV	**Metabolomics:** Technologies in metabolomics, Role of Spectroscopy, Electrophoretic and Chromatography techniques in metabolic profiling, Nutrigenomics, Applications of genomics and proteomics in agriculture,	**15Hrs**

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	human health and industry.	

Suggested Readings

1. Hubert Rehn, 2006 Protein Biochemistry and Proteomics -, Academic press.
2. Liebler, Humana W., 2002. Introduction to proteomics: Tools for new Biology CBS pub O'Reilly, "Developing Bioinformatics Computer Skills".
3. Griffiths JF, "An Introduction to Generic Analysis".
4. Gene Cloning and DNA Analysis: An Introduction, 6th Edition by T. A. Brown.
5. Genomics and Proteomics: Functional and Computational Aspects by Suhai.

Course created by: DR. ZAINAB

Approved by:

MAPPED CO's WITH PO's & PSO's

UNIT	MAPPED CO
I	CO1
II	CO2
III	CO3
IV	CO4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	√	√	√	√	√	√	√		√	√	√		√	√	√	
CO2	√	√	√	√	√	√	√		√	√	√		√	√	√	
CO3	√	√	√	√	√	√	√		√	√	√		√	√	√	
CO4	√	√	√	√	√	√	√		√	√	√		√	√	√	

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ERA UNIVERSITY
Department of Biotechnology
Course Outline
Academic Year: 2025-26

Course Name: Industrial and Pharmaceutical Biotechnology		**Course Code:** BBT0603T		**Year:** III	**Semester:** VI
Co-curricular/Vocational/Core/Elective: Core					
Credits: 4	**Total No. of Lectures:** 60		**Lecture-Tutorial-Practical (in hours/week) L-T-P:** 3-1-0		
Evaluation Spread	**Internal Continuous**	30	**End Term Exam**	70	
Subject prerequisites	To study this subject, a student must have had biology in class 12th				
Course Objective	The objective of this course is to develop the s basic concept of fermentation technology, fermentation media, microbial transformation and production of monoclonal and polyclonal antibodies.				
Course Outcome	*After the successful course completion, learners will develop following attributes:* CO1: To gain better knowledge of fermentation media industries and sterilization techniques. CO2: Students will learn about industrial production of alcohol, antibiotic, amino acid and vitamin. CO3: Students will understand design and selection of biotransformation processes and organisms. CO4: Students will learn the basic concept of monoclonal and polyclonal antibodies production.				
Pedagogy	Interactive, discussion-based, student-centered, Presentation				
Internal Evaluation Mode	Sessional Test; Quiz; Assignments; Attendance; Presentations				

UNIT	**Topic**	**No. of Lectures**
I	**Introduction to industrial biotechnology**, Basic principles of fermentation technology, Fermentation media, Natural and synthetic media, Sterilization techniques: Heat, Radiation and Filtration method. Fermenters, Process of Aeration, Agitation, Temperature regulation and Filtration method.	**15Hrs**
II	**Process Development** - Shake flask fermentation, Downstream processing, Disintegration of cells, Separation, Extraction, Concentration and purification of products.Production of industrial microbiological products: Alcoholic beverage, Antibiotic, Amino acid and Vitamin.	**15Hrs**
III	**Microbial Transformation:** Introduction, types of reactions mediated by microorganisms, design of biotransformation processes, selection of organisms, biotransformation process and its improvements with special reference to steroids. **Microbial Spoilage:** Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non-injectibles, ophthalmic preparations and implants) and their sterilization.	**15Hrs**

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IV	**HybridomaTechnology:** Production of monoclonal and polyclonal antibodies with different types of antigens, antigen preparation and modification, adjuvants dose and route of antigen administration, collection of sera, purification of antibodies, production and applications of monoclonal antibodies.	**15Hrs**

Suggested Readings

1. Bisen P.S (1994) Frontiers in Microbial Technology
2. Prescott & Dunn, Industrial Microbiology, Agrobios (India)
3. Crueger W. &Crueger A. A text of Industrial Microbiology.
4. Stanbury P.F, Ehitaker H, Hall S.J. Priciples of Fermentation Technology.
5. Principles of Fermentation Technology, 3rd Edition by Allan Whitaker

Dr. Israr Ahmad

Course created by: **Approved by:**

UNIT	MAPPED CO
I	CO1
II	CO2
III	CO3
IV	CO4

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	√		√	√	√		√	√	√		√		√	√	√	√
CO2	√		√	√	√		√	√	√		√		√	√	√	√
CO3	√		√	√	√		√	√	√		√		√	√	√	√
CO4	√		√	√	√		√	√	√		√		√	√	√	√

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ERA UNIVERSITY
Department of Biotechnology
Course Outline
Academic Year: 2025-26

Course Name: IPR Biosafety & Ethical Issues	**Course Code:** BBT0604T	**Year:** III	**Semester:** VI
Co-curricular/Vocational/Core/Elective: Core			
Credits: 4	**Total No. of Lectures:** 60	**Lecture-Tutorial-Practical (in hours/week) L-T-P:** 3-1-0	
Evaluation Spread	**Internal Continuous** 30	**End Term Exam**	70
Subject prerequisites	To study this subject, a student must have had biology in class 12th		
Course Objective	The objective of this course is to develop the understanding the importance of IP and to educate the pupils on basic concepts of Intellectual Property Rights, identify the significance of practice and procedure of Patents, make the students to understand the statutory provisions of different forms of IPRs in simple forms, learn the procedure of obtaining Patents, Copyrights, Trade Marks & Industrial Design and enable to keep their IP rights alive.		
Course Outcome	*After the successful course completion, learners will develop following attributes:* CO1: Distinguish and explain various forms of IPRs. CO 2: Identify criteria to fit one's own intellectual work in particular form of IPRs. CO 3: Apply statutory provisions to protect particular form of IPRs. CO4: Analyze rights and responsibilities of holder of Patent, Copyright, Trademark and Industrial Designetc. CO5: Identify procedure to protect different forms of IPRs at national and international level. CO6: Develop skill of making search using modern tools and techniques.		
Pedagogy	Interactive, discussion-based, student-centered, Presentation		
Internal Evaluation Mode	Sessional Test; Quiz; Assignments; Attendance; Presentations		

UNIT	**Topic**	**No. of Lectures**
I	**IPR:** Concept of Intellectual Property, Forms of IPR: Trade secret, Patent, Copy right, Trade mark, Industrial design, Geoghaphical indication, IPR protection and remedies licensing, Indian Patent Act 1970 (amedement 2000).	**15Hrs**
II	**Patent Laws**: International Harmonization of Patent Laws: Paris convention Treaty, WIPO, European Patent Convention, TRIPs, Protection of Biotechnological inventions, Plant Breeder's Right (PBR): Historical requirement for PBR, The extent of protection by PBR, Management of IPR, Benefit and problem from IPR.	**16Hrs**
III	**Rights/protection**: Requirement of patentable novelty, Rights/protection, infringement or violation, remedies against infringement - civil and criminal.	**13Hrs**
IV	**Biosafety:** Historical background; Introduction to biological safety cabinets; Biosafety levels; Biosafety guidelines-Government of India ,	**16Hrs**

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	Risk analysis: Risk assessment ,management and communication Containment, Planned introduction of genetically modified organism (GMOs): Budapest treaty, Biotechnology products Food and Drugs; Bioethical issues.	

Suggested Readings

1. Intellectual property rights- Ganguli-Tat Mc. Grawhill. (2001) ISBN-10: 0074638602,
2. Intellectual Property Right- Wattal- Oxford Publicatiopn House.(1997) ISBN:0195905024.
3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
4. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press. 9. B.D. Singh. Biotechnology expanding horizons

Course created by: Dr. Manjal Jaffera 6/9/25

Approved by:

UNIT	MAPPED CO
I	CO1, CO2, CO3
II	CO4
III	CO5
IV	CO6

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	√	√	√	√	√	√	√		√	√	√		√	√	√	
CO2	√	√	√	√	√	√	√		√	√	√		√	√	√	
CO3	√	√	√	√	√	√	√		√	√	√		√	√	√	
CO4	√	√	√	√	√	√	√		√	√	√		√	√	√	
CO5	√	√	√	√	√	√	√		√	√	√		√	√	√	
CO6	√	√	√	√	√	√	√		√	√	√		√	√	√	

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ERA UNIVERSITY
Department of Biotechnology
Course Outline
Academic Year: 2025-26

Course Name: Communication Skills and Personality Development		**Course Code:** BBT0605H	**Year:** III	**Semester:** VI
Co-curricular/Vocational/Core/Elective: Co-Curricular				
Credits: 2	**Total No. of Lectures:** 30		**Lecture-Tutorial-Practical (in hours/week) L-T-P:** 2-0-0	
Evaluation Spread	**Internal Continuous**	30	**End Term Exam**	70
Subject prerequisites	To study this subject, a student must have had class 12th			
Course Objective	The objective of this course is to develop the understanding of personality and learn about grooming, communication skills and how to perform well in interviews.			
Course Outcome	*After the successful course completion, learners will develop following attributes:* CO1: To understand the concept of Personality. CO2: To learn what personal grooming pertains. CO3: To learn to make good resume and prepare effectively for interview. CO4: To learn to perform effectively in group discussions. CO5: To explore communication beyond language. CO6: To learn to manage oneself while communicating. CO7: To acquire good communication skills and develop confidence.			
Pedagogy	Interactive, discussion-based, student-centered, Presentation			
Internal Evaluation Mode	Sessional Test; Quiz; Assignments; Attendance; Presentations			

UNIT	Topic	No. of Lectures
I	**PERSONALITY AND PERSONAL GROOMING** ***Understanding Personality*** • Definition and Meaning of Personality • Types of Personality • Components of Personality • Determinants of Personality • Assessment of Personality ***Grooming Self*** • Dress for success • Make up & skin care • Hair care & styles for formal look • Art of accessorizing • Oral Hygiene	**7Hrs** All topics will include practical learning
II	**INTERVIEW PREPARATION AND GROUP DISCUSSION** • Meaning and Types of Interview [Face to Face, Telephonic, Video] • Interview procedure [Opening, Listening, Closure] • Preparation for Interview • Resume Writing • LinkedIn Etiquette • Meaning and methods of Group Discussion • Procedure of Group Discussion. • Group Discussion simulation • Group discussion common error	**8Hrs** Mock Interviews Included
III	**BODY LANGUAGE AND BEHAVIOUR** • Concept of human behavior • Individual and group behavior • Developing Self-Awareness • Behaviour and body language	**7Hrs**

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	Dimensions of body language: Proxemics Haptics Oculesics Paralanguage Kinesics Sign Language Chromatics Chronemics Olfactics • Cultural differences in Body Language • Business Etiquette & Body language • Body Language in the Post Corona Era • Virtual Meeting Etiquette • Social Media Etiquette	
IV	**ART OF GOOD COMMUNICATION** • Communication Process • Verbal and Non-verbal communication • 7 C's of effective communication • Barriers to communication • Paralinguistics: Pitch, Tone, Volume, Vocabulary, Word stress, Pause • Types of communication: Assertive, Aggressive, Passive, Aggressive • Listening Skills • Questioning Skills • Art of Small Talk • Email Writing	**8Hrs**

Suggested Readings:

1. Cloninger, S.C., "Theories of Personality: Understanding Person", Pearson, New York, 2008, 5th edition.
2. Luthans F, "Organizational Behaviour", McGraw Hill, New York, 2005, 12th edition.
3. Barron, R.A. & Brian D, "Social Psychology", Prentice Hall of India, 1998, 8th edition.
4. Adler R.B., Rodman G. & Hutchinson C.C., "Understanding Human Communication", Oxford University Press: New York, 2011.
5. Suggestive digital platforms web links

Course created by: UP GOVT. **Approved by:**

MAPPED CO's WITH PO's & PSO's

UNIT	MAPPED CO
I	CO1, CO2
II	CO3, CO4
III	CO5, CO6
IV	CO7

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1			√		√		√						√	√	√	√
CO2			√		√		√						√	√	√	√
CO3			√		√		√						√	√	√	√
CO4			√		√		√						√	√	√	√
CO5			√		√		√						√	√	√	√
CO6			√		√		√						√	√	√	√
CO7			√		√		√						√	√	√	√

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ERA UNIVERSITY
Department of Biotechnology
Course Outline
Academic Year: 2025-26

Course Name: Animal Biotechnology Lab		**Course Code:** BBT0606P	**Year:** III	**Semester:** VI
Co-curricular/Vocational/Core/Elective: Core				
Credits: 2	**Total No. of Lectures:** NIL **Lecture-Tutorial-Practical (in hours/week) L-T-P:**0-0-4			
	Internal Continuous	30	**End Term Exam**	70
Subject prerequisites	To study this subject, a student must have had biology in class 12th			
Course Objective	The objective of this course is to develop the understanding of various procedures, protocols and techniques used in animal biotechnology, food biotechnology, and plant biotechnology experiments.			
Course Outcome	*After the successful course completion, learners will develop following attributes:* CO: Have knowledge of the animal cell culture techniques including media preparation, its sterilisation, characteristics, maintenance of various cell lines, their viability and toxicity analysis, primary cell culture isolation and its maintenance techniques, and mammalian cell staining and protein quantification.			
Pedagogy	Interactive, discussion-based			
Internal Evaluation Mode	Sessional Test; Viva; Attendance; Lab Record			
	List of Experiments			**Practical (in Hrs)**
Animal Biotechnology Lab	1. Equipment, Glass ware, Plastic wares, Media and Reagents for Animal cell culture 2. Preparation of phosphate buffer saline (PBS) buffer at pH= 7.4 3. Preparation of Animal cell culture media and Filter sterilization 4. Morphological characteristics of mammalian cell line under microscopy 5. Cell passaging and maintenance of mammalian cell lines (Adherent cells) 6. Cryopreservation of mammalian cell line. 7. Quantification of cells by haemocytometer 8. Measurement of live and dead cells density by Trypan blue dye exclusion assay. 9. Haematoxylin and eosin staining of mammalian cells.			**30 Hrs**

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	10. Isolation and culture of primary goat hepatocytes 11. Determination of protein concentration by Bradford method.	

Suggested Readings

1. Barker K (2004). At the Bench: A laboratory Navigator. Cold Spring Harbor Laboratory Press. USA.
2. Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (8th ed.) by Amanda Capes-Davis and R. Ian Freshney:
3. Animal Cell Culture: A Practical Approach edited by John R.W. Masters:
4. Practical Approach to Mammalian Cell and Organ Culture edited by Tapan Kumar Mukherjee, Parth Malik, and Srirupa Mukherjee

Course created by: Dr SAHABJADA **Approved by:**

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	√	√	√	√	√	√	√		√	√	√		√	√	√	

ERA UNIVERSITY
Department of Biotechnology
Course Outline
Academic Year: 2025-26

Course Name: Proteomics, Genomics and Metabolomics Lab	**Course Code:** BBT0607P	**Year:** III	**Semester:** VI
Co-curricular/Vocational/Core/Elective: Core			
Credits: 2	**Total No. of Lectures:** NIL **Lecture-Tutorial-Practical (in hours/week) L-T-P:0-0-4**		
	Internal Continuous 30	**End Term Exam**	70
Course Objective	To equip students with comprehensive knowledge and practical skills in using advanced analytical techniques such as PCR-RFLP, FISH, Sanger Sequencing, SDS-PAGE, LC-MS/MS, GC-MS, ICPMS, and UHPLC for genomics, proteomics, and metabolomics analysis.		
Course Outcome	CO1: Students will be able to understand the principles and applications of molecular/genomics, proteomics and metabolomics techniques. CO2: Students will gain practical experience in applying techniques like PCR-RFLP, FISH, Sanger Sequencing, SDS-PAGE, LC-MS/MS, GC-MS, ICPMS, and UHPLC to analyse genetic, proteomic, and metabolite profiles of biological samples in the laboratory setting.		
Pedagogy	The course will utilize a blended learning approach combining lectures, hands-on practical sessions, group work, and discussions to ensure effective learning.		
Internal Evaluation Mode	Sessional Test; Quiz; Assignments; Attendance; Presentations		

	List of Experiments	**Practical (in Hrs)**
	1. PCR-RFLP 2. FISH 3. Sanger Sequencing 4. 1D and 2D SDS-PAGE Analysis 5. LC-MS/MS 6. GC-MS Based Metabolite Profiling 7. ICPMS 8. UHPLC	60

Suggested Readings

1. Principles of Gene Manipulation and Genomics by Sandy B. Primrose and Richard Twyman, John Wiley & Sons, Edition 7th.
2. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson, Andreas Hofmann, John M. Walker, Samuel Clokie, Cambridge University Press, 2018.
3. Modern Proteomics – Sample Preparation, Analysis and Practical Applications by Hamid Mirzaei, Martin Carrasco, Springer Publishing Group, 2016.
4. Introduction to Proteomics: Tools for the New Biology by Daniel C. Liebler, Humana Totowa, NJ, Edition 1st.
5. Introduction to Modern Liquid Chromatography by Lloyd R. Snyder, Joseph J. Kirkland, and John W. Dolan, John Wiley & Sons, Edition 3rd .

ERA UNIVERSITY
Department of Biotechnology
Course Outline
Academic Year: 2025-26

Course Name: Project/Training		**Course Code:** BBT0608R	**Year:** III	**Semester:** VI
Co-curricular/Vocational/Core/Elective: Core				
Credits: 3	**Total No. of Lectures-Tutorial-Practical (In hours/week)** **L-T-P:**0-0-6			
Evaluation Spread	**Internal Continuous**	NIL	**End Term Exam**	100
Course Objective	The main objective of this course is to develop independence in experimental design and interpretation and to develop research skills. To promote education and research in biotechnology and provide academic and professional excellence for immediate productivity in industrial, governmental, or clinical settings for an ultimate benefit of society and environment.			
Course Outcome	After completion of this course students will be able to: CO1: Perform literature review. CO2: Establish a methodology using advanced tools / techniques.			
Pedagogy	Interactive, Discussion Based Sessions, Presentations, Seminars, Practical's			
Internal Evaluation Mode	**NIL**			

Course created by: **Approved by:**

MAPPED CO's WITH PO's & PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	√	√	√	√	√	√	√		√	√	√	√	√	√	√	√
CO2	√	√	√	√	√	√	√		√	√	√	√	√	√	√	√