B.Sc. BIOTECHNOLOGY

Semester	Course Code	Course Category	Hours/	Hours/ Week	Marks for Evaluation		
			Week		CIA	ESE	Total
III	25UBTVAC1	Value Added Course - I	30	-	-	100	100

Course Title

GENE EDITING AND 3D PRINTING IN BIOTECHNOLOGY

SYLLABUS					
UNITS	CONTENT	HOURS			
I	Fundamentals of Gene Editing: Basics of genome editing: Need and significance, Gene editing tools: Zinc-finger nucleases (ZFN), Transcription activator-like effector nucleases (TALENs), Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR-Cas9). Variants of CRISPR (Base Editing, Prime Editing),	6			
II	Advanced Gene Editing Techniques: CRISPR in gene therapy and regenerative medicine, Gene editing in personalized medicine and drug development	6			
III	Introduction to 3D Bio-printing: Overview of 3D printing, Types of 3D printing (SLA, FDM, SLS), Bioprinting vs. Traditional 3D printing,	6			
IV	3D Bioprinting in Biotechnology: Tissue engineering and regenerative medicine applications. 3D printing of artificial organs (Heart, Kidney, Liver, Skin, Bone, Cartilage).	6			
V	Integration of Gene Editing and 3D Bioprinting: CRISPR-engineered tissues using bioprinting. Gene-edited organoids for disease modelling. 3D-printed scaffolds for genetic engineering applications,	6			

Text Book(s):

- 1. Appasani, K. Genome Editing: The Next Step in Gene Therapy. Cambridge University Press, 2018.
- 2. **Doudna, J., & Mali, P.** CRISPR-Cas: A Laboratory Manual. Cold Spring Harbor Laboratory Press, 2016.
- 3. Turksen, K. Gene Editing: Principles and Applications. Springer Nature, 2021.

Reference Book(s):

- 1. Thomas, D., & Ahmad, Z. 3D Bioprinting for Reconstructive Surgery: Techniques and Applications. Woodhead Publishing (Elsevier), 2017.
- 2. Ratner, B. D., Hoffman, A. S., Schoen, F. J., & Lemons, J. E. *Biomaterials Science: An Introduction to Materials in Medicine*. Elsevier Academic Press, 2020 (4th Edition).
- 3. **Rybicki, F. J., & Grant, G. T.** 3D Printing in Medicine: A Practical Guide for Medical Professionals. Springer Nature, 2017.

Web Resource(s):

- 1. <u>https://3dprintingindustry.com/bioprinting/</u>
- 2. <u>https://www.wakehealth.edu/About-Us/Research/Institutes-and-Centers/Wake-Forest-Institute-for-Regenerative-Medicine</u>
- 3. <u>https://3dprintingindustry.com/bioprinting/</u>

Course Outcomes					
Upon successful completion of this course, the student will be able to:					
CO No.	CO Statement				
C01	Explain the fundamental principles of gene editing technologies, including CRISPR-Cas9, TALENs, and ZFNs.				
CO2	Analyze the applications of gene editing in healthcare, agriculture, and synthetic biology, while evaluating its ethical and regulatory aspects.				
CO3	Demonstrate knowledge of 3D bioprinting techniques, biomaterials, and their applications in regenerative medicine and tissue engineering.				
CO4	Evaluate the integration of gene editing and 3D bioprinting in developing bioengineered tissues, organoids, and personalized medicine.				
C05	Design innovative solutions using gene editing and 3D printing technologies for applications in biotechnology, biomedical research, and industrial advancements.				

Course Coordinator: Dr. R. Shalini

Semester	Course Code	Course Category	Hours/	Cradita	Marks for Evaluation		
			Week	creatts	CIA	ESE	Total
V	25UBTVAC2	Value Added Course - II	30	-	-	100	100

Course Title

NUTRACEUTICAL AND FUNCTIONAL FOODS

SYLLABUS				
UNITS	CONTENT	HOURS		
I	Introduction to Nutraceuticals and Functional Foods			
	nutraceuticals - Historical perspective and traditional use of food as medicine- Role	6		
	of functional foods in health promotion and disease prevention.			
	Bioactive Components in Functional Foods			
	Types of bioactive compounds: Phytochemicals (polyphenols, flavonoids,			
II	carotenoids)- Probiotics and Prebiotics-Dietary fibers and their role in gut health,	6		
	Omega-3 fatty acids and heart health- Bioactive proteins and peptides as functional			
	foods. Applications of probiotics and prebiotics.			
	Functional Food and Health Benefits			
ш	Nutraceuticals of animal origin in functional foods and health benefits: collagen	6		
	chitin, chitosan, choline, lecithin; Nutraceuticals of plant origin in functional foods	Ŭ		
	and health benefits: Terpenoids, Phenolics, Alkaloids, Phytoestrogens, Pigments.			
	Processing and Quality Control of Functional Foods			
	Methods of extraction and isolation of bioactive compounds: Solvent Extraction			
IV	Maceration, Percolation, Soxhlet Extraction, Distillation for volatile bioactives,			
	Cold Pressing; Fortification and enrichment of functional foods-Stability,	6		
	bioavailability, and efficacy of nutraceuticals - Safety concerns and toxicological			
	aspects of nutraceuticals			
	Regulations, Market Trends, and Future Perspectives			
	Regulatory aspects (FSSAI, FDA, EFSA, Codex Alimentarius)- Labelling and	et 6		
V	health claims for functional foods and their applications- Global and Indian market			
-	trends in nutraceuticals- Challenges and future scope in the nutraceutical industry-			
	Ethical concerns and sustainability in functional food production.			

Text Book(s):

- 1. Wildman, R. E., Wildman, R., & Wallace, T. C. (2016). *Handbook of nutraceuticals and functional foods*. CRC press.
- 2. Keservani, R. K., Sharma, A. K., & Kesharwani, R. K. (Eds.). (2018). *Nutraceutical and functional foods in disease prevention*. IGI Global.
- 3. Singh, R. B. (Ed.). (2021). Functional foods and nutraceuticals in metabolic and noncommunicable diseases. Academic Press.

Reference Book(s):

- 1. Mine, Y., Li-Chan, E., & Jiang, B. (Eds.). (2010). *Bioactive proteins and peptides as functional foods and nutraceuticals* (Vol. 29). John Wiley & Sons.
- 2. Vattem, D. A., & Maitin, V. (Eds.). (2015). Functional foods, nutraceuticals and natural products: concepts and applications.

Web Resource(s):

- 1. <u>https://www.firsthope.co.in/classification-of-nutraceutical-traditional-nutraceuticals-non-traditional-nutraceuticals</u>
- 2. https://www.healthline.com/nutrition/functional-foods
- 3. https://www.tilleydistribution.com/insights/the-benefits-of-functional-foods/

Course Outcomes					
Upon successful completion of this course, the student will be able to:					
CO No.	CO Statement				
C01	Outline the basic classification and historical perspective of functional foods.				
CO2	Analyze the role of bioactive compounds and dietary fibers present in foods.				
CO3	Evaluate the health benefits of neutraceuticals of plant and animal origin.				
CO4	Demonstrate the process involved in isolation and fortification of bioactive compounds in functional foods.				
CO5	Evaluate the regulatory aspects, market trends and future prospects in neutraceutical industry.				

COURSE COORDINATOR: Ms. M.S. Shabeena Banu

M.Sc. BIOTECHNOLOGY

Semester	Course Code	Course Category	Hours/	Cradita	Marks for Evaluation		
			Week	creuits	CIA	ESE	Total
III	25PBTVAC1	Value Added Course	30	-	-	100	100

Course Title PHARMACOGENOMICS AND PERSONALIZED MEDICINE

SYLLABUS				
UNITS	CONTENT	HOURS		
Ι	Fundamentals of Pharmacogenomics: Introduction to pharmacogenomics and its importance, basic principles of pharmacogenomics- genetic basis of drug response, role of single nucleotide polymorphisms (SNPs) in drug metabolism, pharmacokinetics and pharmacodynamics in relation to genetic variations.	6		
II	Techniques in pharmacogenomics: Principles, applications and result interpretation of genotyping, microarrays, next-generation sequencing (NGS) techniques.	6		
III	Pharmacogenomics in Disease Management: Application of pharmacogenomics in cardiovascular diseases, cancer and autoimmune diseases. Personalized medicine in neurological disorders (Alzheimer's, Parkinson's) disease.	6		
IV	Personalized Medicine and Biomarkers: Concept and significance of personalized medicine, Role of biomarkers in personalized treatment strategies, Companion diagnostics and targeted therapy.	6		
v	Ethical, legal, and regulatory aspects of pharmacogenomics and future challenges: Challenges in clinical implementation of pharmacogenomics, Global initiatives and regulatory framework in personalized medicine. Role of Artificial Intelligence (AI) in pharmacogenomics.	6		

Text Book(s):

- 1. Ajay Sharma, Pharmacogenomics: A primer for clinicians, McGraw Hill Education, 2024.
- 2. **Federico Innocenti**, Pharmacogenomics (Second Edition), Springer protocol, Humana Press, 2024.
- 3. **David F. Kisor,** Pharmacogenomics: Foundations, Competencies, and the Pharmacists' Role, McGraw Hill (Second Edition), 2023.

Reference Book(s):

- 1. Russ B. Altman, Principles of Pharmacogenomics, Cambridge University Press, 2013.
- 2. Howard L. McLeod, Pharmacogenomics in Precision Medicine, CRC Press, 2020.
- 3. Mukesh Verma, Pharmacogenomics: An Introduction and Clinical Perspective, Springer, 2021.

Web Resource(s):

- 1. https://www.fda.gov/Drugs/ScienceResearch/ucm572698.htm
- 2. https://www.pharmgkb.org/
- 3. <u>https://www.genome.gov/genetics-glossary/Pharmacogenomics</u>

Course Outcomes				
Upon successful completion of this course, the student will be able to:				
CO No.	CO Statement			
C01	Explain the fundamental principles of pharmacogenomics and personalized medicine and drug metabolism			
CO2	Demonstrate the various tools and techniques in pharmacogenomics.			
CO3	Evaluate the role of biomarkers and companion diagnostics in personalized therapy.			
CO4	Evaluate innovative strategies in personalized medicine and therapy.			
C05	Examine the ethical and regulatory considerations in pharmacogenomics.			

COURSE COORDINATOR: Ms. S. Geet Andrea