SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Biotechnology	LP: BY22104
B.E/B.Tech/M.E/M.Tech : **M. Tech Biotechnology** Regulation: **2022** PG Specialisation : **Biotechnology** Sub. Code / Sub. Name : **BY22104/ Scaffold Designing and 3D Bioprinting** Unit : I	**Rev. No: 00** **Date:** **09.11.2022**

Unit I: Introduction to 3D Bioprinting **5**

Introduction to 3D Bioprinting, Understanding different types of bioprinting: Extrusion based, Inkjet based and laser assisted bioprinting

Objective: To introduce the concepts of bioprinting and its types.

Session No *	Topics to be covered	Ref	Teaching Aids
1	Introduction and history of 3D Bioprinting	T1 (1-25)	BB/PPT
2	The importance of Industry 4.0 and additive manufacturing in 3D printing	T1 (30-35)	BB/PPT
3	Understanding different types of bioprinting and its application in interdisciplinary aspects	T1 (124-160)	BB/PPT
4	Principle and application of Extrusion based, Inkjet based, and laser assisted bioprinting	T1 (124-160)	BB/PPT
5	Principle and application of Extrusion based, Inkjet based, and laser assisted bioprinting	T1 (124-160)	BB/PPT
Content beyond syllabus covered (if any): Bridging additive manufacturing and 3D printing			

* Session duration: 50 minutes

Sub. Code / Sub. Name: BY22104/ Scaffold Designing and 3D Bioprinting
Unit : II

UNIT II BIOLOGY AND BIOMATERIALS IN 3D BIOPRINTING **7**

Introduction to Cells, Tissues, Organs and ECM, In-Vitro Cell Handling for 3D Bioprinting, Types of Cells used in 3D Bioprinting and their limitations, In-Depth Understanding of Hydrogels and Biomaterials.

Objective: To study the application of cells, crosslinking and scaffold designing in bioprinting.

Session No *	Topics to be covered	Ref	Teaching Aids
6.	Introduction to Cells, Tissues, Organs, and Extracellular matrix as a model for 3D Bioprinting	R5	BB/PPT
7.	In-Vitro Cell Handling for 3D Bioprinting	R4	BB/PPT
8.	Advance In-Vitro Cell Handling for 3D Bioprinting	R4	BB/PPT
9.	Types of Cells used in 3D Bioprinting and their limitations	R5	BB/PPT
10.	Types of Cells used in 3D Bioprinting and their limitations	R5	BB/PPT
11.	In-Depth Understanding of Hydrogels and Biomaterials to implement in 3D Printing Technologies	T2 (129-143)	BB/PPT
12.	In-Depth Understanding of Hydrogels and Biomaterials to implement in 3D Printing Technologies	T2 (129-143)	BB/PPT
Content beyond syllabus covered (if any): Cell Sources and processing for Bioprinting			

* Session duration: 50 mins

Sub. Code / Sub. Name: BY22104/ Scaffold Designing and 3D Bioprinting
Unit : III

UNIT III SCAFFOLD DESIGNING AND CROSSLINKING 3

An Introduction to Crosslinking, importance and application, Scaffolds and Scaffold Design.

Objective: To study the application of cells, crosslinking and scaffold designing in bioprinting.

Session No *	Topics to be covered	Ref	Teaching Aids
13.	An Introduction to Crosslinking related to 3D Bioprinting	T2 (140-145)	BB/PPT
14.	Importance and application of Crosslinking related to 3D Bioprinting specifically in cancer studies	T2 (179-191)	BB/PPT
15.	Importance of Scaffolds and Scaffold Design in 3D printing.	T2 (17-62)	BB/PPT
Content beyond syllabus covered (if any): Application of scaffolds as a model for various diseases/disorders			

* Session duration: 50 mins

REFERENCES:

TEXT BOOKS:

1. 3D Bioprinting - Fundamentals, Principles and Applications by Ibrahim Ozbolat 1st Edition, 2016.
2. Bioprinting: Principles And Applications: 1 (World Scientific Series In 3d Printing) by Wai Yee Yeong and Chee Kai Chua, 2015.
3. 3D Printing: Applications in Medicine and Surgery Volume 2 by Vasileios N. Papadopoulos, Vassilios Tsioukas and Jasjit S. Suri, 2021.
4. Extrusion Bioprinting of Scaffolds for Tissue Engineering Applications by Daniel X. B. Chen, 2019.
5. Pugliese R, Beltrami B, Regondi S, Lunetta C. Polymeric biomaterials for 3D printing in medicine: An overview. Annals of 3D Printed Medicine. 2021 Jun 1;2:100011.

REFRENCE BOOKS:

1. Chia HN, Wu BM. Recent advances in 3D printing of biomaterials. Journal of biological engineering. 2015 Dec;9(1):1-4.
2. Study on Microextrusion-based 3D Bioprinting and Bioink Crosslinking Mechanisms, by Liliang Ouyang, 2020.
3. Mancha Sánchez E, Gómez-Blanco JC, López Nieto E, Casado JG, Macías-García A, Díaz Díez MA, Carrasco-Amador JP, Torrejón Martín D, Sánchez-Margallo FM, Pagador JB. Hydrogels for bioprinting: a systematic review of hydrogels synthesis, bioprinting parameters, and bioprinted structures behavior. Frontiers in Bioengineering and

Biotechnology. 2020 Aug 6;8:776.

4. Gupta D, Negi NP. 3D bioprinting: Printing the future and recent advances. Bioprinting. 2022 May 18:e00211.

5. Zhang YS, Yue K, Aleman J, Mollazadeh-Moghaddam K, Bakht SM, Yang J, Jia W, Dell'Erba V, Assawes P, Shin SR, Dokmeci MR. 3D bioprinting for tissue and organ fabrication. Annals of biomedical engineering. 2017 Jan;45(1):148-63.

	Prepared by	Approved by
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Designation	Assistant Professor	Head of the Department
Date	09.11.2022	09.11.2022
Remarks *: Yes		
Remarks *: Yes		

* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD