SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

Department of Biotechnology	LP: BY22011 Rev. No: 01 Date: 20.11.2022
~~B.E/B.Tech/M.E/~~M. Tech : **Biotechnology** Regulation: 2022 PG Specialisation : Biotechnology Sub. Code / Sub. Name : BY22011/ Bioengineering and Regenerative medicine Unit : I	

Unit Syllabus: INTRODUCTION **9**

Introduction to tissue engineering: cells as therapeutic agents, enumeration of cell numbers and growth rates, measurement of cell characteristics morphology, number viability, motility and functions. Tissue appearance and measurement of tissue characteristics, cellular component, ECM components, mechanical measurements and physical properties.

OBJECTIVE: To learn the fundamentals of tissue engineering

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Introduction to tissue engineering- part 1	T1	PPT/BB
2.	Introduction to tissue engineering – part 2	T2	PPT/BB
3.	Cells as therapeutic agents	T1(1.1)	PPT/BB
4.	Enumeration of cell numbers and growth rates	T1(1.3)	PPT/BB
5.	Measurement of cell characteristics morphology, number viability, motility and functions	T1(1.3.2)	PPT/BB
6.	Tissue appearance and types	T1(2.1)	PPT/BB
7.	Measurement of tissue characteristics, cellular component	T1(2.1.1)	PPT/BB
8.	ECM components	T1(2.1.2)	PPT/BB
9.	Mechanical measurements and physical properties	T1 (9.3.5)	PPT/BB
Content beyond syllabus covered (if any): Natural components as ECM matrices			

* Session duration: 50 minutes

Sub. Code / Sub. Name : BY22011/ Bioengineering and Regenerative medicine
Unit : II

Unit Syllabus: TISSUE ARCHITECTURE 9

Tissue types and Tissue components, Tissue repair, Engineering wound healing and sequence of events. Basic wound healing Applications of growth factors: VEGF/angiogenesis, Cell-Matrix& Cell-Cell Interactions, Self-renewal, Control of cell migration in tissue engineering

OBJECTIVE: To learn the scale up criterions of bioprocesses

Session No *	Topics to be covered	Ref	Teaching Aids
10.	Tissue types and Tissue components	T1(2.2.1)	PPT/BB
11.	Tissue repair	T1(3.3)	PPT/BB
12.	Engineering wound healing and sequence of events	T1(3.3.1)	PPT/BB
13.	Basic wound healing Applications of growth factors	T1(3.3.2, 18.1)	PPT/BB
14.	VEGF/angiognesis	T1(3.4, 18.2)	PPT/BB
15.	Cell-Matrix	T1(7.2)	PPT/BB
16.	Cell-Cell Interactions	T1(7.3)	PPT/BB
17.	Self-renewal	T1(6.1)	PPT/BB
18.	Control of cell migration in tissue engineering	T1(6.2)	PPT/BB
Content beyond syllabus covered (if any)			
Role of growth factors in tissue engineering			

* Session duration: 50 mins

Sub. Code / Sub. Name : BY22011/ Bioengineering and Regenerative medicine
Unit : III

Unit Syllabus: BIOMATERIALS AND SCAFFOLD FABRICATION 9

Scaffold fabrication strategies- 2D planar and hollow organs, Design of 3D scaffolds and 4D bioprinting, Nanocomposite scaffolds, Tailoring of biomaterials, Bioreactors in fabrication of scaffolds- Artificial blood vessels, artificial liver and artificial pancreas

OBJECTIVE: The students will

Session No *	Topics to be covered	Ref	Teaching Aids
19.	Scaffold fabrication strategies	T1(15.1-15.4)	PPT
20.	2D planar and hollow organs	Link 7	PPT
21.	Design of 3D scaffolds	Link 7	PPT
22.	4D bioprinting	Link 7	PPT
23.	Nanocomposite scaffolds	R5	PPT
24.	Tailoring of biomaterials	T1(16.1-16.5)	PPT
25.	Bioreactors in fabrication of scaffolds	R1	PPT
26.	Artificial blood vessels	R3	PPT
27.	artificial liver and artificial pancreas	R4	PPT
Synthetic scaffold in artificial organ development			

* Session duration: 50 mins

Sub. Code / Sub. Name : : BY22011/ Bioengineering and Regenerative medicine
Unit : IV

Unit Syllabus: REGENERATIVE MEDICINE AND ITS ADVANCEMENTS

Regenerative Therapy —Introduction, Applications of Regenerative Medicine in the nervous system, eye, heart, lung, liver, kidney, pancreas and kidney, large scale manufacturing of cells, tissues and organs, Artificial organs, Engineered Tissues and Regenerative Medicine, Personalized therapies in Regenerative Medicine.

OBJECTIVE: The students will gain knowledge on

Session No *	Topics to be covered	Ref	Teaching Aids
28.	Regenerative Therapy —Introduction	T1(17.1-17.3)	PPT
29.	Applications of Regenerative Medicine in the nervous system- eye, heart	Link 1 & Link 2	PPT
30.	Applications of Regenerative Medicine in the nervous system- lung, liver,	Link 3 & Link 4	PPT
31.	Applications of Regenerative Medicine in the nervous system- kidney	Link 5	PPT
32.	Applications of Regenerative Medicine in the nervous system- pancreas	Link 6	PPT
33.	large scale manufacturing of cells, tissues and organs	Link 7	PPT
34.	Artificial organs	Link 8	PPT
35.	Engineered Tissues and Regenerative Medicine	T1(17.1-17.4)	PPT
36.	Personalized therapies in Regenerative Medicine.	Link 9	PPT

Content beyond syllabus covered (if any): Nil

* Session duration: 50 mins

Sub. Code / Sub. Name : BY22011/ Bioengineering and Regenerative medicine
Unit : V

Unit Syllabus ETHICS AND REGULATORY APPROVALS

Translational Approaches of Tissue Engineering - Animal Study Protocols, Hurdles in Translation of Therapies to the Clinic and Solutions, Engineered Scaffolds and Matrices - Principles of Biomedical Ethics, Funding of Research, Regulatory Mechanisms, Business of Regenerative Medicine

OBJECTIVE: The students.

Session No *	Topics to be covered	Ref	Teaching Aids
37.	Translational Approaches of Tissue Engineering - Animal Study Protocols	Link 10	PPT
38.	Translational Approaches of Tissue Engineering - Animal Study Protocols-II	Link 11	PPT
39.	Hurdles in Translation of Therapies to the Clinic and Solutions	Link 12	PPT
40.	Hurdles in Translation of Therapies to the Clinic and Solutions -II	Link 12	PPT
41.	Engineered Scaffolds and Matrices	Link 13	PPT
42.	Principles of Biomedical Ethics	Link 14	PPT
43.	Funding of Research	Link 15	PPT
44.	Regulatory Mechanisms	Link 16	PPT
45.	Business of Regenerative Medicine	Link 17	PPT
Content beyond syllabus covered (if any): Guidelines to be followed for commercialization of artificial organs			

* Session duration: 50 mins

TEXTBOOKS:

1. Bernhard O.Pa1sson, Sangeeta, N.Bhatia, “Tissue Engineering” Pearson Publishers 2009
2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.
3. Bernard N. Kennedy (editor). New York: Nova Science Publishers, c2008.Stem cell transplantation, tissue engineering, and cancer applications

REVIEW ARTICLE LINKS:

1	**Link 1**	Ocular progenitor cells and current applications in regenerative medicines – Review - ScienceDirect
2	**Link 2**	Cardiac Regenerative Medicine: The Potential of a New Generation of Stem Cells - FullText - Transfusion Medicine and Hemotherapy 2016, Vol. 43, No. 4 - Karger Publishers
3	**Link 3**	Lung regeneration: mechanisms, applications and emerging stem cell populations - PMC (nih.gov)
4	**Link 4**	Regenerative Medicine of Liver: Promises, Advances and Challenges - PMC (nih.gov)
5	**Link 5**	Application of Regenerative Medicine for Kidney Diseases - PMC (nih.gov)
6	**Link 6**	Regenerative Medicine and Tissue Engineering for the Treatment of Diabetes | IntechOpen
7	**Link 7**	3D bioprinting of cells, tissues and organs | Scientific Reports (nature.com)
8	**Link 8**	Frontiers | Current Developments in 3D Bioprinting for Tissue and Organ Regeneration–A Review (frontiersin.org)
9	**Link 9**	Personalized Regenerative Medicine - PubMed (nih.gov)
10	**Link 10**	Frontiers | Large Animal Models in Regenerative Medicine and Tissue Engineering: To Do or Not to Do (frontiersin.org)
11	**Link 11**	Tissue engineering and surgery: from translational studies to human trials (degruyter.com)
12	**Link 12**	Hurdles to clinical translation of human induced pluripotent stem cells - PMC (nih.gov)
13	**Link 13**	Matrices and Scaffolds for DNA Delivery in Tissue Engineering - PMC (nih.gov)
14	**Link 14**	The Four Principles of Biomedical Ethics — Healthcare Ethics and Law
15	**Link 15**	Top 5 grants in regenerative medicine: May 2021 – RegMedNet
16	**Link 16**	A Worldwide Overview of Regulatory Frameworks for Tissue-Based Products | Tissue Engineering Part B: Reviews (liebertpub.com)
17	**Link 17**	Business of Regenerative Medicine 2019: Conference Summary | Harvard Stem Cell Institute (HSCI) [The regenerative medicine and stem cell business: confusion with legal implications] - PubMed (nih.gov)

2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.
3. Bernard N. Kennedy (editor). New York: Nova Science Publishers, c2008.Stem cell transpkantation, tissue engineering, and cancer applications

REFERENCE BOOKS:

1. Robert Lanza et a1. Principles of Tissue Engineering, 3rd Edition. Academic Press; 3 edition (August 21, 2007)
2. Naggy N. Habib, M.Y. Levicar, L. G. Jiao,.and N. Fisk, Stem Cell Repair and Regeneration, volume-2, Imperial College Press,2007.
3. Bernard N. Kennedy (editor). Stem cell transplantation, tissue engineering, and cancer applications, Nova Science Publishers, 2008.
4. Hossein Baharvand (Editor), Nasser Aghdami (Editor). Regenerative Medicine and Cell Therapy (Stem Cell Biology and Regenerative Medicine). Humana Press; 2013 edition (August 8, 2012)
5. J.J. Mao, G. Vunjak-Novakovic et.a1 (Eds): Translational Approaches In Tissue Engineering & Regenerative Medicine. (2008), Artech House, INC Publications

	Prepared by	Approved by
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Designation	**Assistant Professor**	HOD
Date	20/11/22.	20/11/22
Remarks *: If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD.		