

FT/GN/68/01/23.01.16

SRI VENKATESWARA COLLEGE OF ENGINEERING

COURSE DELIVERY PLAN - THEORY

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,	Department of Biotechnology		LP: BT18022 Rev. No: 00 Date: 29.12.2023
B.E/B. Tech/M.E/M.Tech UG Specialisation Sub. Code / Sub. Name	+ : Biotechnology : Biotechnology : BT 18022/ Tissue Engineering	Regulation: 2018A	
Unit	:1		

Unit Syllabus: BASICS OF TISSUE ENGINEERING

Tissue organization, Tissue Components, Tissue types, Functional subunits, Tissue Dynamics, Dynamic states of tissues, Homeostasis in highly prolific tissues and Tissue repair, Angiogenesis, Cell cycle - cell determination and differentiation - cell adhesion - cell adhesion molecules - cell migration - cell aggregation and tissue equivalent.

OBJECTIVE: To study tissue organization, remodeling, cell cycle and differentiation.

Session No *	Topics to be covered	Ref	Teaching Aids
1.	Introduction to Tissue organization	T4(1-17)	BB & PPT
2.	Tissue Components & types	T4(18-31)	BB & PPT
3.	Functional subunits	T4(31-33)	BB & PPT
4.	Tissue Dynamics & Dynamic states of tissues	T4(34-35)	BB & PPT
5.	Homeostasis in highly prolific tissues and Tissue repair	T4(35-37)	BB & PPT
6.	Angiogenesis	T4(305-308)	BB & PPT
7.	Cell cycle - cell determination and differentiation	T4(74-79)	Animation &PPT
8.	cell adhesion - cell adhesion molecules	T4(281-198)	Video Lecture
9.	cell migration - cell aggregation and tissue equivalent	T4(299-317)	BB & PPT
Content beyond syllabus covered (if any): Wound healing mechanism using Nanopolymeric constructs			

* Session duration: 50 minutes

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Sub. Code / Sub. Name : BT 18022/ Tissue Engineering Unit : II

Unit Syllabus: COMPONENTS OF TISSUE ENGINEERING 9

Cell and tissue culture - types of tissue culture, Media - synthetic and biological media, Culture environment and maintenance of cells in vitro, Cryopreservation, Coordination of cellular fate processes - soluble signals, types of growth factors and chemokines, Cell separation - characterization and methods, signaling molecules, Bioreactors for Tissue Engineering.

Session No *	Topics to be covered	Ref	Teaching Aids
10.	Cell and tissue culture - types of tissue culture	T4(175)	BB & PPT
11.	Media - synthetic and biological media	T4(176-179)	BB & PPT
12.	Culture environment and maintenance of cells in vitro	T4(181-183)	BB & PPT
13.	Cryopreservation	T4(184-188)	BB & PPT
14.	Coordination of cellular fate processes - soluble signals	T4(105-106)	BB & PPT
15.	types of growth factors and chemokines	T4 (106-109)	BB & PPT
16.	Cell separation - characterization and methods	T4 (244-251)	Experimental Learning
17.	Signaling molecules	T4 (109-116)	Animation &PPT
18.	Bioreactors for Tissue Engineering.	T2(51-59)	Video Lecture
Content beyond syllabus covered (if any):			
Standalone bioreactors in bone tissue regeneration			

OBJECTIVE: To understand the components involved in tissue engineering

* Session duration: 50 mins



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Sub. Code / Sub. Name	: BT 18022/ Tissue Engineering
Unit	: III

Unit Syllabus: STEM CELLS

Definition of stem cells, Stem cell properties – differentiation, dedifferentiation, maturation, proliferation, pluripotency and immortalization, Types of stem cells based potency and sources, niche of stem cells, Overview about induced pluripotent stem cells.

OBJECTIVE: To learn basics about stem cells and its applications

Session No *	Topics to be covered	Ref	Teaching Aids
19.	Definition of stem cells	T3(1-39)	BB & PPT
20.	Stem cell properties – differentiation, dedifferentiation	T3(29-59)	BB & PPT
21.	Stem cell properties- maturation and proliferation,	T4(61)	BB & PPT
22.	Stem cell properties- pluripotency and immortalization	T4(61-64)	BB & PPT
23.	Types of stem cells based potency	T4(65-67)	BB & PPT
24.	Types of stem cells based sources	T4(67-70)	BB & PPT
25.	niche of stem cells	T4(69-70)	BB & PPT
26.	Overview about induced pluripotent stem cells	R2	Animation &PPT
27.	IPSC in Tissue Engineering	R2	BB
Content beyond syllabus covered (if any):			
Self healing injectable stem cell carriers			

* Session duration: 50 mins

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Sub. Code / Sub. Name	: BT 18022/ Tissue Engineering
Unit	: IV

Unit Syllabus: MATERIALS IN TISSUE ENGINEERING

Cell-extracellular matrix interactions, Direct cell-cell contact, Cell interaction with polymers, Scaffolds – function, Biomaterials in tissue engineering – Absorbable biomaterials – natural polymer, synthetic polymer, inorganic materials and composite materials, Pore creation biomaterials – phase separation, fiber bonding and electrospinning, Special scaffolds – micro and nanofabricated scaffolds, 3-dimensional scaffolds, Biocompatibility studies In Vitro and In Vivo.

Session No *	Topics to be covered	Ref	Teaching Aids
28.	Cell-extracellular matrix interactions	T2(85-87)	BB & PPT
29.	Direct cell-cell contact	T2(29-31)	BB & PPT
30.	Cell interaction with polymers & Scaffolds – function	T2(32-44)	Participative learning
31.	Biomaterials in tissue engineering – Absorbable biomaterial	T4(252-262)	BB & PPT
32.	Biomaterials in tissue engineering – natural polymer, synthetic polymer, inorganic materials and composite materials	T4(270-286)	BB & PPT
33.	Pore creation biomaterials – phase separation, fiber bonding and electrospinning	T2(26-30)	BB & PPT
34.	Special scaffolds – micro and nanofabricated scaffolds	T2(31-36)	BB & PPT
35.	3-dimensional scaffolds	T2(36-42)	Animation &PPT
36.	Biocompatibility studies In Vitro and In Vivo.	T2(46-64)	BB & PPT
Content beyond syllabus covered (if any):			
Role of dendrimers in tissue engineering			

OBJECTIVE: To describe different biomaterials in tissue replacements

* Session duration: 50 mins



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Sub. Code / Sub. Name : BT 18022/ Tissue Engineering

Unit

: V

Unit Syllabus: APPLICATION OF TISSUE ENGINEERING

Replacement Engineering - skin, blood vessels, pancreas, liver and bone. Regenerative engineering - Regeneration of bone, muscle and nerve. Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver. Ethical Issues in Tissue Engineering, Regulation, Commercialization and Patenting

OBJECTIVE: To design tissue regeneration and tissue injury repair strategies.

Session No *	Topics to be covered	Ref	Teaching Aids
37.	Replacement Engineering – Skin and blood vessels	Link 1&2	BB & PPT
38.	Replacement Engineering – Pancreas and liver	Link 3& 4	BB & PPT
39.	Regenerative engineering - Regeneration of muscle and nerve	Link 5 & 6	BB & PPT
40.	Replacement Engineering: bone & cartilage	Link 7 & 8	BB & PPT
41.	Replacement Engineering: pancreas	Link 9	Group Discussion
42.	Replacement Engineering: kidney	Link 10	BB & PPT
43.	Replacement Engineering: heart valve	Link 11	Participative Learning
44.	Replacement Engineering: liver	Link 12	BB & PPT
45.	Ethical Issues in Tissue Engineering- Regulation, Commercialization and Patenting	Link 13	PPT
Content beyond syllabus covered (if any):			
Regulatory challenges of tissue engineering and regenerative medicine in India			

* Session duration: 50 mins

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TEXT BOOKS:

- 1. Mark Saltzman W, "Tissue Engineering Engineering principles for design of replacement organs and tissue", Oxford University Press Inc New York, 2004
- 2. Ikada Y, "Tissue engineering: fundamentals and applications", Elsevier; 2011.
- 3. Potten C.S, "Stem cells", Elsevier, 1996
- Bernhard O.P, and Sangeeta N.B, "Tissue Engineering", 1st Edition, Pearson Prentice Hall, 2004.

REFERENCES:

- Gary E.W, and Gary L.B, "Encyclopedia of Biomaterials and Biomedical Engineering", Marcel Dekker Inc, New York, 2008.
- Lanza R, and Anthony A, "Essential of Stem Cell Biology", Academic Press, USA, 2013.
- 3. Lanza R, Anthony A," Handbook of Stem Cells", Academic Press, USA, 2012.

E RESOURCES:

- Link 1: <u>Tissue engineering of replacement skin: the crossroads of biomaterials, wound</u> <u>healing, embryonic development, stem cells and regeneration - PMC (nih.gov)</u>
- Link 2: <u>Frontiers</u> | Vascular Tissue Engineering: Challenges and Requirements for an <u>Ideal Large Scale Blood Vessel (frontiersin.org)</u>
- Link 3: The emerging field of pancreatic tissue engineering: A systematic review and evidence map of scaffold materials and scaffolding techniques for insulin-secreting cells - PMC (nih.gov)
- Link 4: <u>Tissue Engineering in Liver Regenerative Medicine: Insights into Novel</u> <u>Translational Technologies - PMC (nih.gov)</u>
- Link 5: Engineering muscle constructs for the creation of functional engineered musculoskeletal tissue - PMC (nih.gov)
- Link 6: Tissue engineering for the repair of peripheral nerve injury PMC (nih.gov)
- Link 7: Bone Tissue Engineering: Recent Advances and Challenges PMC (nih.gov)
- Link 8: <u>The Role of Tissue Engineering in Articular Cartilage Repair and Regeneration</u> <u>- PMC (nih.gov)</u>

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- Link 9:<u>The emerging field of pancreatic tissue engineering</u>: A systematic review and evidence map of scaffold materials and scaffolding techniques for insulin-secreting cells - PMC (nih.gov)
- Link 10: <u>Tissue-Engineering Approaches to Restore Kidney Function PubMed</u> (nih.gov)
- Link 11:<u>Heart valve tissue engineering for valve replacement and disease modeling -</u> <u>ScienceDirect</u>
- Link 12:<u>Developing tissue engineering strategies for liver regeneration -</u> <u>ScienceDirect</u>
- Link 13:<u>The Ethical Implications of Tissue Engineering for Regenerative Purposes: A</u>
 <u>Systematic Review PMC (nih.gov)</u>

	Prepared by	Approved by
Signature	G. KLOZO.	Arr.
Name	Dr G Karthigadevi	Dr E Nakkeeran
Designation	Assistant Professor	HOD
Date	29.12.2023	29.12.2023
Remarks *: NIL		
Remarks *: NIL		

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

