

Semester	Course Code	Course Category	Hours/Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	24UBTVAC1	VALUE-ADDED COURSE	30	-	-	100	100
<b>Course Title</b>		<b>LIQUID WASTE MANAGEMENT</b>					

SYLLABUS		
Unit	Contents	Hours
I	<b>Introduction to Liquid Waste Management:</b> Overview of liquid waste and its types, Importance of liquid waste management, Environmental and health impacts of improper liquid waste disposal, Regulatory frame works and standards.	6
II	<b>Characteristics of Liquid Waste:</b> Physical, chemical, and biological properties of liquid waste. Classification of liquid waste (e.g., industrial, domestic, hazardous), Quantitative and Qualitative analysis techniques for liquid waste.	6
III	<b>Collection and Transportation of Liquid Waste:</b> Collection methods for different types of liquid waste, Transportation systems and equipment, Safety measures in collection and transportation, Case studies on successful liquid waste collection and transportation programs.	6
IV	<b>Treatment Technologies for Liquid Waste:</b> Primary, Secondary, and Tertiary treatment processes, Biological, Physical, and Chemical treatment methods, Emerging technologies in liquid waste treatment, Case studies on successful liquid waste treatment projects.	6
V	<b>Disposal and Reuse of Treated Liquid Waste:</b> Safe disposal methods for treated liquid waste, Guidelines for land application and agricultural reuse, recycling and resource recovery from liquid waste, economic and environmental considerations in disposal and reuse.	6

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. Liquid Waste Management: Principles and Practice" by K. Vasanthi, CRC Press, 2019.</li> <li>2. Liquid Waste Management: A Global Perspective" by P. K. Goel, Springer, 2018.</li> <li>3. Liquid Waste Management: Current Practices and Future Trends" by R. S. Kookana, Wiley, 2017.</li> </ol>
<b>Reference Book(s):</b>
<ol style="list-style-type: none"> <li>1. Liquid Waste Management: Challenges and Solutions" edited by R. S. Kookana, Springer, 2020.</li> <li>2. Liquid Waste Management: Technologies and Innovations" edited by A. K. Gupta, CRC Press, 2021.</li> <li>3. Liquid Waste Management: Case Studies and Best Practices" edited by P. K. Goel, Wiley, 2022.</li> </ol>
<b>Web Resource(s):</b>
<ol style="list-style-type: none"> <li>1. <a href="https://www.unep.org/explore-topics/waste-waste-management/what-we-do/liquid-waste-management">https://www.unep.org/explore-topics/waste-waste-management/what-we-do/liquid-waste-management</a></li> <li>2. <a href="https://www.epa.gov/wastewater-management">https://www.epa.gov/wastewater-management</a></li> <li>3. <a href="https://www.usgs.gov/mission-areas/water-resources/science/wastewater-and-water-quality?qt-science_center_objects=0#qt-science_center_objects">https://www.usgs.gov/mission-areas/water-resources/science/wastewater-and-water-quality?qt-science_center_objects=0#qt-science_center_objects</a>.</li> </ol>

<b>Course Outcomes</b>		
Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Understand the various types and sources of liquid waste and their environmental impacts.	K2
<b>CO2</b>	Analyse liquid waste's physical, chemical, and biological properties and classify it based on its characteristics.	K4
<b>CO3</b>	Apply the knowledge of effective collection, transportation, and safety measures in liquid waste management.	K3
<b>CO4</b>	Evaluate different treatment technologies for liquid waste and comprehend emerging trends in the field.	K5
<b>CO5</b>	Assess safe disposal methods, guidelines for reuse, and consider economic and environmental aspects in liquid waste management.	K5

**Course Coordinator: Ms.M.Habibunisha**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
V	24UBTVAC2	VALUE-ADDED COURSES	30	-	-	100	100
<b>Course Title</b>		<b>BIOMIMICRY AND BIOMIMETIC TECHNOLOGY</b>					

SYLLABUS		
Unit	Contents	Hours
I	<b>Introduction to Biomimicry:</b> Importance of biomimicry- nature's unifying patterns- how to do biomimicry- types of biomimicry- organism level, behaviour level, ecosystem level.	6
II	<b>Approaches to Biomimicry:</b> Mimicking- function and strategy- top-down and bottom-up approach - from problem to solution- proposing sustainable solutions for existing problems from nature- abstract design strategies from nature- evaluation of design feasibility- developing creative confidence- mind mapping- systems thinking- using biomimicry design.	6
III	<b>Biomimicry in Industrial Applications:</b> Case studies- Biomimetics in daily life, Biomimicry technology in cosmetics and skincare, Biomimetics in medical technology, Biomimetics in nanotechnology.	6
IV	<b>Application of Biomimicry in engineering and design (bionics):</b> Defining a problem- biologizing a problem- discovering and emulating strategies in nature to solve the problem- formulating a design with real examples.	6
V	<b>Commercialization of ideas:</b> Unlocking your creativity- Design and development of biomimetics for simple applications- taking your ideas to the market.	6
<b>Text Book(s):</b>		
1. F. Dyson, Our biotech future, The New York Review of Books, 2007. 2. Michael Pawlyn Biomimicry in Architecture (reprint edition), RIB Publishing (2011). 3. M. Helms, S.V. Swaroop, A.K. Goel Biologically Inspired Design: Process and Products Elsevier (2009).		
<b>Reference Book(s):</b>		
1. Biomimicry: Innovation Inspired by Nature by Janine Benyus, Mariner Books, 2002. 2. Nature Design: From Inspiration to Innovation, Abe Books, 2007		
<b>Web Resource(s):</b>		
1. <a href="https://onlinecourses.nptel.ac.in/noc22_ge24/preview">https://onlinecourses.nptel.ac.in/noc22_ge24/preview</a> 2. <a href="https://www.learnbiomimicry.com/biomimicry-practitioner-programme">https://www.learnbiomimicry.com/biomimicry-practitioner-programme</a>		

**Course Outcomes**

Upon successful completion of this course, the student will be able to:

<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Apprehend the fundamentals and significance of biomimicry.	K2
<b>CO2</b>	Appraise about the various approaches to perform biomimicry.	K3
<b>CO3</b>	Explore and employ the tools and techniques involved in biomimetic technology used in daily life and various industries.	K4
<b>CO4</b>	Evaluate the aspects of biomimetic design technology in engineering and Architecture.	K5
<b>CO5</b>	Analyse and develop Marketing and Commercialization strategies for Biomimetic Products.	K6

**Course Coordinator: Ms. S. Geet Andrea**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	24PBTVAC1	VALUE-ADDED COURSES	30	-	-	100	100
<b>Course Title</b>		<b>BIOENTREPRENEURSHIP AND INNOVATION</b>					

SYLLABUS		
Unit	Contents	Hours
I	<b>Introduction to Biotechnology Entrepreneurship:</b> Overview of Biotechnology Entrepreneurship, Importance of Entrepreneurship in Biotechnology, Historical Perspective and Success Stories, Key Entrepreneurial Traits in the Biotech Industry, Identifying Opportunities and Challenges.	6
II	<b>Business Planning and Strategy:</b> Business Model Canvas for Biotech Ventures, Market Analysis and Customer Segmentation, Competitive Landscape and SWOT Analysis, Intellectual Property (IP) and Regulatory Considerations, Funding Options for Biotech Start-ups.	6
III	<b>Legal and Ethical Aspects of Biotech Entrepreneurship:</b> Legal Structures for Biotech Ventures, Contracts and Agreements in Biotechnology, Ethical Issues in Biotech Research and Business, Compliance with Regulatory Standards, Responsible Innovation and Corporate Social Responsibility (CSR).	6
IV	<b>Marketing and Commercialization in Biotech:</b> Product Development and Commercialization Strategies, Branding and Marketing for Biotech Products, Distribution and Supply Chain Management, Sales and Customer Relationship Management, Global Market Expansion in Biotechnology.	6
V	<b>Scaling Up and Sustainable Growth:</b> Scaling Strategies for Biotech Startups, Financial Management and Budgeting, Team Building and Leadership, Exit Strategies: Mergers, Acquisitions, and IPOs, Sustainable Practices in Biotechnology Entrepreneurship.	6
<b>Text Book(s):</b>		
<ol style="list-style-type: none"> <li>"Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies" by Craig Shimasaki, <b>2014</b>.</li> <li>"Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers" by Alexander Osterwalder and Yves Pigneur,</li> </ol>		
<b>Reference Book(s):</b>		
<ol style="list-style-type: none"> <li>Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy, and Science" by Yali Friedman</li> <li>"Biotechnology for Beginners" by Reinhard Renneberg (Chapter on Entrepreneurship)</li> <li>"Biotechnology Entrepreneurship: From Science to Solutions" by Michael L. Salgaller</li> </ol>		
<b>Web Resource(s):</b>		
<ol style="list-style-type: none"> <li><a href="https://onlinecourses.nptel.ac.in/noc19_mg55/preview">https://onlinecourses.nptel.ac.in/noc19_mg55/preview</a></li> <li><a href="https://onlinecourses.nptel.ac.in/noc20_mg35/preview">https://onlinecourses.nptel.ac.in/noc20_mg35/preview</a></li> </ol>		

### Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Understand the fundamentals and significance of Biotechnology Entrepreneurship.	K2
CO2	Identify key entrepreneurial traits specific to the Biotech Industry.	K3
CO3	Evaluate opportunities and challenges in Biotechnology Entrepreneurship.	K5
CO4	Navigate Legal and Ethical aspects relevant to Biotech Entrepreneurship.	K4
CO5	Develop Marketing and Commercialization strategies for Biotech Products	K6

**Course Coordinator: Ms. M. Habibunisha**