

# Development of algae assisted Microbial Fuel Cell for power generation and algae cultivation

A Thesis submitted by  
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*in partial fulfillment of the requirements for the award of the degree of*  
**Doctor of Philosophy**



॥ त्वं ज्ञानमयो विज्ञानमयोऽसि ॥

**Indian Institute of Technology Jodhpur**  
**Department of Bioscience & Bioengineering**  
May 2021



## Declaration

I hereby declare that the work presented in this Thesis titled *Development of algae assisted Microbial Fuel Cell for power generation and algae cultivation*, submitted to the Indian Institute of Technology Jodhpur in partial fulfilment of the requirements for the award of the degree of Doctor of Philosophy, is a bonafide record of the research work carried out under the supervision of Dr. Meenu Chhabra. The contents of this thesis in full or in parts, have not been submitted to, and will not be submitted by me to, any other Institute or University in India or abroad for the award of any degree or diploma.



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## Certificate

This is to certify that the thesis titled *Development of algae assisted Microbial Fuel Cell for power generation and algae cultivation*, submitted by *Amitap Khandelwal (P14BL003)* to the Indian Institute of Technology Jodhpur for the award of the degree of *Doctor of Philosophy*, is a bonafide record of the research work done by him under my supervision. To the best of my knowledge, the contents of this report, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.



*Meenu Chhabra*  
Ph.D. Thesis Supervisor



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## List of Symbols

<i>Symbol</i>	<i>Description</i>
A	Ampere
C	Celsius
E	Cell Potential
F	Faraday Constant
I	Current
M	Molar
P	Power
R	Gas Constant/Resistance
T	Temperature
V	Volt
W	Watt
Cm	Centimeter
d	Day
g	Gram
h	Hour
kg	Kilogram
l/L	Liter
m	Milli
m <sup>2</sup>	Square meter
m <sup>3</sup>	Cubic meter
ppm	Parts Per Million
pH	Hydrogen Ion Concentration
α	Alpha
β	Beta
γ	Gamma
ε	Epsilon
η	Eta
θ	Theta
μ	Micro
Ω	Ohm
ω	Omega
°	Degree
%	Percentage

## List of Abbreviations

<i>Abbreviation</i>	<i>Full form</i>
AEM	Anion Exchange Membrane
BES	Bio electrochemical System
CA	Chronoamperometry
CEM	Cation Exchange Membrane
COD	Chemical Oxygen Demand
CSTR	Continuous Stir Tank Reactor
CV	Cyclic Voltammetry
DO	Dissolved Oxygen
EDX	Energy Dispersive X- Ray Spectroscopy
EET	Extracellular Electron Transfer
EIS	Electrochemical Impedance Spectroscopy
EPA	Environmental Protection Agency
FAME	Fatty Acid Methyl Ester
FP	Fruit Pulp
HRT	Hydraulic Retention Time
HTC	Hydrothermal Carbonization
LDPE	Low Density Polythene
LEA	Lipid Extracted Algae
MCC	Microbial Carbon Capture Cell
MFC	Microbial Fuel Cell
NEP	Net Energy Production
NER	Net Energy Recovery
NGS	Next Generation Sequencing
OCP	Open Circuit Potential
OCV	Open Circuit Voltage
ORR	Oxygen Reduction Reaction
OTU	Operational taxonomic Unit
PBR	Photo-bioreactor
PEM	Proton Exchange Membrane
PMFC	Photosynthetic Microbial Fuel Cell
QIIME	Quantitative Insight Into Microbial Ecology
RP	Rock Phosphate
SEM	Scanning Electron Microscope
SHE	Standard Hydrogen Electrode
SRA	Sequence Read Archive
TN	Total Nitrogen
TP	Total Phosphorus
WHC	Water Holding Capacity
XRD	X-ray Diffraction

