SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF AGRICULTURAL ENGINEERING

QUESTION BANK

VI SEMESTER

AG3662 - BIO - ENERGY RESOURCE TECHNOLOGY

Regulation – 2023

Academic Year 2025 – 26 (EVEN)

Prepared by

Dr. E. Maheswari, Assistant Professor/Agri

SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OFAGRICULTURAL ENGINEERING

QUESTION BANK

SUBJECT: AG3662 - BIO - ENERGY RESOURCE TECHNOLOGY

SEM / YEAR: VI/III

UNIT I - BIO RESOURCE- AN INTRODUCTION

Introduction, Classification and properties of biomass, Biomass characterization, different energy conversion methods, Bio Energy Resources, World Bio Energy Potential, India's Bio Energy Potential, Biomass Resources and classification, Physio- chemical characteristics. Biomass Combustion, Loose biomass densification, Biomass based power generation and utilization for domestic cooking, Improved biomass cookstoves.

PART – A

Q.No	Questions	BT Level	Competence
1.	Define biomass energy	BT-1	Remember
2.	List any two sources of biomass used for energy production	BT-1	Remember
3.	What is meant by bioenergy**?**	BT-1	Remember
4.	Classify biomass based on its origi	BT-2	Understand
5.	Write any two properties of biomass relevant to energy conversion.	BT-1	Remember
6.	What is biomass characterization?	BT-1	Remember
7.	Mention any two parameters used in biomass characterization.	BT-1	Remember
8.	Differentiate between proximate analysis and ultimate analysis of biomass	BT-2	Understand
9.	Define moisture content of biomass.	BT-1	Remember
10.	Why is calorific value important in biomass energy utilization?	BT-2	Understand
11.	List any two bioenergy resources available globally.	BT-1	Remember
12.	What is meant by world bioenergy potential?	BT-1	Remember
13.	State any two factors influencing global bioenergy potential	BT-2	Understand
14.	What is India's bioenergy potential?	BT-1	Remember
15.	Mention any two major biomass resources in India.	BT-1	Remember
16.	Classify biomass based on its physical form	BT-2	Understand
17.	What is physio-chemical characteristics of biomass?	BT-1	Remember
18.	List any two physio-chemical characteristics of biomass.	BT-1	Remember
19.	What is biomass combustion?	BT-1	Remember
20.	Mention any two stages involved in biomass combustion.	BT-2	Understand

21.	What is meant by loose biomass? Give one example.	BT-1	Remember
22.	Define biomass densification.	BT-1	Remember
23.	State any two advantages of biomass densification.	BT-2	Understand
24.	Name any **two densified biomass products**.	BT-1	Remember

PART - B

1.	Explain the classification of biomass with suitable examples and discuss how its properties influence energy conversion efficiency.	BT-3	Application
2.	Describe the biomass characterization process and explain how proximate and ultimate analyses are used in selecting biomass for power generation.	BT-3	Application
3.	Analyze the properties of biomass and their impact on different energy conversion technologies.	BT-4	Analyses
4.	Compare and analyze thermo-chemical and bio-chemical energy conversion methods used for biomass.	BT-4	Analyses
5.	Evaluate the sustainability of biomass energy as a renewable energy source.	BT-5	Evaluate
6.	Critically assess the potential of biomass energy conversion technologies in reducing fossil fuel dependency.	BT-5	Evaluate
7.	Illustrate the different biomass energy conversion methods with neat diagrams and state their applications.	BT-3	Application
8.	Apply physio-chemical characteristics of biomass to explain its suitability for combustion and gasification processes.	BT-3	Application
9.	Explain the steps involved in biomass combustion and apply them to a typical agricultural residue.	BT-3	Application
10.	Analyze the world bioenergy potential and discuss the major contributing biomass resources.	BT-4	Analyses
11.	Examine India's bioenergy potential with respect to availability, regional distribution and utilization.	BT-4	Analyses
12.	Analyze the physio-chemical characteristics of various biomass fuels and their influence on combustion performance.	BT-4	Analyses
13.	Compare loose biomass and densified biomass in terms of energy density, handling and efficiency.	BT-4	Analyses
14.	Evaluate the world bioenergy potential in the context of global energy security and climate change mitigation.	BT-5	Evaluate
15.	Assess the advantages and limitations of biomass combustion compared to other renewable energy systems.	BT-5	Evaluate

16.	Discuss the role of loose biomass densification in improving handling, transportation and storage of biomass fuels.	BT-3	Application
17.	Describe the utilization of biomass for domestic cooking and explain the need for improved cooking systems.	BT-3	Application

UNIT II – BIOENERGY

Technology of Biogas production, Biogas Plants, Digester types, Digester design, Chemical kinetics and mathematical modeling of bio methanation process, Dung, Vegetable Waste and Municipal Waste based Biogas plants, Biogas as fuel for transportation, Lighting, Running Dual Fuel Engines, Electricity generation, Biogas Bottling Plant Technology, Application of Biogas slurry in agriculture, Design of Biogas for cold climates. Case studies and numerical.

PART – A

Q.No	Questions	BT Level	Competence
1.	Define biogas.	BT-1	Remember
2.	What are the main constituents of biogas?	BT-1	Remember
3.	List any two raw materials used for biogas production.	BT-1	Remember
4	Explain the role of pH in biogas production.	BT-2	Understand
5.	Why is temperature control important in biogas digesters?	BT-2	Understand
6.	Differentiate between fixed dome and floating drum biogas plants.	BT-2	Understand
7.	What is meant by bio-methanation?	BT-1	Remember
8.	Name any two types of biogas digesters.	BT-1	Remember
9.	Explain the importance of mathematical modeling in bio-methanation.	BT-2	Understand
10.	Why is cattle dung considered a suitable feedstock for biogas production?	BT-2	Understand
11.	What is a biogas plant?	BT-1	Remember
12.	What is the function of a digester in a biogas plant?	BT-1	Remember
13.	Explain how vegetable waste can be used in biogas plants.	BT-2	Understand
14.	What are the challenges in using municipal solid waste for biogas generation?	BT-2	Understand
15.	Explain the use of biogas as a transportation fuel.	BT-2	Understand
16.	Define hydraulic retention time (HRT).	BT-1	Remember
17.	What is meant by organic loading rate (OLR)?	BT-1	Remember
18.	Why is biogas suitable for dual fuel engines?	BT-2	Understand
19.	Explain the principle of electricity generation using biogas.	BT-2	Understand
20.	Name any two stages of anaerobic digestion.	BT-1	Remember
21	What is the need for biogas bottling technology?	BT-2	Understand
22	What is the typical methane content in biogas?	BT-1	Remember
23	Explain the process of biogas purification for bottling.	BT-2	Understand

24	Explain the agricultural importance of biogas slurry.	BT-2	Understand

PART– B

1.	Apply the concept of hydraulic retention time (HRT) to justify its role in digester design	BT-3	Application
2.	Given a high volatile solids content in dung, explain how it affects methane yield.	BT-3	Application
3.	Analyze the suitability of dung, vegetable waste and municipal waste for anaerobic digestion.	BT-4	Analysis
4.	Analyze the impact of organic loading rate (OLR) on digester stability and gas production.	BT-4	Analysis
5.	Evaluate the feasibility of biogas bottling plants for decentralized energy systems.	BT-5	Evaluate
6.	Critically assess the use of biogas for running dual fuel engines.	BT-5	Evaluate
7.	A family biogas plant uses 40 kg of cattle dung per day mixed with equal quantity of water. Assuming a hydraulic retention time of 30 days, calculate the required digester volume.	BT-3	Application
8.	Compare and analyze fixed dome and floating drum digesters with respect to gas pressure and maintenance.	BT-4	Analysis
9.	Analyze the role of mathematical modeling in predicting biogas yield.	BT-4	Analysis
10.	Apply chemical kinetics concepts to explain the rate-limiting step in bio-methanation.	BT-3	Application
11.	A biogas plant produces 120 m^3/day of biogas containing 60% methane. Calculate: a) Volume of methane produced per day b) Energy available per day assuming methane calorific value = 35.8 MJ/m^3 Analyze its suitability for electricity generation.	BT-4	Analysis
12.	A biogas engine generator operates at an efficiency of 30%. If biogas availability is 150 m^3/day with a calorific value of 21 MJ/m^3, estimate the **electrical energy generated per day**.	BT-4	Analysis
13.	Evaluate the effectiveness of **biogas slurry** as a substitute for chemical fertilizers.	BT-5	Evaluate
14.	A biogas plant processes 500 kg/day of vegetable waste with a gas yield of 0.35 m^3/kg of volatile solids. If volatile solids content is 80%, estimate the **daily biogas production**.	BT-3	Application

15.	Assess the challenges of municipal solid waste–based biogas plants in urban areas.	BT-5	Evaluate
16.	Analyze the performance of biogas when used for electricity generation versus cooking applications.	BT-3	Application
17.	How would you apply temperature control strategies while designing a biogas plant for cold climates?	BT-3	Application

UNIT III - BIO REACTORS AND FERMENTORS

Bio reactors/ fermentors – Batch type – continuous stirred tank reactors- Biological wastewater treatment- Activated sludge process- Downstream processing- Recovery and purification of products.

PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Define a bioreactor	BT-1	Remember
2.	What is meant by batch type bioreactor?	BT-1	Remember
3.	Define continuous stirred tank reactor (CSTR).	BT-1	Remember
4.	Distinguish between batch reactor and continuous reactor.	BT-2	Understand
5.	Explain the importance of pH control in a fermentor.	BT-2	Understand
6.	Why is stirring essential in a CSTR?	BT-2	Understand
7.	List any two components of a bioreactor.	BT-1	Remember
8.	What is the role of agitator in a fermentor?	BT-1	Remember
9.	Describe the working principle of a batch fermentor.	BT-2	Understand
10.	Explain the role of microorganisms in biological wastewater treatment.	BT-2	Understand
11.	What is activated sludge?	BT-1	Remember
12.	Why is oxygen supply important in the activated sludge process?	BT-2	Understand
13.	Explain the function of secondary clarifier in the activated sludge process.	BT-2	Understand
14.	What is aeration in wastewater treatment?	BT-1	Remember
15.	Explain the term biodegradation in wastewater treatment.	BT-2	Understand
16.	Define hydraulic retention time (HRT).	BT-1	Remember
17.	What is meant by downstream processing?	BT-1	Remember
18.	Explain the purpose of solid–liquid separation in downstream processing.	BT-2	Understand
19.	Describe how filtration is used in product recovery.	BT-2	Understand
20.	What is cell harvesting?	BT-1	Remember
21	Explain the need for purification of bioproducts.	BT-2	Understand

22	Define product recovery in bioprocessing.	BT-1	Remember
23	List any two product purification methods.	BT-1	Remember
24	How does centrifugation help in recovery of fermentation products?	BT-2	Understand

PART – B

1.	Select a suitable bioreactor type for antibiotic production and justify your choice.	BT-3	Application
2.	Apply the concept of CSTR operation to maintain steady biomass concentration.	BT-3	Application
3.	Analyze the operational differences between batch fermentor and CSTR with respect to productivity.	BT-4	Analysis
4	Examine how mixing intensity affects mass transfer in a bioreactor.	BT-4	Analysis
5.	Evaluate the suitability of batch reactors for large-scale industrial fermentation.	BT-5	Evaluate
6.	Justify the selection of activated sludge process over trickling filters for municipal wastewater treatment.	BT-5	Evaluate
7.	A batch fermentor of 500 L volume produces 50 kg of biomass. Calculate the biomass concentration (kg/m^3).	BT-3	Application
8.	A CSTR operates with an influent substrate concentration of 800 mg/L and effluent concentration of 200 mg/L. Determine the substrate removal efficiency.	BT-3	Application
9.	Assess the importance of purification steps in pharmaceutical product recovery.	BT-5	Evaluate
10.	Analyze the causes of sludge bulking in biological wastewater treatment.	BT-4	Analyse
11.	Compare aerobic and anaerobic treatment processes in terms of energy requirement.	BT-4	Analyse
12.	How can temperature control be applied to improve fermentor productivity?	BT-3	Application
13.	Evaluate the economic impact of downstream processing in bioprocess industries.	BT-5	Evaluate
14.	Examine the impact of hydraulic retention time on biological treatment efficiency.	BT-4	Analyse
15.	A biological reactor has a flow rate of 100 m^3/day and volume of 500 m^3. Calculate the hydraulic retention time (HRT).	BT-4	Analyse
16.	During downstream processing, 80 g of product is recovered		

	from 100 g present. Calculate the recovery efficiency.	BT-3	Application
17.	The influent COD of wastewater is 1000 mg/L and effluent COD is 250 mg/L. Calculate the COD removal efficiency.	BT-3	Application

UNIT IV - ALCOHOL PRODUCTION

Bio-ethanol production from lignocelluloses, waste material, including crop residue, sugar and starch-biodiesel production from vegetable oil and animal fat, algae-bio- fuel derived from-economics of bio-fuel production-environmental impacts of bio- fuels- bio- fuel blends- green diesel from vegetable oil- biodiesel production process, by-product utilization. Production of butanol and propanol-Production of bio- hydrogen-production of hydrogen by fermentative bacteria.

PART – A

Q.No	Questions	BT Level	Competence
1.	Define bio-ethanol.	BT-1	Remember
2.	What are lignocellulosic materials?	BT-1	Remember
3.	Explain why lignocellulosic biomass is preferred over food crops for bio-ethanol production.	BT-2	Understand
4.	Describe the role of pretreatment in lignocellulosic ethanol production.	BT-2	Understand
5.	List any two crop residues used for bio-ethanol production.	BT-1	Remember
6.	Name the microorganisms used in ethanol fermentation.	BT-1	Remember
7.	Explain the significance of waste materials in bio-fuel production.	BT-2	Understand
8.	Why is biodiesel considered renewable?	BT-2	Understand
9.	Name the microorganisms used in ethanol fermentation.	BT-1	Remember
10.	What is biodiesel?	BT-1	Remember
11.	Define transesterification.	BT-1	Remember
12.	How does animal fat serve as a biodiesel feedstock?	BT-2	Understand
13.	What is green diesel?	BT-1	Remember
14.	Name any two by-products formed during biodiesel production.	BT-1	Remember
15.	Explain the advantages of algal bio-fuels over conventional bio-fuels.	BT-2	Understand
16.	Describe the economic factors affecting bio-fuel production.	BT-2	Understand
17.	Explain the environmental benefits of using bio-fuels.	BT-2	Understand
18.	What is bio-hydrogen?	BT-1	Remember
19.	Differentiate between biodiesel and green diesel.	BT-2	Understand
20.	Name any two fermentative bacteria used for hydrogen production.	BT-1	Remember

21.	What is propanol?	BT-1	Remember
22.	Describe the basic steps involved in butanol production.	BT-2	Understand
23.	Define butanol as a bio-fuel.	BT-1	Remember
24.	Explain the process of bio-hydrogen production by fermentative bacteria.	BT-2	Understand

PART - B

1.	Explain the process of bio-ethanol production from lignocellulosic biomass, highlighting pretreatment, hydrolysis, and fermentation steps with suitable flow diagrams	BT-3	Application
2.	Illustrate the production of biodiesel from vegetable oil by transesterification and explain the role of catalyst and operating conditions.	BT-3	Application
3.	Analyze the technical challenges involved in bio-ethanol production from lignocellulosic feedstocks.	BT-4	Analyse
4.	Compare and analyze biodiesel production from vegetable oil and animal fat with respect to yield, processing difficulty, and fuel quality.	BT-4	Analyse
5.	Evaluate the sustainability of bio-ethanol production from lignocellulosic waste compared to sugar- and starch-based feedstocks.	BT-5	Evaluate
6.	Assess the economic viability of algal bio-fuel production at commercial scale.	BT-5	Evaluate
7.	Analyze the economic factors influencing the large-scale production of bio-fuels in developing countries.	BT-4	Analyse
8.	Explain the production of green diesel from vegetable oil and compare it with conventional biodiesel.	BT-3	Application
9.	Describe the production process of butanol and propanol using microbial fermentation, indicating key microorganisms involved.	BT-3	Application
10.	Analyze the role of algal bio-fuels in meeting future energy demands.	BT-4	Analyse
11.	Compare and analyze bio-fuel blends (B5, B10, E10, E20) in terms of engine performance and emissions.	BT-4	Analyse
12.	Explain the process of bio-hydrogen production by fermentative bacteria with suitable biochemical reaction	BT-3	Application
13.	Illustrate the steps involved in biodiesel by-product utilization, emphasizing glycerol recovery and applications.	BT-3	Application
14.	A bio-fuel blend contains 20% ethanol and 80% petrol. Calculate the volume of ethanol required for preparing 5000 L of blend.	BT-4	Analyse
15.	A fermentative bio-hydrogen reactor produces 60 L H_2 per kg of substrate. Calculate the hydrogen produced from 50 kg of substrate.	BT-3	Application

16.	Ethanol yield from fermentation is 0.48 g/g of sugar. Calculate the ethanol produced from 200 kg of fermentable sugar.	BT-4	Analyse
17.	Evaluate the environmental benefits and limitations of bio-fuel usage in transportation.	BT-5	Evaluate

UNIT V - SOCIO-ECONOMIC ASPECT OF BIOENERGY

Social, economic and environmental aspects of bioenergy resources. Policies and measures to promote the use of bioenergy resources for sustainable environmental - Impact on Environment– Bio energy policy.

PART – A

Q.No	Questions	BT Level	Competence
1.	List any two bioenergy resources.	BT-1	Remember
2.	What is meant by renewable energy?	BT-1	Remember
3.	Name two biomass-based fuels.	BT-1	Remember
4.	Explain how bioenergy helps in reducing greenhouse gas emissions.	BT-2	Understand
5.	Describe the role of bioenergy in rural employment generation.	BT-2	Understand
6.	Explain why bioenergy is considered environment-friendly.	BT-2	Understand
7.	Mention any two social benefits of bioenergy.	BT-1	Remember
8.	State two economic advantages of using bioenergy.	BT-1	Remember
9.	What is carbon neutrality in bioenergy?	BT-1	Remember
10.	List two environmental benefits of bioenergy resources.	BT-1	Remember
11.	How does bioenergy contribute to energy security?	BT-2	Understand
12.	Explain the importance of bioenergy in waste management.	BT-2	Understand
13.	Describe the economic impact of bioenergy on rural areas.	BT-2	Understand
14.	How do bioenergy policies support sustainable environmental protection?	BT-2	Understand
15.	Explain the impact of bioenergy on air pollution reduction.	BT-2	Understand
16.	What is meant by waste-to-energy?	BT-1	Remember
17.	How does the use of biogas improve public health?	BT-2	Understand
18.	Identify any two government agencies promoting bioenergy in India.	BT-1	Remember
19.	What is meant by sustainable development?	BT-1	Remember
20.	Explain the need for government incentives in bioenergy promotion.	BT-2	Understand
21.	Define bioenergy.	BT-1	Remember
22.	Explain the role of bioenergy in achieving Sustainable Development Goals (SDGs).	BT-2	Understand
23.	How do bioenergy resources promote environmental sustainability?	BT-1	Remember

24.	What is bioethanol?	BT-1	Remember

PART-B

1.	Illustrate the application of bioenergy resources in rural development with suitable examples.	BT-3	Application
2.	Apply the concept of life cycle assessment (LCA) to evaluate the environmental impact of biogas production.	BT-3	Application
3.	Analyze the social impacts of large-scale bioenergy projects on rural communities.	BT-4	Analyse
4.	Examine the environmental trade-offs associated with bioenergy resource utilization.	BT-4	Analyse
5.	Evaluate the contribution of bioenergy towards sustainable environmental development.	BT-5	Evaluate
6.	Assess the impact of bioenergy utilization on land use and biodiversity.	BT-5	Evaluate
7.	A bioethanol plant produces 10,000 liters/day of ethanol. Calculate the daily energy output if the calorific value of ethanol is 26.8 MJ/liter.	BT-5	Evaluate
8.	A village generates 2 tonnes/day of biomass waste. If 60% is convertible to bioenergy with efficiency of 30%, estimate the usable energy output (CV = 15 MJ/kg).	BT-5	Evaluate
9.	Demonstrate how bioenergy projects can be integrated into municipal solid waste management systems.	BT-3	Application
10.	Apply bioenergy policy measures to promote decentralized energy systems in rural India.	BT-3	Application
11.	Analyze the economic feasibility of bioenergy plants compared with conventional fossil fuel systems.	BT-4	Analyse
12.	Compare and analyze bioenergy and fossil fuels in terms of sustainability and environmental impact.	BT-4	Analyse
13.	Explain the application of bioenergy technologies in reducing carbon emissions from the transport sector.	BT-3	Application
14.	Analyze the role of bioenergy in climate change mitigation strategies.	BT-4	Analyse
15.	An MSW-based bioenergy plant processes 100 tonnes/day of waste with methane generation of 120 m^3/tonne. Estimate the total methane produced per day.	BT-4	Analyse

16.	Illustrate the role of bioenergy in achieving **energy security** using suitable Indian case studies.	BT-3	Application
17.	A household biogas plant replaces 3 LPG cylinders/month. Estimate the annual LPG savings and discuss the environmental significance.	BT-4	Analyse