M.TECH/RE/1ST SEM/REEN 5102/2020

NON-SOLAR RENEWABLE ENERGY
(REEN 5102)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) 3rd generation biofuel is primarily being produced from _____
(a) rice husk (b) lignocellulosic biomass
(c) algae (d) starchy material

(ii) Environmental adaptation is done at _____ phase during the growth of an organism in media.
(a) death (b) exponential
(c) lag (d) stationary

(iii) Power number will _____ with the decrease in the Reynold's number in case of mixing.
(a) linearly increase (b) exponentially increase
(c) linearly decrease (d) exponentially decrease

(iv) _____ are the harvesting techniques of algal colony from the culture media.
(a) Flocculation (b) Ultrasonication
(c) Milling (d) (a) and (b)

(v) AFEX pretreatment _____ lignin from lignocellulosic biomass
(a) removes high amount of
(b) removes very low amount of
(c) doesn't have any impact on the removal of
(d) releases carbohydrates but not

(vi) Mean wind speed _____ with increasing height above the ground.
(a) decreases (b) increases
(c) remain the same (d) become zero

(vii) The _____ is the main reason for lift generation in airfoils.
(a) pressure distribution (b) shear stress distribution
(c) streamline shape (d) leading edge radius

(viii) The cut-out speed of most industrial wind turbines, is almost
(a) 5m/s (b) 10m/s
(c) 25m/s (d) 100m/s

(ix) The speed ratio for Pelton wheel varies from _____
(a) 0.33 to 0.41 (b) 0.65 to 0.70
(c) 0.48 to 0.55 (d) 0.43 to 0.48

(x) A turbine is called a reaction turbine if at the inlet of the turbine the total energy is _____
(a) kinetic energy only (b) pressure energy only
(c) kinetic and pressure energy (d) none of the above

Group – B

2. (a) A chemostat follows Monod kinetics model. The data for reaction velocity (V) and substrate concentration ([S]) is obtained as the below table, where the biomass concentration is kept at constant '1 unit'. Compute the maximum specific growth rate and the half velocity constant in Monod model.

[S] (unit)	0.24	0.32	0.70	1.37	1.58	2.04	2.26	2.28	2.39	2.41
V (unit)	0.384	0.394	0.911	1.498	1.574	1.849	1.936	1.893	1.97	1.924

(b) The elementary liquid phase irreversible reaction $A+B \rightarrow C$ is to be carried out in a flow reactor. Two reactors are available, an 800 dm^3 PFR that can only be operated at 300 K and a 200 dm^3 CSTR that can be operated at 350 K. The two feed streams to the reactor mix to form a single feed stream that is equal molar in A and B, with a total volumetric flowrate (v_0) of 10 dm^3/min. Which of the two reactors will give us the highest conversion? Given: at 300 K, k=0.07 dm^3/mol.min and at 350 K, k=8.447 dm^3/mol.min. $C_{A0}=C_{B0}$= 2 mol/dm^3, $v_{A0}=v_{B0}$=50% of v_0.

(5 + 7) = 12

3. (a) Why baffle is required in a CSTR type bioreactor?

(b) Through a refinery, fuel ethanol is flowing in a pipe at a velocity of 1 m/s and a pressure of 0.1 MPa. The refinery needs the ethanol to be at a pressure of 2 atm (0.2 MPa) on a lower level. How far must the pipe drop in height in order to achieve this pressure? Assume the velocity does not change. The density of ethanol is 789 kg/m^3 and gravity g is 9.8 m/s^2.

(c) During saccharification, the product solution is being drawn by a plunger pump and delivered to a filtration unit. After 3-4 hours the available NPSH suddenly decreases and goes on decreasing with time (Assume no mechanical failures

within the pump). What are the possible reasons for such a decrease in the NPSH? Provide proper justification.

(4 + 4 + 4) = 12

Group – C

4. (a) What are the stages that must be thoroughly assessed during design, planning and management of a biogas plant installation? Provide a brief overview on the individual stages.

   (b) What are the advantages that could be felt with the fast pyrolysis in the production of liquid fuel?

(8 + 4) = 12

5. (a) Through diagram cite the difference between downdraft and updraft gasification unit.

   (b) A lab scale throat-less downdraft gasifier for gasification of wood pellets is designed for 2 hours batch operation. The below table shows the assumptions and initial design conditions. Density of air: 1.25 kg/m^3. To produce 5 kW amount of energy through gasifier calculate the grate area, reactor diameter and air flow rate to the gasifier.

Type of Gasifier	Downdraft (Throatless)
Type of fuel	Wood pellets
Calorific Value of fuel	15 MJ/kg
Density of fuel	370 kg/m^3
Gasification Efficiency	60%
Specific Gasification Rate	100 kg/m^{2}h
Equivalence Ratio	0.3
Stoichiometric Air-to-fuel Ratio	6.5 kg of air/kg wood
Random packing factor (cubes)	0.7

(6 + 6) = 12

Group – D

6. (a) What are the factors influencing the cost of wind energy generation?

   (b) Briefly discuss about design parameters of a wind turbine blade**.**

(6 + 6) = 12

7. (a) Write short notes on: **(4 × 3) = 12**
   (i) Shadow flicker
   (ii) Icing of wind turbines
   (iii) Tip speed ratio.

Group – E

8. (a) What is hydraulic efficiency of a turbine? Show that maximum hydraulic efficiency of a pelton wheel turbine is given by, $\eta_h = 0.5(1+\cos\phi)$, where angle of deflection = (180^o-ϕ).

   (b) A draft tube connected with a hydraulic turbine has inlet water velocity 6 m/s and outlet water velocity 1.2 m/s. For friction loss of 0.1 m and a tailrace 5 m below the entrance to the draft tube, find the pressure head at the entrance.

(2 + 6) + 4 = 12

9. (a) What is hydrograph and mass curve?

   (b) Design a Pelton wheel for a head of 60 m when running at 200 rpm. The Pelton wheel develops 100 kW shaft power. The velocity of the buckets is 0.45 times the velocity of the jet, overall efficiency is 0.85 and co-efficient of velocity is 0.98.

(2 + 10) = 12

Department & Section	Submission Link
RE	https://classroom.google.com/c/MTY2MDUxNTA1NDU5/a/Mjc0MDYxNDMyNTY0/details