Name: **Enrolment No:** **Roll No.**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Supplementary Examination, July 2020

Course: Renewable Energy Technologies I **Semester: II Semester**
Program: M.Tech Energy Systems **Time 03 hrs.**
Course Code: EPEC7011 **Max. Marks: 100**

Instructions:
1.Use of solar hand book and wind data table is permitted
2. Assume the suitable data and mention in solution at start.
3. Draw the necessary diagrams.

Note:

1. Read the instruction carefully before attempting.

2. This question paper has one section, Section A.

3. There are total of seven questions in this question paper **Section A**

4. **Section A** will be conducted online on BB Collaborate platform

5. **Answer sheet** to be submitted within **24 hrs** from the scheduled time *(exceptional provision due extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas).*

Section – A (Attempt all the questions)

Use of solar hand book and wind data are allowed while solving the problems.

Paper consisting of 7 problems from entire syllabus. Assume the suitable data if not provided from DDHB. Time duration to solve the problems are limited to 24 hrs for each student which includes the submission of the solution through blackboard . Any issue may be escalated to concern faculty member through mail/WhatsApp/ call etc.

SECTION A (100 Marks)

S. No.	Statement of question	Marks	CO
	SECTION A		
Q 1	a. Discuss the dynamics of tar formation during Pyrolysis of biomass. Also, comment on tar composition at different temperature levels.	**10**	**CO1**

<table>
<tr><td></td><td>b. What are the salient characteristics of gasification process over other bioconversion methods?</td><td></td><td></td></tr>
<tr><td>Q 2</td><td>Explain the working principal of a down draft, up draft and cross draft biomass gasifier</td><td>10</td><td>CO2</td></tr>
<tr><td>Q 3</td><td>What do you mean by briquetting of a biomass? How it is different from palletization? Discuss various process involved in the briquetting of a biomass?</td><td>10</td><td>CO2</td></tr>
<tr><td>Q 4</td><td>What are the different available pathways to convert biomass to other forms of fuels? Explain.</td><td>10</td><td>CO1</td></tr>
<tr><td>Q 5</td><td>The ultimate analysis of a biomass fuel is given to be:

Type of boiler: Biomass fired

Ultimate analysis of biomass:

<table><tr><td>Carbon</td><td>39.07</td></tr><tr><td>Hydrogen</td><td>6.03</td></tr><tr><td>Nitrogen</td><td>0.81</td></tr><tr><td>Sulphur</td><td>0.27</td></tr><tr><td>Oxygen (Remainder)</td><td>50.35</td></tr><tr><td>Ash</td><td>3.47</td></tr></table>
i. GCV of Biomass: 16 MJl/kg
ii. Excess air 30%
iii. Flue gas temperature (Tf): 2000C
iv. Ambient Temperature (Ta): 270C
v. Humidity of Air: 0.0132 kg/kg of dry air
Cp of air 1.005kJ/kg,</td><td>10</td><td>CO4</td></tr>
</table>

	Find a) Total Air required, b) the total volume of combustion products c) the dry flue gas analysis based on CO_2, O_2, and N_2.		
Q 6	A vertical stick, 1m long, is fixed on the ground. Calculate the length and direction of the shadow cast by the stick on the wall for the following situation Location : Dehradun (30.3180° N, 78.0290° E) Date : Date of Examination Time : 10:00AM	**10**	**CO2**
Q7	A flat-plate collector is made up of a copper absorber plate, copper tubes fixed on the underside and one glass cover. The following data is given: i. Length of collector:2.08 m ii. Width of collector:1.07 m iii. Length of absorber plate:2.00 m iv. Width of absorber plate:0.98 m v. Plate to cover spacing:2.5 cm vi. Thermal conductivity of plate material:350 W/m-K vii. Plate thickness:0.15 mm viii. Plate absorptivity for solar radiation:0.94 ix. Plate emissivity for re-radiation:0.14 x. Outer diameter of tube:13.7 mm xi. Inner diameter of tube:12.5 mm xii. Tube centre-to-centre distance:11.3 cm xiii. Glass cover emissivity/absorptivity:0.88 xiv. Extinction coefficient of glass:19.0 m^{-1} xv. Thickness of glass cover:4 mm xvi. Refractive index of glass relative to air:1.526 xvii. Location of collector: Pune (18°32¢ N, 73°51¢ E)	**40**	**CO3**

	xviii. Date: May 15Time:12 noon (IST)Collector xix. tilt: latitude angle xx. Surface azimuth angle: 0° xxi. I_b:725 W/m^2 xxii. I_d (uniformly distributed over the sky):230 W/m^2 xxiii. Adhesive resistance: Negligible xxiv. Fluid to tube heat transfer coefficient:205 W/m^2-K xxv. Water flow rate:70 kg/h xxvi. Water inlet temperature:60°C xxvii. Ambient temperature:25°C xxviii. Wind speed:3.1 m/s xxix. Back insulation thickness:5cm xxx. Insulation thermal conductivity:0.04 W/m-K xxxi. Reflectivity of the surrounding surfaces:0.2 xxxii. Assume that the side loss coefficient is 10 per cent of the bottom loss coefficient. Calculate, 1. The angle of incidence of beam radiation on the collector, 2. The total solar flux incident on the collector, 3. $(\tau\alpha)_b$ and $(\tau\alpha)_d$ 4. The incident flux absorbed by the absorber plate, 5. The collector heat-removal factor and overall loss coefficient, 6. The water outlet temperature, and 7. The instantaneous efficiency.		

	Assume appropriate data if required		