Name: **Enrolment No:**	

UPES
End Semester Examination, December 2024
School of Business

UPES

Program: BBA (GES) | **Semester: V**
Course: Bio Energy Resource Management | **Time: 3 hrs**
Course Code: OGET 3007 | **Max. Marks: 100**

Instructions: Attempt all questions

S. No.	Define the following terms in two lines	Marks	
	SECTION A **10Qx2M=20Marks**		
Q 1	Biogas	**2**	**CO 1**
Q 2	Food-based Portion of Crops	**2**	**CO 1**
Q 3	Unconsolidated wood	**2**	**CO 1**
Q 4	Pyrolysis	**2**	**CO 1**
Q 5	Ethanol	**2**	**CO 1**
Q 6	Landfill gas	**2**	**CO 1**
Q 7	Anaerobic digestion	**2**	**CO 1**
Q 8	Fire as Forest Health Improvement	**2**	**CO 1**
Q 9	Product by Transesterification	**2**	**CO 1**
Q 10	Bio diesel	**2**	**CO 1**
	SECTION B **4Qx5M= 20 Marks**		
	Answer the following questions in brief		
Q 1	Explain the factors influencing biomass resource potentials	**5**	**CO 1**
Q 2	Explain the Socio-economic impact of biomass across the globe	**5**	**CO 2**
Q 3	Elucidate the main opportunities for national/international trade of bioenergy	**5**	**CO 1**
Q 4	List down the Intergovernmental platforms for exchange on bioenergy policies	**5**	**CO 2**

SECTION-C **3Qx10M=30 Marks**			
Q 3	**Answer the following questions in detail**		
A	Explain the salient features of biomass programme in India	**10**	**CO2**
B	Describe the challenges (PESTEL) of incorporating biomass in China	**10**	**CO2**
C	Conduct a SWOT analysis of including biomass in India	**10**	**CO2**
SECTION-D **2Qx15M= 30 Marks**			
Q4	Refer the case study on **"Small Scale Biomass Gasifier based Decentralized Energy Generation Systems"** below and answer the following question: **Explain the issues faced by both the villages in making sustained availability of biomass locally and how these issues can be addressed. (15+15 marks)**	**30**	**CO 3**
	From the case studies described below, an important learning is that even at small capacities, by using gas engines, a sustained economical operation is possible, as the major operational cost are related to biomass cost. In this case, it is important to address the sustained availability of biomass locally, thus reducing the dependence on fossil fuel, an important concept for distributed power generation packages for the rural sector. **Hosahalli Village Gasifier** Hosahalli is the first un-electrified village in the country to be served by a biomass gasifier in terms of quality supply of electricity. The village is located 100 km from Bangalore in Tumkur District, Karnataka. It has about 35 houses with agriculture being the main occupation of the people. Hosahalli didn't have any agricultural pumps sets or a flourmill. Kerosene was used in traditional wick lamps for lighting. Women carried water from a polluted open water tank nearly 1 km away from the village. Farmers depended on rainfed agriculture and were subjected to the vagaries of monsoon and low crop yields. They occasionally hired diesel engines for pumping water for irrigation. The bio-energy project was planned and implemented by the Centre for Sustainable Technology (CST), Indian Institute of Science (IISc) in the year 1988. The project was planned by holding discussions and meetings with the Hosahalli village communities explaining the roles, responsibilities, benefits and the need for their participation. A role was created for the village committee to participate	**15**	**CO 2**

	and help in raising and protecting an energy forest on about 2.5 hectare of land. Mixed species forestry concept was adopted, the species planted include: Acacia auriculiformis (13 %), Eucalyptus (58 %), Dalbergia sisso (7 %), Casia siamea (22 %). Fast growing and coppicing species were preferred and most of the species were also legumes, which fix Nitrogen to enrich the soil. A productivity of 6 t/ ha/yr was reported during the initial years when detailed measurements of productivity were made. A 3.75 kWe biomass gasification coupled to a diesel engine was installed in the year 1988 and the local youth were trained to operate and undertake minor maintenance of the systems. The village committee managed the systems, taking decisions on operation of the units, supervision of the operator, protection of the forest and ensuring repayment for the services. The biomass feedstock in the initial years came from social forestry plantations in the nearby villages. The quality of the drinking water was also better as the project provided water from a deep bore well. This system no doubt got social acceptance but did not change the quality of life as anticipated. The gap that prevailed between perception and reality was that the power generation system did not aid in any income generation activity. Towards this end the system configuration was enhanced to 20 kWe and power was provided for irrigation. The 20 kWe power package consisted of a gasification system and a diesel engine. The gasification system in turn consisted of a reactor, cooling and cleaning system and flare to check the gas quality during start-up. Since there was no other form of electricity available in the village, the diesel engine had to be initially operated to start the gasification system and once gas generation was ensured by flaring the gas in the burner, the gas was supplied to the engine and operated in dual fuel mode (producer gas + diesel). After about 10 minutes the system got stabilized and the electric switch gear was energized to supply electricity to the entire village. The load stabilization also improved the diesel substitution to as high as 87%. The improvement in average annual diesel substitution from 54 to 87% was also due to better practice in terms of operation of the system. In terms of providing services to the Hosahalli village, lighting was provided for over 80% of the days in most years. Piped water supply was also provided for over 80% of the days in all the years and over 90% of the days during 2001- 2003. A flourmill was operated twice or thrice a week depending on the demand for milling of grains. The irrigation system was Schematic Representation of the Gasifier. Thus, the basic services critical for determining the quality of life such as home and street lighting and piped water supply was provided on most days, again a unique achievement for a village in India.		

Kasai Village Gasifier

Under the Village Energy Security Program (VESP) the Ministry of New and Renewable Energy Sources (MNRE), Govt. of India has a mandate of addressing the complete energy requirements of un-electrified villages in the states of Madhya Pradesh, West Bengal and Uttaranchal. Since the beneficiaries under this program were the forest fringe villages, the program is rightly implemented and monitored by the District Forest Officials (DFOs). This program addresses the complete energy requirement of a village, which includes fuel efficient stoves, biogas, biodiesel and biomass gasification system for electricity generation. Under this program, eleven forest fringe un-electrified villages in the state of Madhya Pradesh have been identified. The first among these villages to have benefited from this program is Kasai, which is located in Betul district. This village is located far away from the district center and is not easily accessible by road. The village has about 55 households with a population of 392. The villagers are mostly tribals and agriculture is their main economic activity. Under this project, grid lines were laid in order to supply electricity to the households. The electricity is generated in the 2 x 9 kWe gasification plant installed under this project. The plant is also equipped with a small capacity diesel generating set for black start purpose. The uniqueness of this power plant is that electricity is generated using a producer gas engine, which has been specially developed for this purpose. The power plant consists of a gasifier reactor with screw-based ash extraction system, cyclone, cooling and scrubbing systems, sand bed and fabric filter. The gas engine is modified from a three-cylinder diesel frame engine with necessary accessories such as gas carburetor, ignition system and an electronic governor to function as a spark ignited engine. The complete package is supplied by M/S Aruna Electrical Works, Villupuram (One of the Technology Holders of IISc). To make the power plant sustainable, the forest department has planted a 10-hectare energy plantation. Currently the day-to-day plant operation is managed by the village panchayat. Currently the services being met are home illumination, street lighting and supply of drinking water. A flourmill has been energized and a water pump and milk-chilling unit are also proposed. A few households have started using music systems and colour televisions. An expeller unit is proposed to be installed to extract oil from the Jatropha oilseeds, which will be used for operating pump sets. Improved chulhas have been constructed in every house to conserve firewood and biogas

	plants are being set up to meet cooking energy needs of households. The plant operates daily in the evening hours to supply power to the village. The system operates for 5 hours a day and on an average generates 40 units per day and 1200 units per month. The operation and maintenance of the plant is done by the local youth who have been trained in this aspect. As a startup process, a diesel engine is used to operate the gasification system before switching the operations to gas alone mode. During this period the amount of diesel used depends upon the operator's care. It amounts to about Rs. 0.4 per kWh which can be reduced to about Rs. 0.2 per kWh. Further, the cost of labour is about Rs.2.5 per kWh. **Conclusion** The case studies bring out the following message: • Biomass gasification technology holds large promise as a decentralized power generation system in terms of improving the quality of life, which includes supply of quality electricity on demand for illumination, supply of hygienic drinking water, irrigation and possibility for rural micro enterprises • This technology can be sustained using local available resources such as fuel and manpower for day-to-day operation of the plant • The Hosahalli village case study has shown that there are not many technologies ridden problems with high plant availability • Gasifier coupled with gas engine generator set is more economically viable compared to diesel generator set. For dual fuel operations to become attractive, we have to use locally generated biodiesel in place of expensive diesel. Also, the plant needs to be operated close to rated capacity to derive the best in terms of efficiency and cost of power generation • The technology package being conceived for remote village electrification must encompass a suitable system for black start purpose. Also, the technology package should encompass subcomponents that are easily maintainable by the trained local operators		