BIORESOURCE TECHNOLOGY (ChBC-82)

B.Tech. 8TH Semester

S. No.	Questions	COs
1.	The lignin contents and higher heating values (HHV) for some of the biomass samples are given in the following Table:	CO4

Biomass Samples	Lignin (L) Measured (wt.%)^{db}	HHV (wt.%)^{db} (MJ/kg)	HHV (wt.%)^{daf} (MJ/kg)	HHV (Calculated) (MJ/kg)	Difference
Corn Stover	14.4	17.8	18.5	17.7	-0.8
Corncob	15.0	17.0	17.2	17.8	+0.6
Sunflower Shell	17.0	18.0	18.8	18.0	-0.8
Beech Wood	21.9	19.2	19.5	18.4	-1.1
Ailanthus Wood	26.2	19.0	19.4	18.9	-0.5
Hazelnut Shell	42.5	20.2	20.5	20.1	-0.4
Wood Bark	43.8	20.5	20.8	20.1	-0.7
Olive Husk	48.4	20.9	21.6	21.0	-0.6
Walnut Shell	52.3	21.6	22.2	21.4	-0.8

With the help of the above data, develop a mathematical model which correlates higher heating values and the lignin contents.

2. After finding the mathematical correlation between HHV and L in question (1), determine the square of correlation coefficient (R^2) and also calculate percentage of average error, and what is the root mean square error (RMSE)? — CO4

Note: The correlation: $RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\text{Observed value} - \text{Predicted value})^2}$ may be used.

3. The proximate and ultimate analyses results of some of the bioresources are given in the Table below: — CO4

Biomass	Proximate analysis				Ultimate analysis^{daf}					References
	M	**VM ^{db}**	**FC ^{db}**	**A ^{db}**	**C**	**H**	**N**	**S**	**O**	
Pine chips	7.6	72.4	21.6	6	52.8	6.1	0.5	0.09	40.5	Masia (2007)
Poplar	6.8	85.6	12.3	2.1	51.6	6.1	0.6	0.02	41.7	Miles et al. (1995)
Sawdust	34.9	84.6	14.3	1.1	49.8	6	0.5	0.02	43.7	Tillman (2000)
Willow	10.1	82.5	15.9	1.6	49.8	6.1	0.6	0.06	43.4	Moilanen (2006)

db: Dry basis daf: Dry, ash-free basis, M:Moisture, VM: Volatile Matter, A: Ash, FC:Fixed Carbon

Using the correlations: HHV (MJ/kg) = (0.3536×FC + 0.1559×VM-0.0078×Ash) and HHV(kJ/kg) = ($3.55\times C^2$-232×C-2230×H + 51.2×C×H + 131× N + 20600) based on proximate and ultimate analyses, respective, predict the lignin contents present in the bioresources by using the correlation developed for the data in question (1).

4. Estimate the values of HHVs for the bioresources given in question (1) by using the correlations of question (2) and repeat for finding the mathematical model. — CO4

CO1:	Fundamental understanding of the bioresources and its applications for attainment of social objectives (energy, environment, product, sustainability).	
CO2:	Acquire knowledge with respect to the properties of the bioresources and the conversion technologies.	
CO3:	Exhibiting knowledge of the systems used for bioresources and bioresource technology.	
CO4:	Understanding about analysis of data and their applications in design of the systems and development of the bioprocess.	