Complex Engineering Problem
Signals and Systems (EE-341)

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Scenario:

Data transfer using wireless means are integral component of our daily activities. For such, mostly Bluetooth or Wi-Fi technologies are used. However, another technology, i.e., Light-Fidelity (Li-Fi) is another limited range communication technology which is dependent on the ambient light, and it utilizes the light spectrum to transfer data packets. Furthermore, easily assesible resources such as PCs/Laptops and hand-phones can be used to develop working prototype of a Li-Fi system. The design of such system whould have several sub-problems and it is therefore it is required that the analysis shall be performed on transcivers which enable the Li-Fi technology. The scenario and the requirements in the cemplex engineering problem is outlined in Figure 1.
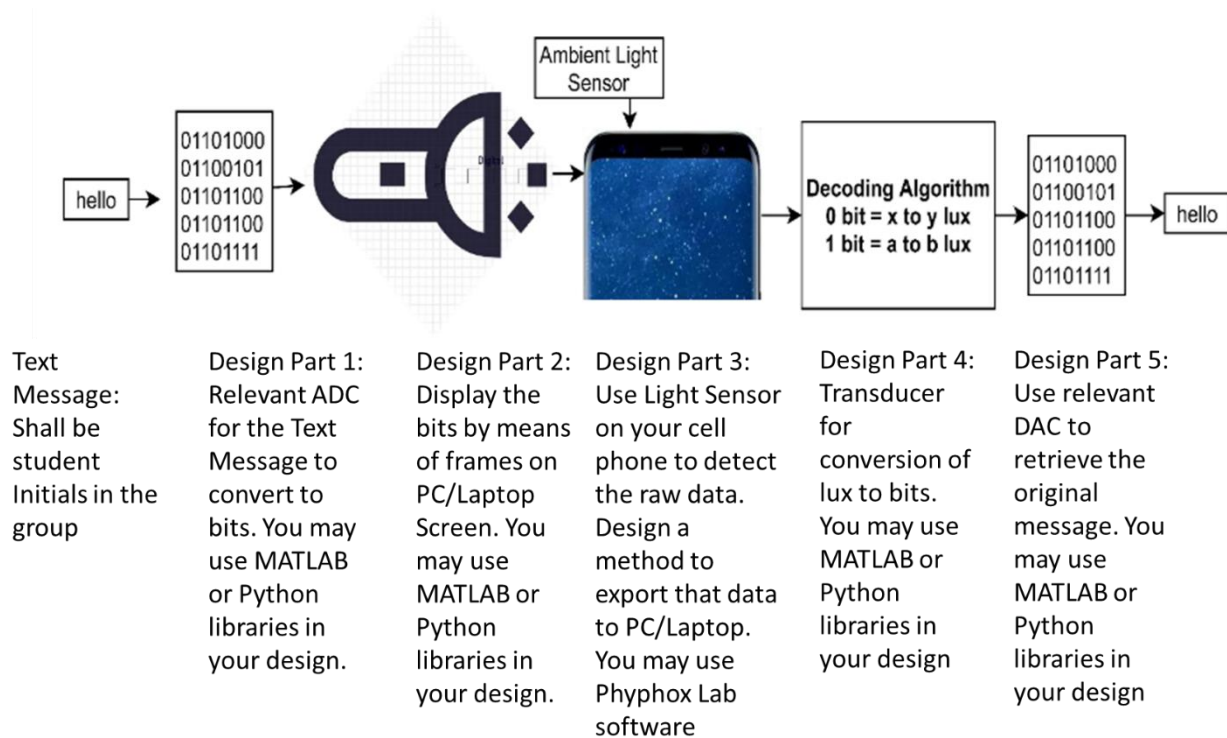

Figure 1 : A scenario for the construct of Li-Fi Transceiver design

Problem Statement:

"Design and Development of Li-Fi Transceiver System using Computer and Mobile Phones."

In a group of maximum four students, you are required to type a text message which shall include initials of students' names, convert the text data to binary form by using appropriate ADC. Develop

a mechanism of transferring those bits into encoded light through PC or Laptop Screens. Use Ambient Light sensor in smart phones and record out the lux reading by any software e.g., Phyphox Lab. Develop a mechanism to export the raw lux data from the cell phone. Develop a transducer to convert lux reading to binary bits. Employ a relevant DAC to convert the binary bits to text form again. Table 1 outlines the CEP attributes.

Major Tasks:

- Literature review of relevant techniques in your experiment.
- Design and implementation of algorithms.
- Use or construction of libraries and toolboxes in your design.
- Display encoded message using PC/Laptop Screen.
- Export of raw data from cellphones.
- Analysis of your system under the room/testing conditions.

Expected Outcomes:

Students are expected to
- Understand and explain the stages in Li-Fi system.
- Understand the use of modern tools for data acquisition and signal processing.
- Perform analysis of the system designed in Li-Fi.
- Write a report using an IEEE template. All the references should be in IEEE format. The report should be 4-5 pages in length including the references page.

The assessment will be based on live demonstration, code, and report according to the rubrics shown in Table 2.

Table 1: CEP Attributes Mapping and Justification

Attribute	Justification
Depth of Knowledge	Li-Fi based transceiver design includes concepts of ADC, DAC, and various types of transducers which require in-depth engineering knowledge.
Depth of analysis required	The channel between Transmitter and Receiver impairs the signals thus requiring analysis of different parameters in the experimental setup.
Extent of stakeholders, range of conflicting requirements	A minimum bit error rate must be ensured for the system. Moreover, maximizing the accuracy can be at the cost of low data rate which is a conflicting requirement.

Table 2 : Rubrics of the CEP

	Unsatisfactory (0-1)	Developing (1.1-2.5)	Satisfactory (2.5-4)	Exemplary (4.1-5)	PLOs	Remarks
Description How well are the key elements of the methods/design are expalined	Descrition of the key elements of the methods/design is poor	Descrition of the key elements of the methods/design is representing a developing level	Key elements of the methods/ design are described with sufficient details	Key elements of the methods/ design are deeply and well elaborted	**PLO-1**	
Design How accurately the developed algorithm works	Designing and working of the developed algorithm are representing an unsatisfactory level	The developed algorithm is working however, it is not optimally solving the problem	Good design and averagre level of optimized algorithm for solving the problem	Excellent and optimal design. High accuracy of the algorithm for solving the problem	**PLO-3**	
Report structure and its technical level How well the acquired skills are used for formulating a technical report for presenting and summarizing the results of the conducted studies	Very weak rather poor report writing skills, neither well-structured nor well-organized data, no consistent flow of information	Technically good, however, not very structured and organized presentation of the required report contents, some conceptual mistakes/errors	Showing good implementation of the acquired skills of writing technical reports, well formatted report, good literature survey	The report is very well-written and organized, the student understands the concept of intellectual property, good and updated referencing	**PLO-10**	