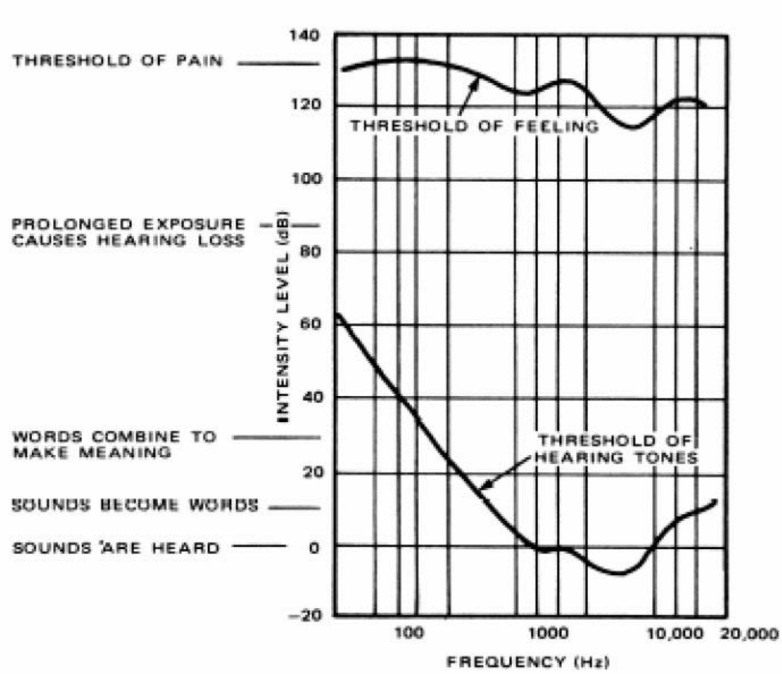
Measuring Human Senses

Part A: Measuring Threshold of Hearing Curve

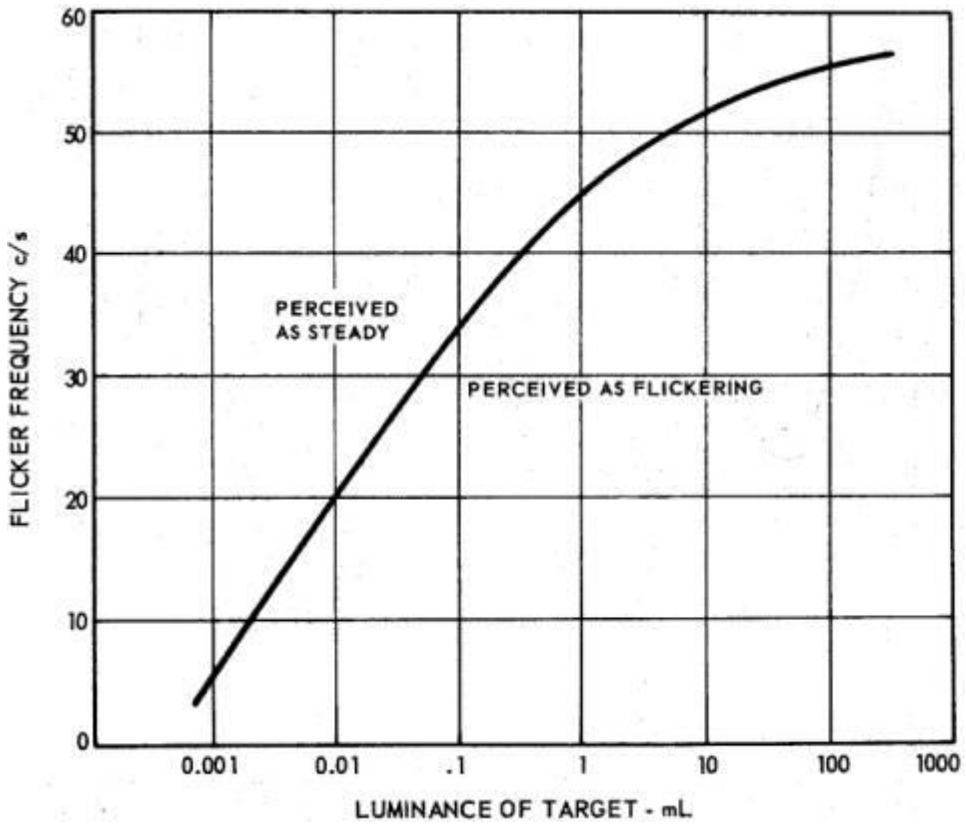
Human Hearing range usually describes the range of frequencies that can be heard by humans. The human range is often given as 20 to 20,000 Hz, but there is considerable variation between individuals, especially at high frequencies. Also, a gradual decline of this range with age is considered normal. Routine investigation for hearing loss usually involves an audiogram, which is a graph that shows the audible threshold for standardized frequencies as measured by an audiometer. The Y-axis represents intensity measured in decibels (dB) and the X-axis represents frequency measured in Hertz (Hz) as shown below. At each frequency, the lowest sound intensity that can be heard is measured and recorded and the Threshold of Hearing Curve is just the collection of such points at different frequencies spanning the range of human hearing.



Design, conduct and analyze results of an experiment to generate Threshold of Hearing Curve for your group. Provide your results as Log-Log plots as the figure shown using your own Matlab code.

Part B: Measuring Critical Fusion Frequency

An important practical concept in human vision is the perception of flickering lights as steady. The frequency at which a flashing light is perceived as having a continuous intensity level is called the critical fusion frequency (CFF). The CFF generally increases with increasing average light intensity and with decreasing proportion of the light–dark cycle occupied by the flash (percent modulation or duty cycle). An example curve showing how the CFF changes with intensity of light is given below.



Design, conduct and analyze results of an experiment to generate CFF curve showing changes with light intensity and duty cycle for your group. Provide your results as semilog plots as the figure shown using your own Matlab code.

General Requirements

1. Experimental Design procedure including all requirements of Assessment Rubrics must be ready and approved by Lab Engineer before conducting any experiment.
2. All students must Conduct the experiment and document it according to the requirements of Assessment Rubrics and approved by Lab Engineer after conducting any experiment.
3. You are free to select any components you prefer for your experiments.
4. You should be prepared to demonstrate your experimental setup and answer questions in all aspects related to your experiment.
5. You should work in groups of 2 students each. One report addressing all parts of Assessment Rubrics should be submitted on behalf of the whole group.
6. You may use any resources you find useful to your experiment as long as you acknowledge such use in your report in accordance to ethical guidelines.

Assessment Rubrics

	Exemplary	Satisfactory	Developing	Unsatisfactory
KPI's	**3**	**2**	**1**	**0**
Designs a reliable and relevant experiment	**Objectives** are identified and measurable. Covers relevant **Background/ Theory** with exhaustive references. **Work Plans** are meticulously developed step by step. Identifies **Variables** and selects appropriate **Tools**. Lists and explains all pertinent **Safety/Environmental/ Ethical issues**	**Objectives** are identified and measurable. Covers relevant **Background/Theory** with sufficient references. **Work Plans** are meticulously developed step by step. Identifies **Variables** and selects appropriate **Tools.** Just lists all pertinent **Safety/ Environmental/**	**Objectives** are identified but contains technical and conceptual error. **Work Plans** are developed with no distinct steps. Not all **Variables/Tools** are appropriately selected. List some of the pertinent **Safety/Environmental/**	**Objectives** are not identified. **Work Plans** are not developed step by step. Selects inappropriate **Tools.** Fails to list any pertinent **Safety/ Environmental/ Ethical issues**.
Conducts the experiment	Experimental **Set-up** is always neat and accurate. Always r**ecords** complete data, identifies possible sources of error. **Measurements** are always accurate with symbols, units and significant digits. **Collects data** always in a meaningful way. Always demonstrates **reproducibility** and good knowledge of lab procedures.	Experimental **Set-up** is mostly neat and accurate. Mostly r**ecords** complete data, identifies possible sources of error. **Measurements** are mostly accurate with symbols, units and significant digits. **Collects data** mostly in a meaningful way. Mostly demonstrates **reproducibility** and good knowledge of lab procedures.	Experimental **Set-up** is workable with minor help. **Records** incomplete data e.g., sampling (number of data points) is just sufficient, understands possible sources of error with minor help. **Measurements** are less accurate with some errors in symbols, units and significant digits. **Collects data** that are sometimes difficult to handle and understand. Lacks **reproducibility** in results and demonstartes some	Experimental **Set-up** is mostly untidy and inaccurate. Rarely r**ecords** and **collects** data in a meaningful way. **Measurements** are inaccurate and often without symbols, units and significant digits. Does not demonstrate **reproducibilty** as well as required knowledge of lab procedures.
Analyzes and interprests data	**Comprehensively understands** the data in terms of variables (dependent/ independent), assumptions, deviations and experimental uncertainties etc. **Organizes** the data in figures and tables using modern software tools extensively for analysis. **Discusses/compares** his/her results in the light of obtained results/theoretical models of similar studies from other sources extensively. **Concludes** rationally based on experimentation and clear reasoning.	**Sufficiently understands** the data in terms of variables (dependent/independent), assumptions, deviations and experimental uncertainties etc. **Organizes** the data in figures and tables using modern software tools sufficiently for analysis. **Discusses/compares** his/her results in the light of obtained results/theoretical models of similar studies from other sources sufficiently. **Concludes** rationally based on experimentation and fair reasoning.	**Fairly understands** the data in terms of variables (dependent/independent), assumptions, deviations and experimental uncertainties etc. **Organizes** the data in figures and tables using modern software tools fairly for analysis. **Discusses/compares** his/her results in the light of obtained results/ theoretical models of similar studies from other sources fairly. **Concludes** based on his/her experimentation and acceptable reasoning.	**Poorly understands** the data in terms of variables (dependent/independent), assumptions, deviations and experimental uncertainties. Fails to **Organize** the data in figures and tables using modern software tools. Fails to **Discuss/compare** his/her results in the light of obtained results/theoretical models of similar studies from other sources. Fails to **conclude** rationally based on experimentation and acceptable reasoning.

References

- ANSI/AAMI HE75:2009, Human Factors Engineering – Design of Medical Devices, 2009.
- http://en.wikipedia.org/wiki/Hearing_range
- http://en.wikipedia.org/wiki/Audiogram
- https://en.wikipedia.org/wiki/Flicker_fusion_threshold