Music, vibrations, and frequency analysis: Deliverables

ME 240: Fundamentals of Instrumentation & Measurement • D. H. Kelley and I. Mohammad • 139 points

Name: _____ Student ID: _____

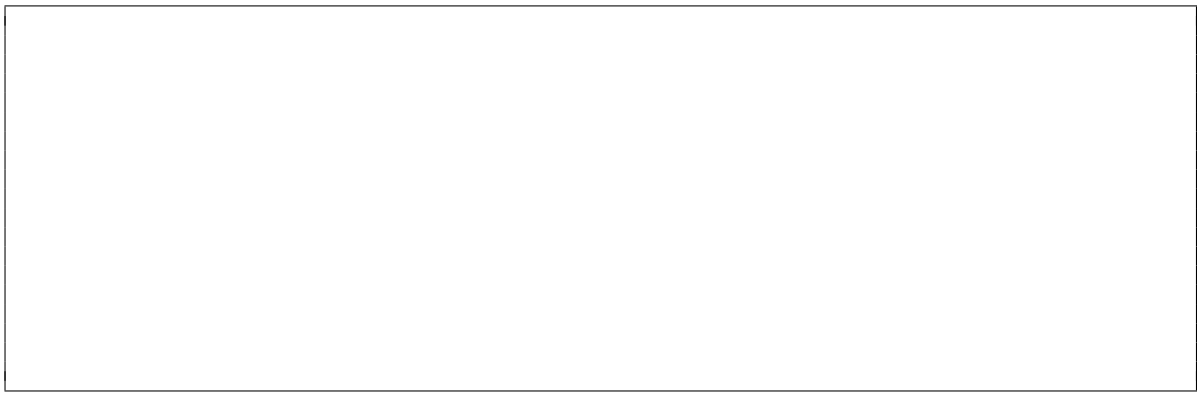
Lab partners: _____

Please write the following sentence in the box below in your own handwriting and **SIGN**: ***"I affirm that I have not given or received any unauthorized help on this assignment, and that this work will be my own."***

Tuning a ukulele

1. (2 points) Why is audio typically sampled with frequency 44,100 Hz?

2. (6 points) Attach two plots of your recording of the A string, one showing the entire duration and one showing just 0.2 s.Axes should be labelled with proper units. Below, write a descriptive caption for the figure showing your recording of the A string.

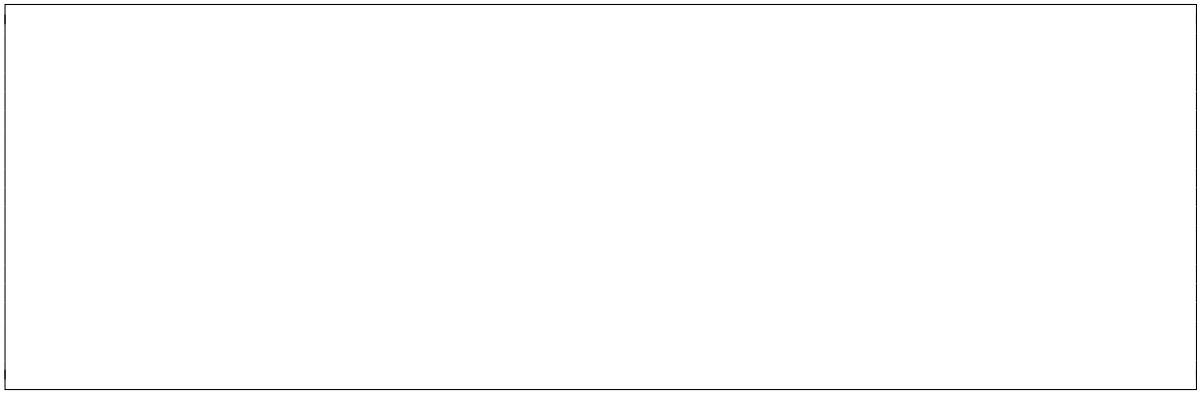


3. (1 point) Record the original fundamental frequency of the A string in Table 1.

4. (4 points) Attach a plot of the original spectrum of the A string. Axes should be labelled with proper units. Write a descriptive caption for the figure.

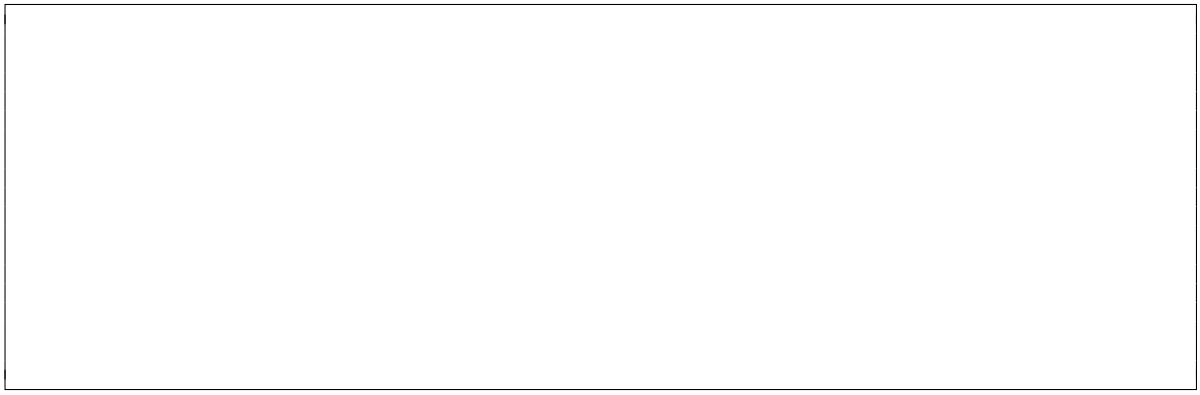
5. (1 point) Record the original fundamental frequency of the C string in Table 1.

6. (4 points) Attach a plot of the original spectrum of the C string. Axes should be labelled with proper units. Write a descriptive caption for the figure.



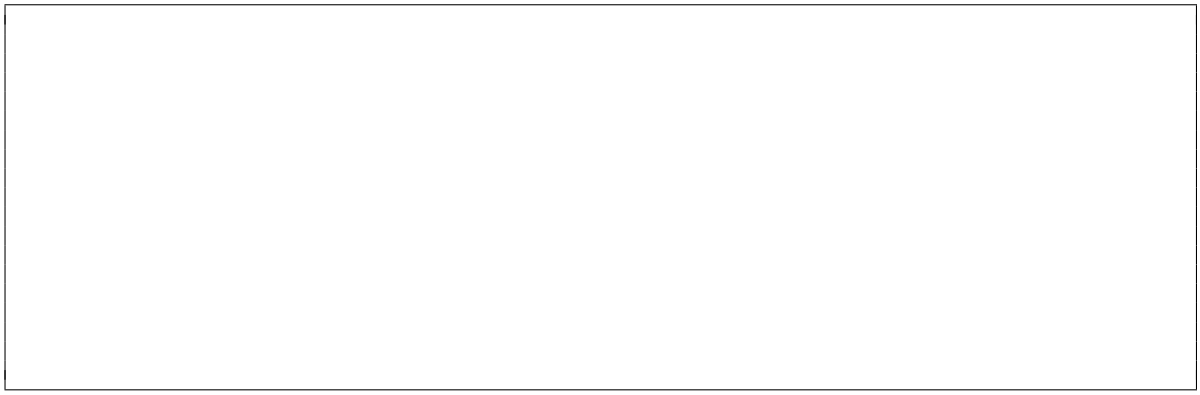
7. (1 point) Record the original fundamental frequency of the E string in Table 1.

8. (4 points) Attach a plot of the original spectrum of the E string. Axes should be labelled with proper units. Write a descriptive caption for the figure.



9. (1 point) Record the original fundamental frequency of the G string in Table 1.

10. (4 points) Attach a plot of the original spectrum of the G string. Axes should be labelled with proper units. Write a descriptive caption for the figure.



11. (1 point) Record the fundamental frequency of the C note (between 220 and 440 Hz) in Table 1.

12. (1 point) Record the fundamental frequency of the E note (between 220 and 440 Hz) in Table 1.

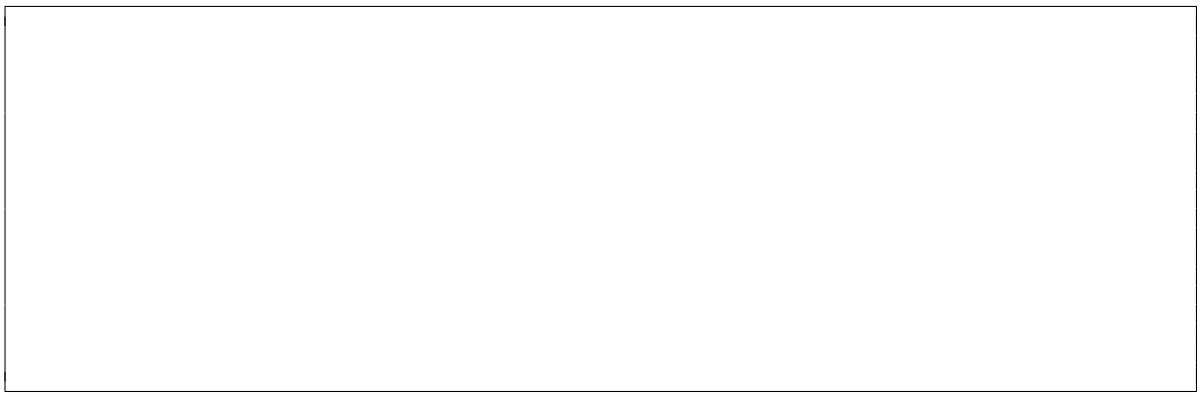
13. (1 point) Record the fundamental frequency of the G note (between 220 and 440 Hz) in Table 1.

14. (1 point) Record the fundamental frequency produced by the A string after tuning in Table 1.

15. (4 points) Attach a plot of the spectrum of the A string after tuning. Axes should be labelled with proper units. Write a descriptive caption for the figure.

16. (1 point) Record the fundamental frequency of the C string after tuning in Table 1.

17. (4 points) Attach a plot of the spectrum of the C string after tuning. Axes should be labelled with proper units. Write a descriptive caption for the figure.



18. (1 point) Record the fundamental frequency of the E string after tuning in Table 1.

19. (4 points) Attach a plot of the spectrum of the E string after tuning. Axes should be labelled with proper units. Write a descriptive caption for the figure.

20. (1 point) Record the fundamental frequency of the G string after tuning in Table 1.

21. (4 points) Attach a plot of the spectrum of the G string after tuning. Axes should be labelled with proper units. Write a descriptive caption for the figure.

Diagnosing a damaged bearing

22. (2 points) Do you expect the shaft to spin faster or slower than the motor? Why?

23. (2 points) Predicted gear ratio γ : _____

24. (1 point) Measured motor rotation frequency f_m : _____

25. (1 point) Measured shaft rotation frequency f_s : _____

26. (1 point) Ratio of measurements f_s/f_m : _____

27. (1 point) Percent difference between γ and f_s/f_m: _____

28. (2 points) What might cause the mismatch between γ and f_s/f_m?

29. (1 point) Inner radius R_i : _____

30. (1 point) Outer radius R_o : _____

31. (1 point) Shaft rotation frequency f_s : _____

32. (2 points) Predicted click frequency f_c : _____

33. (4 points) Attach a figure showing the recorded sound of the spinning apparatus (including an enlargement) and write a caption in the space below.

34. (4 points) Attach a figure showing power spectrum of the recorded signal and write a caption in the space below.

35. (1 point) Shaft rotation frequency f_s, from spectrum: _____

36. (1 point) Click frequency f_c, from spectrum: _____

37. (1 point) Percent difference between predicted and measured values of f_c: _____

38. (2 points) What might cause the mismatch between predicted and measured click frequency?

39. (20 points) Type and attach an abstract.

40. (20 points) Type and attach a description of the methods used.

41. (20 points) Type and attach a description of your results, explaining your measurements and how they connect to the questions you were trying to answer. Write a few sentences describing the implications of each plot you made. You need not repeat basic information that appears in the captions, like the meanings of colors and symbols in your plots. Instead, explain at a higher level, focusing on how the measurements answer your questions. Present sufficient evidence to convince other engineers that you achieved a solution to the stated problem, or else explain why it was not possible. Avoid using generalizations, vague terms, or presenting the same data multiple times.

Note	Original frequency (Hz)	Goal frequency (Hz)	Tuned frequency (Hz)

Table 1: Tuning a ukulele: fundamental frequencies