CG2023 Signals & Systems

AY2020/21-2

Online Midterm Quiz

Date: 4 March 2021 Time Allowed: 1 Hours

INSTRUCTIONS TO CANDIDATES:

1. This paper contains **TWO (2)** questions and comprises **FOUR (4)** printed pages.
2. Answer **ALL** questions. Each question carries 20 marks.
3. Write the answers for each question on a new A4-size page and paginate your answer script.
4. This is an **OPEN BOOK** quiz.
5. The "**Exam Declaration Form**" is located in the APPENDIX.
6. For the purpose of this quiz, please take note of the digits ***a***, ***b***, ***c*** and ***d*** in your student number A0xx***abcd***X. These digits will be used in the questions in this quiz.

At the end of the quiz, please do the following:

a. Enter your Student Number and Name (**as appeared on your NUS matriculation card**), your Group Number, and the total number of submitted pages in the boxes provided below.

Student №:	
Name:	
Group №:	

Number of pages in this PDF file (including this cover page and the Exam Declaration Form): i.e. 2 + number of answer pages	

b. Use a scanning app (such as Microsoft Office Lens or CamScanner) to capture this cover page, your answer pages (in page number sequence) and the filled/signed Exam Declaration Form in the **Appendix**.

c. Generate a consolidated PDF file consisting of this cover page, followed by the **signed** Exam Declaration Form, followed by your answer pages using the filename "**A0123456J-CG2023-Quiz.pdf**" where you replace **A0123456J** with your **matriculation number**. Upload the consolidated PDF file to the

Your Group Number
↓
LumiNUS → CG2023 → Files → QUIZ → Quiz Submission Group (#)

folder within **20 minutes** from the time the examination ended.

For examiner use only →

Question	Q.1	Q.2	TOTAL
Marks			

QUESTIONS

ATTENTION!

- **Justify each of your answers by showing the working or providing the reason that leads to it.**
- **Ensure that the parameter values are accurately derived from your student number and substituted into your answers.**

A penalty of up to 100% of the marks may be imposed for answer without justification or question solved without using the correct parameter values.

Q.1 A signal $y(t)$ has a spectrum given by $Y(f) = X\left(\frac{f}{M}\right)e^{-j2\pi Lf}$ where

$$X(f) = M\cos\left(\frac{\pi f}{2W}\right)\cdot \text{rect}\left(\frac{f}{2W}\right)$$

is the spectrum of another signal $x(t)$.

The values of L, M and W are obtained as

$$L = \frac{a+c+d+3}{5},\quad M = \frac{a+b+c+6}{4} \text{ and } W = \frac{b+c+d+10}{2},$$

where a, b, c and d are the values from your student number.

Write down the values of L, M and W in your answer script and answer the following questions using these values.

(a) Find the inverse Fourier transform of $X(f)$ and express it in terms of the $\text{sinc}(\cdot)$ function.

(7 marks)

(b) Calculate the 3dB bandwidth of $x(t)$.

(6 marks)

(c) Derive an expression for $y(t)$ in terms of $x(t)$.

(7 marks)

Q.2 A signal

$$x(t) = 2 + A \cdot \sin\left(10\pi t + \frac{\pi}{5}\right) - B \cdot e^{-j\left(30\pi t + \frac{3\pi}{5}\right)}.$$

Another signal

$$y(t) = 5 \cdot x(t - 0.02) * \text{sinc}^2(10t),$$

where $*$ is the convolution operation. The values of A and B are obtained as

$$A = \frac{a+1}{2} \quad \text{and} \quad B = \frac{a+b+2}{5}.$$

The values of a and b are from your student number.

Write down the values of A and B in your answer script and answer the following questions using these values.

(a) Find the Fourier series of $x(t)$ and its average power.

(6 marks)

(b) Find the Fourier transform $X(f)$ of $x(t)$ and sketch the spectrum.

(4 marks)

(c) Is $z(t) = x(t) \times e^{j10\sqrt{5}\pi t}$ a periodic signal? Explain briefly.

(4 marks)

(d) Find the Fourier transform $Y(f)$ of $y(t)$.

(6 marks)

END OF PAPER

APPENDIX

Exam Declaration Form

Please read sections A, B and C below. Sign and submit this declaration form together with your answers.

A. Academic, Professional and Personal Integrity

1. *The University is committed to nurturing an environment conducive for the exchange of ideas, advancement of knowledge and intellectual development. Academic honesty and integrity are essential conditions for the pursuit and acquisition of knowledge, and the University expects each student to maintain and uphold the highest standards of integrity and academic honesty at all times.*

2. *The University takes a strict view of cheating in any form, deceptive fabrication, plagiarism and violation of intellectual property and copyright laws. Any student who is found to have engaged in such misconduct will be subject to disciplinary action by the University.*

3. *It is important to note that all students share the responsibility of protecting the academic standards and reputation of the University. This responsibility can extend beyond each student's own conduct, and can include reporting incidents of suspected academic dishonesty through the appropriate channels. Students who have reasonable grounds to suspect academic dishonesty should raise their concerns directly to the relevant Head of Department, Dean of Faculty, Registrar, Vice Provost or Provost.*

B. I have read and understood the rules of the assessments stated below:

a. *Students should attempt the assessments on their own. There should be no discussion or communication, via face to face or communication devices, with any other person during the assessment.*

b. *Students should not reproduce any assessment materials, e.g. by photography, videography, screenshots, copying down of questions, etc. Posting on public forums, e.g. social media and websites, is prohibited.*

C. I understand that by breaching any of the rules above, I would have committed offences under clause 3(I) of the NUS Statute 6, Discipline with Respect to Students, which is punishable with disciplinary action under clause 10 or clause 11 of the said statute.

3) Any student who is alleged to have committed or attempted to commit, or caused or attempted to cause any other person to commit any of the following offences, may be subject to disciplinary proceedings:

(I) plagiarism, giving or receiving unauthorised assistance in academic work, or other forms of academic dishonesty.

I have read and will abide by the NUS Code of Student Conduct (in particular, (A) Academic, Professional and Personal Integrity), B and C when attempting this assessment.

Signature: _____ Date: _____

Matric. No.: _____