

# ENGR101 Test 1

## Practice Questions

### Abstract

Test is worth 60 marks  
Core 65%, Completion 15%, Challenge 20%  
**Answers in red**

## 1 Core

### 1.1 Binary

Convert the following unsigned binary numbers to decimal

- 1101 1111 **223**
- 0000 0100 **4**
- 1000 0000 **128**

Convert the following 2's complement signed binary numbers to decimal

- 1101 1111 **-33**
- 0000 0100 **4**
- 1000 0000 **-128**

Convert the following decimal numbers to both 2's complement and unsigned binary numbers (where possible). How many bits are required for each?

- 10 UB: 0000 1010 (4 bits) , SB: 0000 1010 (5 bits)
- -64 UB: Not possible , SB: 1100 0000 (8 bits)
- 102 UB: 0110 0110 (7 bits) , SB: 0110 0110 (8 bits)
- -1025 UB: Not possible , SB: 1011 1111 1111 (12 bits)

## 1.2 Memory

1. How much memory is required to store 1000, 16 bit numbers? **2 kB**
2. Explain the difference (specifically giving reference to bytes or bits) between an 'int' variable and a 'char' and a 'long' variable in C. **char = 1 byte uses ASCII encoding (127 possible characters), int uses 4 bytes, long uses 8 bytes**
3. What is ASCII? **127 character encoding set (so can fit into 1 byte)**

## 1.3 LMC

Name each component of the LMC. **Input/Output, Little Man, Calculator, Addressable Memory, Program Counter**

What will the output of the following LMC assembly code be when run on the LMC (if these input value was 64)? **OUT 1: 64, OUT 2: 69, OUT 3: 69**

```
INP  
OUT  
ADD b  
OUT  
STO 99  
OUT  
HLT  
b DAT 5
```

For the above program what OpCodes will the memory addresses 0,5,6, 7 and 99 contain one the program has run? **#0: 901**

**#5: 902**  
**#6: 000**  
**#7: 5**  
**#99: 69**

## 1.4 Networking

List all the layers of the OSI model and give an example of each.

Layer : Name : Example  
Layer 1: Physical : Wire, Radio frequency  
Layer 2: Data : Ethernet  
Layer 3: Network : IPv4  
Layer 4: Transport : TCP/UDP  
Layer 5: Session : connection and maintenance  
Layer 6: Presentation: Encryption  
Layer 7: Application: HTTP, DNS, SSH, FTP

List 3 benefits of layering in the construction of networks.

- Consistent and independent technological development at each level
- Common standard in between different companies
- Lower barrier to entry for small commercial enterprises

What is the difference between an intranet and the internet?

- Intranet - internal network, not always connected to the network. Usually contains private information and requires some form of authentication
- Internet - network of networks, allows connection to external networks, inherently "public"

## 2 Completion

### 2.1 ADC

What is the minimum resolution of a 4 bit ADC converter on a 12V signal?  
0.75V

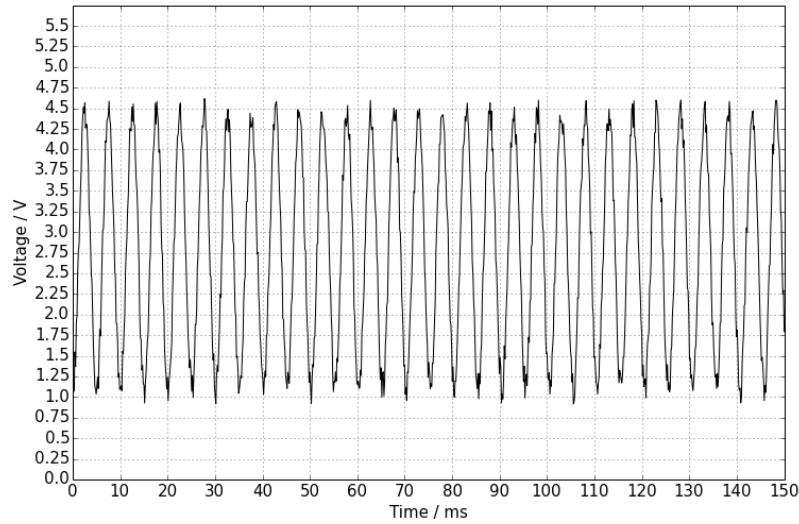


Figure 1: Noisy Analog Signal

For the signal above, which frequency would be most appropriate to use when sampling it and why?

- 1 Hz
- 50 Hz
- 200 Hz
- 1000 Hz - Nyquist

Are the signals above and below analog or digital? Both analog (although the second one appear to be based off an original digital signal)

What is the SNR of the two signals?

SNR of sine wave: about 14 SNR of square wave: about 11

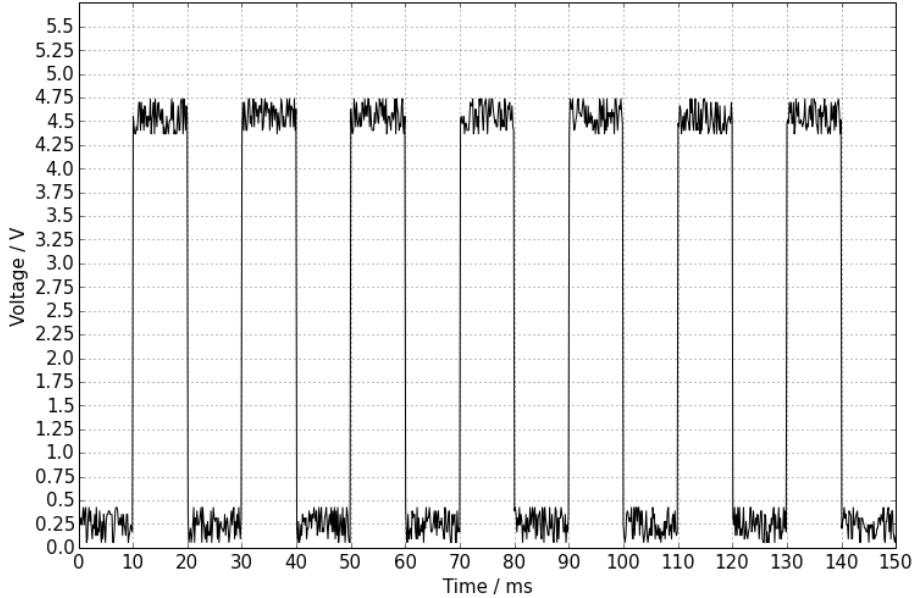


Figure 2: Signal

### 3 Challenge

#### 3.1 Engineering Ethics

Congratulations! You have just developed an open source flight control software for multirotors (big quadcopters) which allows autonomous navigation and allows control of payloads of over 100kg to be flown autonomously. The accompanying hardware can be easily purchased from Ebay for less than US\$100.

Give examples of an ethical and social implication of you releasing this software.

Hint: Watching this may help: <https://www.youtube.com/watch?v=K4NRJoCNHIs>

Ethical implication - the software and low cost to entry could allow people to use this as a personal transport device. An autonomous transport device would also be responsible for the occupant's safety.

Social implication - There is also the potential for such a device to be used as weapon (it's essentially a self-controlling drone). If hacked or used maliciously this could inflict serious harm on large numbers of people. There are also surveillance concerns (as with all quadcopters).

Before release it may be prudent to ensure a vehicle licensing framework exists to ensure owners have some training prior to use. Alternatively use of these devices could also be limited to specific zones under supervision. Or perhaps these could be released for military use only. On a positive note this could also revolutionize safety systems for evacuations from planes or skyscrapers.

Statement of position: I would create this code, but only release it publicly once a suitable legal framework existed to ensure safe use. I don't want someone's harm or death on my conscience.

Alternative statement of position: I would create and release this code regardless of the potential for harm. The potential good this technology could bring far outweigh the risks. Consumers can already purchase or create explosives and weapons, this is no different. However I must ensure that the 'autonomousness' of the bot is controlled by the user (like cruise control on cars) thereby placing responsibility in the user's hands.