Question 1

In a system, the analog range is **M** to **N** (where **N > M**) and there is 1 byte in the digital system. If the analog values of the system are presented in Hexadecimal number of $2A_{16}$ and $1C_{16}$ correspond to Gray Codes of 01110010 and 01101111 respectively, determine

i) maximum of the analog range which is presented in Decimal number.

ii) if the same of analog range of the system is used and the total number of bits is 128 bits,

   a) what is the new resolution of converter for the system. With this new resolution of converter, what will happen to the system?

   b) find out the summation of all bits weight that are in the even number position from left to right.

(25 marks)

Question 2

In a gear box type transmission dynamometer, the input and output shafts are co-axial and rotate in the same direction. The input and output shaft information and its application is shown in **Figure Q2(i)** and **Figure Q2(ii)** respectively. The overall mechanical efficiency is 60%. Find the input power of the system if the forces at point A and B are parallel to each other and point A and D are perpendicular**.**

Figure Q2(i)

Figure Q2(ii)

(25 marks)

Question 3

Based on the block diagram in **Figure Q3**, obtain the Overall Gain (Y/X). Show your calculation (block by block reduction).

Figure Q3

(25 marks)

Question 4

In the seismic device as shown in **Figure Q4**, the transducer is attached to the object which motion is to be measured. **Figure Q4** consists of the mass, ***m*** is supported by a spring of stiffness, ***k*** and viscous damper with damping coefficient of ***c***.

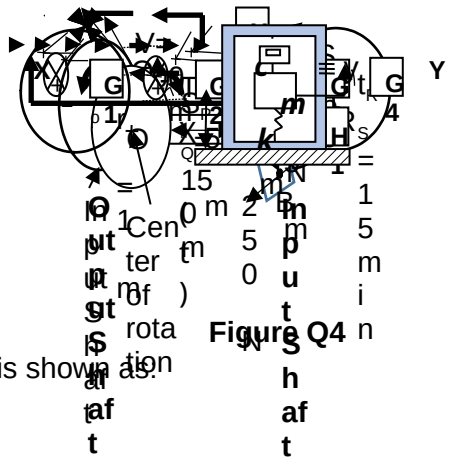
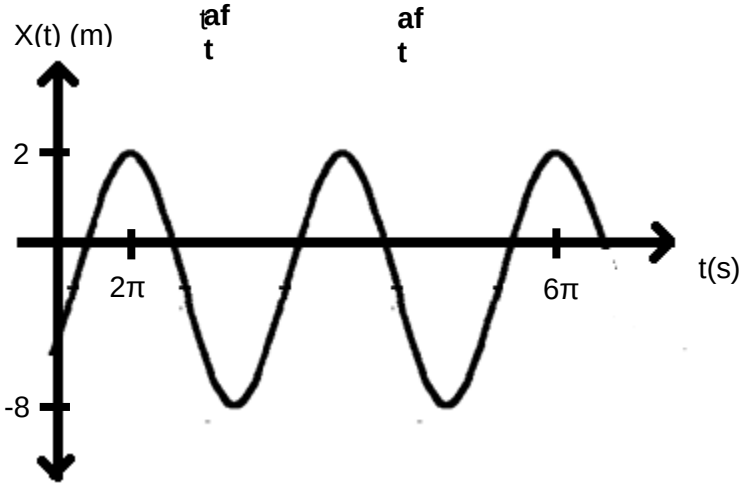


Figure Q4

and the input for this system is shown as:



i)
a) Find the equation of input function X(t)
b) Find the equation of v(t) and draw its graph
c) Find the equation of a(t) and draw its graph

(10 marks)

ii) If frequency ratio is 2, damping ratio is 0.3 and static sensitivity is 0.01
a) Find **m**, **c** and **k**.
b) Find the amplitude of recorded motion.

(10 marks)

iii) The instrument can be used as accelerometer if the error is not to exceed 1%. Using the data in previous question, **Q4(ii),** and graph analysis in **Figure Q4(iii)**, show the calculation and complete the **Table Q4**.

Table Q4

ζ	0	0.65	0.7
ω_n (rad/s)			
f (Hz)			

(5 marks)

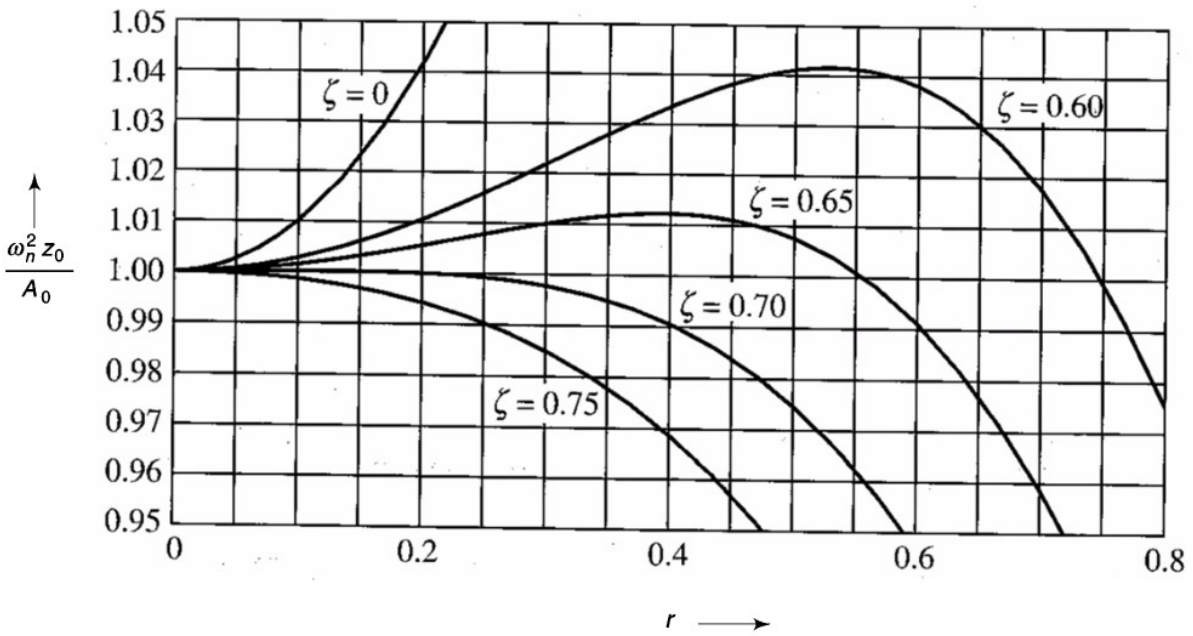


Figure Q4(iii)

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