ICOM-5217: Microprocessor Interfacing   **Midterm Exam – October 2008**

Name: _SOLUTION_   Student ID: _____

Part I: Concepts (30%)

Provide brief answers to the questions below.

1. An MP3 player for an audio application is being designed as an embedded system application. Three methods of implementation are under consideration: Under method A, the design would use a Digital Signal Processor (DSP); in method B, the design would be completed with an embedded microcontroller; while in method C, the design will be completed with an Application Specific Integrated Circuit (ASIC) where all functions will reside in hardware. Alternative A has NRE_a of $250,000 and a recurrent cost per unit RP_a of $75. Alternative B has NRE_b =$150,000 and RP_b =$130; while the ASIC solution has NRE_c =$2,000,000 and RP_c =$20.
   a. For each of the three alternatives, plot the per-unit cost break-even price of the system production volume V
   b. Determine the production volume V where the ASIC solution becomes the most cost effective solution.
   c. c. If the market for this product had an expected volume sales of 1,500 units, which implementation alternative would you recom-mend? Justify you recommendation.
   d. d. In part c, what should be the market price of the system if the company expects a profit margin of 25%? How much would be the expected revenues if all marketed units were sold? (15%)

$NRE_a = 250,000 \qquad RP_a = 75$

$NRE_b = 150,000 \qquad RP_b = 130$

$NRE_c = 2M \qquad RP_c = 20$

$U_c = \dfrac{NRE}{V} + RP$

Using spread sheet

a)
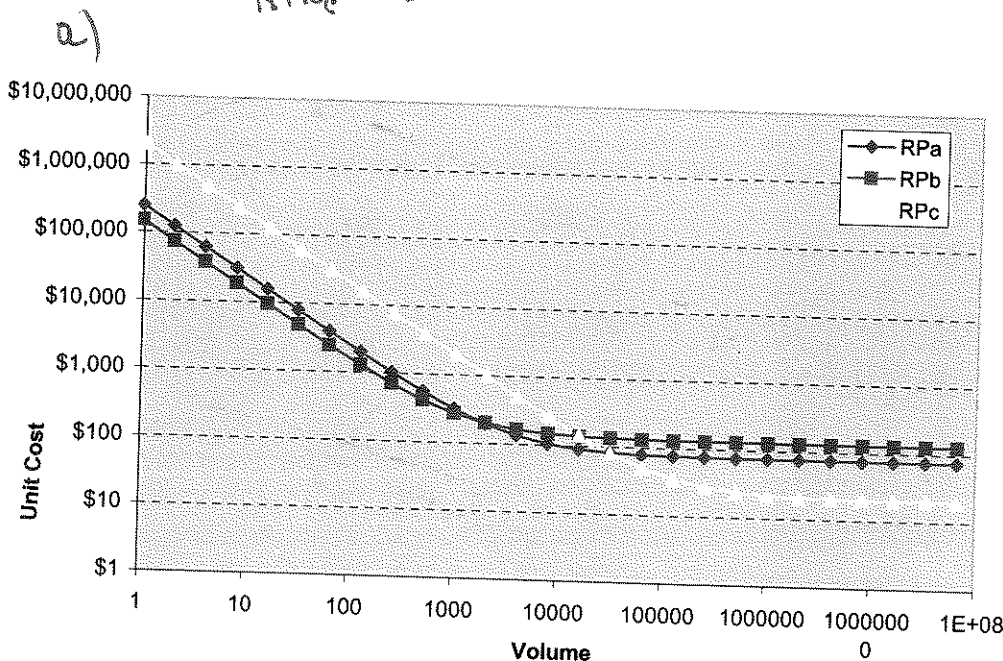
Vol	RPa	RPb	RPc
1	$250,075	$150,130	$2,000,020
2	$125,075	$75,130	$1,000,020
4	$62,575	$37,630	$500,020
8	$31,325	$18,880	$250,020
16	$15,700	$9,505	$125,020
32	$7,888	$4,818	$62,520
64	$3,981	$2,474	$31,270
128	$2,028	$1,302	$15,645
256	$1,052	$716	$7,833
512	$563	$423	$3,926
1024	$319	$276	$1,973
2048	$197	$203	$997
4096	$136	$167	$508
8192	$106	$148	$264
16384	$90	$139	$142
32768	$83	$135	$81
65536	$79	$132	$51
131072	$77	$131	$35
262144	$76	$131	$28
524288	$75	$130	$24
1048576	$75	$130	$22
2097152	$75	$130	$21
4194304	$75	$130	$20
8388608	$75	$130	$20
16777216	$75	$130	$20
33554432	$75	$130	$20
67108864	$75	$130	$20

4pts

b)

$$\frac{NRE_a}{V} + RP_a = \frac{NRE_b}{V} + RP_b$$

$$\frac{RP_b - RP_a}{NRE_a - NRE_b} = \frac{1}{V} \quad \therefore \quad V = \frac{NRE_a - NRE_b}{RP_b - RP_a}$$

4 pts

$$\frac{1}{V}(NRE_a - NRE_b) + (RP_a - RP_b) = 0$$

$$V = \frac{250,000 - 2 \times 10^6}{20 - 75} = 31,818$$

$$\boxed{V = 31,818 \text{ units}}$$

c) From Plot it can be easily seen ~~that~~ that Alternative b (mcu) is the best. ~~verify~~ Verifyin

4 pts

Cost A: $\frac{NRE_c}{V} + RP_a = \frac{250,000}{1500} + 75 = 241.67$

Cost B $= \frac{150,000}{1500} + 30 = 230$ ⟵ $\boxed{\text{Alternative B is best}}$

d) For a 25% profit the street price would be Cost × 1.25 =

$$S.P. = (230)(1.25) = \boxed{287.50}$$

3 pts

$$Rev. = 230 \times 0.25 \times 1500 = \boxed{\$86,250}$$