Department of Electrical Engineering

Max Marks: 15 | **EEL 602, Operating Systems** |

Duration: 1 Hour | **Major Exam** | May 5th, 2007

1. Suppose we have a demand-paged memory. The page table is held in registers. It takes 8 milliseconds to service a page fault if an empty frame is available or the replaced page is not modified and 20 milliseconds if the replaced page is modified. Memory access time is 100 nanoseconds.

Assume that the page to be replaced is modified 70 percent of time. What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds? **[4]**

2. (a) Consider a demand paging system with **four** physical memory frames and the following reference string over **seven** pages: **[3]**

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6

Assuming that memory starts empty, *how many page faults* will occur **and** *what will be the final contents of memory* under the **FIFO** page replacement policy?

Clearly Circle your answers.

(b) Answer the problem of part (a) for the **LRU** policy.

Clearly circle your answers.

(c) Answer the problem of part (a) for the **OPTIMAL** policy.

Clearly circle your answers.

3. Consider the following snapshot of a system. There are no current outstanding queued unsatisfied requests.

currently available resources

r1	r2	r3	r4
2	1	0	0

	current allocation				**max demand**			
process	**r1**	**r2**	**r3**	**r4**	**r1**	**r2**	**r3**	**r4**
p1	0	0	1	2	0	0	1	2
p2	2	0	0	0	2	7	5	0
p3	2	3	5	4	4	3	5	6
p4	2	3	5	4	4	3	5	6
p5	0	3	3	2	0	6	5	2

A request from p3 arrives for (0, 1, 0, 0). In what state (deadlocked, safe, unsafe) would immediately granting the whole request leave the system? Which processes, if any, are or may become deadlocked if this whole request is granted immediately? **[2]**

2. Consider a multi-level memory management using the following virtual addresses:

Virtual Seg #	Virtual Page #	Offset

Each virtual address has 2 bits of virtual segment #, 8 bits of virtual page #, and 12 bits of offset. Page table entries are 8 bits. *All values are in hexadecimal.*
Translate the following virtual addresses into physical addresses: **[6]**

(+ 1 marks a piece, -0.5 for every incorrect answer!)

Virtual Address	Physical Address
0x204ABC	
0x102041	
0x304F51	

Virtual Address	Physical Address
0x23200D	
0x1103DB	
0x010350	

Segment Table

Start	Size	Flags
0x2004	0x40	Valid, read only
0x0000	0x10	Valid, read/write
0x2040	0x40	Valid, read/write
0x1010	0x10	Invalid

Physical Memory

Address	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
0x0000	0E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
0x0010	1E	1F	20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D
....																
0x1010	0E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
....																
0x2000	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11
0x2010	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21
0x2020	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F	30	31
0x2030	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F	40	41
0x2040	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51
0x2050	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	60	61
0x2060	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F	70	71
0x2070	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F	80	81