ME101, Midterm Examination, Fall 2009 Name ___________________________________

Closed Book Examination (one 3”x5” card of handwritten notes, one side, allowed)

Time Limit: 80 minutes

p. 2 (20 pts possible) ____________

p. 3 (18 pts possible) ____________

p. 4 (10 pts possible) ____________

p. 5 (20 pts possible) ____________

p. 6 (25 pts possible) ____________

TOTAL ____________

READ THESE INSTRUCTIONS!

Total Points Available: 93
Values as marked.
6 pages, not including this cover sheet. Make sure you have all the pages!

Do not start until told to begin.
Write your SID at the top of every inside page when you are told to begin.

1. (15 pts as marked) Please choose one **or more** correct options and explain your answer.

   a) 5 pts As you move along the supply chain from the factory toward the retailer, each supply chain participant will tend to have (greater) (smaller) (the same) observed variation in demand than the previous participant.

   b) 5 pts (EOQ) (EMQ) (ROI) will minimize (ordering costs) (production costs) (total costs).

   c) 5 pts If your total labor costs are fixed for operating the bottleneck machine, you will (always) (sometimes) (never) minimize inventory costs if you set batch size big enough to ensure that production time for a batch of the i^{th} product is (<) (>) (<=) (>=) (=) the external setup time for the $\{i+1\}^{th}$ product.

2. (5 pts) If F.W. Taylor were alive today, would you recommend hiring him as a manufacturing consultant? Back up your answer with specifics from the movie.

3. (8 pts) You are setting up a new production line for widgets. The first 4 widgets take the following amounts of time to produce:

1^{st}	10 hrs
2^{nd}	8 hrs
3^{rd}	7 hrs
4^{th}	6.4 hrs

Estimate the time to produce the 6^{th} widget using the theory of learning curves. Show your work.

4. (10 pts) The demand for a product in the last four years is shown below. Apply exponential smoothing with α=0.1 to forecast the demand for 2009. Show your work.

Year	Demand
2008	2400
2007	2800
2006	2600
2005	2500

5. (10 pts) Using an 18% annual interest rate compounded annually, what is the present value of a project with the estimated cash flows shown? (It is currently year 0.) Show your work. See interest rate tables below.

Year	Expenditures	Income
0	$1200	--
1	$4600	$1300
2	$1500	$6500

Factor Table - i = 18.00%

n	P/F	P/A	P/G	F/P	F/A	A/P	A/F	A/G
1	0.8475	0.8475	0.0000	1.1800	1.0000	1.1800	1.0000	0.0000
2	0.7182	1.5656	0.7182	1.3924	2.1800	0.6387	0.4587	0.4587
3	0.6086	2.1743	1.9354	1.6430	3.5724	0.4599	0.2799	0.8902
4	0.5158	2.6901	3.4828	1.9388	5.2154	0.3717	0.1917	1.2947
5	**0.4371**	**3.1272**	**5.2312**	**2.2878**	**7.1542**	**0.3198**	**0.1398**	**1.6728**
6	0.3704	3.4976	7.0834	2.6996	9.4423	0.2859	0.1059	2.0252
7	0.3139	3.8115	8.9670	3.1855	12.1415	0.2624	0.0824	2.3526
8	0.2660	4.0776	10.8292	3.7589	15.3270	0.2452	0.0652	2.6558
9	0.2255	4.3030	12.6329	4.4355	19.0859	0.2324	0.0524	2.9358
10	**0.1911**	**4.4941**	**14.3525**	**5.2338**	**23.5213**	**0.2225**	**0.0425**	**3.1936**
11	0.1619	4.6560	15.9716	6.1759	28.7551	0.2148	0.0348	3.4303
12	0.1372	4.7932	17.4811	7.2876	34.9311	0.2086	0.0286	3.6470
13	0.1163	4.9095	18.8765	8.5994	42.2187	0.2037	0.0237	3.8449
14	0.0985	5.0081	20.1576	10.1472	50.8180	0.1997	0.0197	4.0250
15	**0.0835**	**5.0916**	**21.3269**	**11.9737**	**60.9653**	**0.1964**	**0.0164**	**4.1887**
16	0.0708	5.1624	22.3885	14.1290	72.9390	0.1937	0.0137	4.3369
17	0.0600	5.2223	23.3482	16.6722	87.0680	0.1915	0.0115	4.4708
18	0.0508	5.2732	24.2123	19.6731	103.7403	0.1896	0.0096	4.5916
19	0.0431	5.3162	24.9877	23.2144	123.4135	0.1881	0.0081	4.7003
20	**0.0365**	**5.3527**	**25.6813**	**27.3930**	**146.6280**	**0.1868**	**0.0068**	**4.7978**
21	0.0309	5.3837	26.3000	32.3238	174.0210	0.1857	0.0057	4.8851
22	0.0262	5.4099	26.8506	38.1421	206.3448	0.1848	0.0048	4.9632
23	0.0222	5.4321	27.3394	45.0076	244.4868	0.1841	0.0041	5.0329
24	0.0188	5.4509	27.7725	53.1090	289.4944	0.1835	0.0035	5.0950
25	**0.0159**	**5.4669**	**28.1555**	**62.6686**	**342.6035**	**0.1829**	**0.0029**	**5.1502**
30	0.0070	5.5168	29.4864	143.3706	790.9480	0.1813	0.0013	5.3448
40	0.0013	5.5482	30.5269	750.3783	4,163.2130	0.1802	0.0002	5.5022
50	0.0003	5.5541	30.7856	3,927.3569	21,813.0937	0.1800		5.5428
60	0.0001	5.5553	30.8465	20,555.1400	114,189.6665	0.1800		5.5526
100		**5.5556**	**30.8642**	**15,424,131.91**	**85,689,616.17**	**0.1800**		**5.5555**

6. (20 pts) The table below contains the tasks needed to manufacture a product.

   a) If the demand for this product is 24,000 units per year, and the factory will operate 40 hours per week, 50 weeks per year, what is the desired cycle time?
   b) Give a lower bound on the number of stations required to meet the demand. Assume the transfer and repositioning time between stations is negligible.
   c) Draw a precedence diagram, find the positional weight of each element, rank them, and assign to stations using the RPW technique.

Task	Task Time (min)	Immediate Predecessor Tasks
1	2.5	-
2	2.5	1
3	1.5	1
4	0.6	3
5	2.3	2, 4
6	2.4	3
7	3.5	5, 6

7. (15 pts) A factory purchases sheet metal and produces brackets at a work center. For each bracket, the necessary sheet metal costs $1.50. The work center takes 60 minutes to set up, and each setup costs $50.00. Each bracket is processed for 5 minutes in total, among all the stations at the work center. The finished bracket is valued at $8.00. A study has shown that jobs spend 60% of their time waiting and in transit, and 40% in setup and processing. The holding cost rate is 75% per year. The factory operates 10 hours per day, 250 days per year. Annual demand is 8,000 brackets (continuous, constant demand).

   a) What is the average annual holding cost for one piece of WIP (in $/piece/year)?
   b) Find the optimal batch size to minimize overall cost.

8. (10 pts) Widgets are produced in batches of 16 in a job shop. The widgets are processed in 8 stations in turn, with manual, asynchronous transfer of batches between stations. Processing time is 12 minutes per batch per station. On average, there are 4 batches of widgets in process at any given time. An average of 3 batches are completed during each 8-hour shift. Estimate the average throughput time for a widget.