3 hrs	27/ 05 /08		EXAMS OFFICE USE ONLY

University of the Witwatersrand, Johannesburg

Course or topic No(s)	MECN4000
Course or topic name(s) Paper Number & title	SYSTEMS MANAGEMENT
Examination Test* to be held during month(s) of (*delete as applicable)	MAY 2008
Year of Study (Arts & Science leave blank)	FOURTH
Degree/Diplomas for which this course is prescribed (BSc (Eng) should indicate which branch)	BSc. (ENG.) ELECTRICAL
Faculty/ies presenting candidates	ENGINEERING
Internal examiner(s) and telephone extension number(s)	Ms. B. SUNJKA (x 77367)
External examiner(s)	Mr. M.F. Shamley
Special materials required (graph/music/drawing paper) maps, diagrams, tables, computer cards, etc.	NONE

Time allowance

Course Nos.	MECN4000	Hours	3 hours

Instructions to candidates (Examiners may wish to use this space to indicate, inter alia, the contribution made by this examination or test towards the year mark, if appropriate)

ANSWER ALL QUESTIONS.

TABLES AND FORMULA SHEET FORM PART OF THE QUESTION PAPER.

CALCULATORS MAY BE USED.

TOTAL MARK: 100

Question 1

A project has been defined to contain the following list of activities, along with their times for completion:

Activity	Immediate Predecessors	Time (days)
A	-	1
B	A	4
C	A	3
D	A	7
E	B	6
F	C,D	2
G	E,F	7
H	D	9
I	G,H	4

1.1 Draw the network diagram
1.2 On the diagram, show the early start and early finish times
1.3 On the diagram, show the critical path
1.4 What would happen if activity F were revised to take 4 days instead of 2 days?

TOTAL: 15 Marks

Question 2

Answer **ONLY 1** of the following 2 questions ie answer either 2.1 or 2.2

2.1 CONCORDVILLE, Pa. - May 08, 2006 .....Southco, a privately held, global provider of engineered access hardware solutions and applications for a broad spectrum of industries, has selected SAP to enable its **lean manufacturing strategy** and allow it to compete with agility as it expands global operations. With rapidly expanding global operations and customers in the marine, automotive, truck, off-highway/construction, RV/caravan, consumer electronics, computer hardware, and industrial enclosures industries, ... [t]he company sought an **... ERP solution to support its lean six sigma initiatives** ...
(www.sap.com/southafrica/industries/machinery/large/newsevents/press.epx?pressid=6181)

Explain in detail how the principles of **MRP/ERP systems and Lean Thinking** may be combined to maximize operational competitiveness in a global company such as Southco, where efficiency improvement and cost savings are a priority. Incorporate concepts such as inventory, quality, scheduling, component ordering etc. in your answer.

QUESTION 2 CONTINUES OVERLEAF/....
PTO/Page 2...

2.2 In operations management explain what the following concepts are, why they are each important competitiveness issues and how each of them impact on the company's operating strategy:

(a) Inventory (include in your explanation a discussion on the costs associated with holding inventory)
(b) Quality (include in your explanation a discussion on a methodical approach to quality)

TOTAL: 15 Marks

Question 3

3.1 Connector leads for electronic ignition components are produced to a specification of 80.0 +/- 0.1 mm. The quality manager is in the process of assessing the capability of the production process. A sample of 100 connector leads is taken and the average is found to be 80.03 mm with a standard deviation of 0.04 mm. Given that the process is normally distributed, determine

2.1.1 the process capability index, C_{pk} (4)
2.1.2 whether the process is in control
(include a drawing to illustrate/support your answer) (3)
2.1.3 the probability of producing a defect based on the current sample (3)

3.2 Explain the relationship between producer and consumer risk. (3)

3.3 The company buying the connector leads in 2.1, now wishes to determine the appropriate critical values, in order to be 95% confident that for a sample size of 10, the results truly represent the total population. From past experience, this company has found that the standard deviation for the 80 mm connector leads is 0.02 mm.

(3)

3.4 Construct the appropriate process control chart for the following information drawn from a production process. All samples were of the same size, n=180. Assume a 99.9% confidence interval. What conclusions can you make about the process? Briefly explain your answer.

(4)

QUESTION 3 CONTINUES OVERLEAF/....
PTO/Page 3...

Sample	% defects
1	2
2	5
3	5
4	3
5	1
6	0
7	2
8	2
9	6
10	2
11	7
12	1
13	4
14	3
15	2
16	3

TOTAL: 20 Marks

Question 4

4.1 Explain the difference between dependent and independent demand in inventory management. (1)

4.2 Company X assembles microwave ovens at a rate of 20 000 units per annum. A key component (Y) is made in-house in a fabrication area adjacent to the assembly area. Part Y is valued at R50 per unit and the combined storage and handling cost is R8 per unit per annum. The cost of preparing the order and making the production setup is R200, and the fabrication area can make 160 units of Y per day. The plant operates 250 days per year. Calculate

4.1.2 the economic order quantity.
4.2.2 the reorder point

(4)

4.3 Assume that product Z is made up of two units of A and four units of B. A is made of three units of C and four of D. D is made of two units of E. The lead times for purchase or fabrication of each unit to the final assembly are: Z takes two weeks; A, B, C and D take one week each, and E takes 3 weeks. Fifty units are required in period 10. Assume that there is currently no inventory on hand for any of these items. Do the following:

4.3.1 Draw a product structure tree (Bill of Materials)
4.3.2 Develop the materials requirements plan showing all relevant information

(10)

TOTAL: 15 Marks

QUESTION 5 CONTINUES OVERLEAF/....
PTO/Page 4...

Question 5

5.1 Briefly explain how **Six Sigma** improves process control (use drawings to support your explanation. (5)

5.2 You are the production manager responsible for a manufacturing process that produces 100g slabs of chocolate. Specifications for the product are 100 g +/- 1 gram. Sample size is 5. Assume a 99.7% confidence interval.

5.2.1 Plot the appropriate SPC chart(s) for this process.
5.2.2 Is the process in control? Explain your answer.

Sample	Ave. mass	Range
1	101.2 g	0.8 g
2	100.8	0.3
3	99.1	0.4
4	98.3	0.9
5	99.7	0.6
6	100.3	0.5
7	98.0	1.0
8	99.7	1.1
9	100.8	0.7
10	99.8	1.3
11	101.1	0.3
12	99.3	0.2
13	99.8	0.8
14	100.3	1.5
15	100.9	0.9

(10)

TOTAL: 15 Marks

QUESTION 6 CONTINUES OVERLEAF/....
PTO/Page 5...

Question 6

6.1 What **leadership style** is described in each of the following scenarios. Briefly, motivate your answer.

(10)

6.1.1 " … leading a group of highly motivated people with an average of 25 years of experience likely calls for a different approach than does a group of new hires unsure of what they are supposed to be doing."

6.1.2 "This exchange pursues a cost-benefit, or economic exchange strategy, whereby the leader exchanges rewards and treatment for desirable [work] from the subordinate."

6.1.3 " … engage the whole person by asking followers to transcend their self-interest for the sake of the team or organization and by raising employee awareness about the importance and value of goals." and are, thus, able to take the organization through major strategic change.

6.1.4 "… as *steward* of the resources (human, financial and otherwise) provided by the organization. It encourages leaders to serve others while staying focused on achieving results in line with the organization's values and integrity."

6.1.5 "… he or she invites other members of the team to contribute to the decision-making process. This not only increases job satisfaction by involving employees or team members in what's going on, but it also helps to develop people's skills

6.2 "The development of teams typically occurs in [a number of] phases, and the key to the journey to high performance is the establishment of shared and productive norms and a working approach whereby the team can effectively manage – not eliminate – conflict."
Discuss **team development** in the context of this statement. (10)

TOTAL: 20 Marks

----------**08**----------

Mean or average

[TN8.1] $$\bar{X} = \sum_{i=1}^{N} x_i / N$$

Standard deviation

[TN8.2] $$\sigma = \sqrt{\frac{\sum_{i=1}^{N} (x_i - \bar{X})^2}{N}}$$

$CV = \mu \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$

Capability index

[TN8.3] $$C_{pk} = \min\left[\frac{\bar{\bar{X}} - \text{LTL}}{3\sigma}, \frac{\text{UTL} - \bar{\bar{X}}}{3\sigma}\right]$$

Process control charts using attribute measurements

[TN8.4] $$\bar{p} = \frac{\text{Total number of defects from all samples}}{\text{Number of samples} \times \text{Sample size}}$$

[TN8.5] $$s_p = \sqrt{\frac{\bar{p}(1 - \bar{p})}{n}}$$

[TN8.6] $$\text{UCL} = \bar{p} + zs_p$$

[TN8.7] $$\text{LCL} = \bar{p} - zs_p$$

[TN8.8] $$\text{UCL}_{\bar{X}} = \bar{\bar{X}} + zs_{\bar{X}} \quad \text{and} \quad \text{LCL}_{\bar{X}} = \bar{\bar{X}} - zs_{\bar{X}}$$

Process control $\bar{X}$ and R charts

[TN8.9] $$\bar{\bar{X}} = \frac{\sum_{j=1}^{m} \bar{X}_j}{m}$$

[TN8.10] $$\bar{R} = \frac{\sum_{j=1}^{m} R_j}{m}$$

Q-model. Total annual cost for an ordered Q, a per-unit cost C, setup cost S, and per-unit holding cost H.

[15.2] $$TC = DC + \frac{D}{Q}S + \frac{Q}{2}H$$

Q-model. Optimal (or economic) order quantity.

[15.3] $$Q_{\text{opt}} = \sqrt{\frac{2DS}{H}}$$

Q-model. Reorder point R based on average daily demand $\bar{d}$ and lead time L in days.

[15.4] $$R = \bar{d}L$$

Q-model. Reorder point providing a safety stock of $z\sigma_L$.

[15.5] $$R = \bar{d}L + z\sigma_L$$

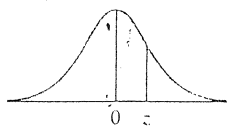
Average daily demand over a period of n days.

[15.6] $$\bar{d} = \frac{\sum_{i=1}^{n} d_i}{n}$$

Standard deviation of demand over a period of n days.

[15.7] $$\sigma_d = \sqrt{\frac{\sum_{i=1}^{n} (d_i - \bar{d})^2}{n}}$$

AREAS OF THE STANDARD NORMAL DISTRIBUTION



An entry in the table is the proportion under the entire curve that is between $z = 0$ and a positive value of z. Areas for negative values of z are obtained by symmetry. Using Microsoft Excel® these probabilities are generated with the equation:

NORMSDIST (z) − .5

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2703	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Factor for Determining from $\bar{R}$ the Three-Sigma Control Limits for $\bar{X}$ and R Charts

Number of Observations in Subgroup n	Factor for $\bar{X}$ Chart A_2	Factors for R Chart: Lower Control Limit D_3	Factors for R Chart: Upper Control Limit D_4
2	1.88	0	3.27
3	1.02	0	2.57
4	0.73	0	2.28
5	0.58	0	2.11
6	0.48	0	2.00
7	0.42	0.08	1.92
8	0.37	0.14	1.86
9	0.34	0.18	1.82
10	0.31	0.22	1.78
11	0.29	0.26	1.74
12	0.27	0.28	1.72
13	0.25	0.31	1.69
14	0.24	0.33	1.67
15	0.22	0.35	1.65
16	0.21	0.36	1.64
17	0.20	0.38	1.62
18	0.19	0.39	1.61
19	0.19	0.40	1.60
20	0.18	0.41	1.59

Upper control limit for $\bar{X} = \text{UCL}_{\bar{X}} = \bar{\bar{X}} + A_2\bar{R}$

Lower control limit for $\bar{X} = \text{LCL}_{\bar{X}} = \bar{\bar{X}} - A_2\bar{R}$

Upper control limit for $R = \text{UCL}_R = D_4\bar{R}$

Lower control limit for $R = \text{LCL}_R = D_3\bar{R}$