3 hrs	02/06/09		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)	JUNE 2009
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)	DR. A VAN DER MERWE
Special materials required (graph/music/drawing paper) maps, diagrams, tables, computer cards, etc.	NONE

Time allowance

Course Nos.	MECN4000	Hours	3 nours

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

1.1 Which of the following two statements is true? (1)

(i) Supplier-managed inventories are always consignment inventories.
(ii) Consignment inventories are always supplier-managed.

a) (i) only.
b) (ii) only.
c) Both (i) and (ii).
d) Neither.

1.2 What role does the management of customer's expectations play in service quality? (2)

1.3 In terms of Juran's categories of cost of quality, give one example of an activity or investment associated with *(only the first example given in each case will be marked)*:

a. Cost of prevention (1)
b. Cost of internal failure (1)

(Total: 5 Marks)

QUESTION 2

Refer to the TEM Case Study attached for the following questions:

2.1 Explain the concept Takt time, what does it mean for a process? (1)
2.2 Calculate the Takt time for the idler bracket product family. (1)
2.3 Identify the current bottleneck / constraining activity in the newly changed Section of Factory 2. (1)
2.4 Should management consider employing an additional operator for this process?
2.5 What is the purpose of the kanban and supermarket in the new process? (2)
2.6 In the old system, Factory 2 operated using batches of 100 as management believed that this would give them "economies of scale". The parts were pushed through the factory using a monthly production schedule based on historical customer sales. With their new pull system, the factory has seen many benefits. Discuss how a pull system would have affected the following and discuss the potential benefits:

a. Inventory (2)
b. Lead time (2)
c. Flexibility (2)

(Total: 11 Marks)

QUESTION 3 CONTINUES OVERLEAF/....

PTO/Page 2...

QUESTION 3

Consider the following consulting project:

Activity	Designation	Immed. Pred.	Time (Weeks)
Assess customer's needs	A	None	2
Write and submit proposal	B	A	1
Obtain approval	C	B	1
Develop service vision and goals	D	C	2
Train employees	E	C	5
Quality improvement pilot groups	F	D, E	5
Write assessment report	G	F	1

Develop a critical path diagram and determine the duration of the critical path and slack times for all activities.

(Total: 11 Marks)

QUESTION 4

4.1 Assume 80 components are placed on test for 1000 hrs. From previous testing, we believe that the hazard rate is constant and the MTTF = 500hrs.

a. What is the reliability of the components at the MTTF? (2)
b. Estimate the number of components that will fail in the time interval of 100 to 200 hrs. (3)
c. How many components will fail if it is known that 15 components failed in T < 50 hrs. (3)

4.2 For the Weibull distribution

a. Define the parameters that represent the distribution. (3)
b. Draw the wear curve represented by $\beta = 3.2$, $\gamma = 200$, $\eta = 1$. Label your drawing. (2)
c. What is the reliability when $\eta = t$ and there is no delay or latent period before the onset of the wear pattern? (2)

(Total: 15 Marks)

QUESTION 5 CONTINUES OVERLEAF/....

QUESTION 5

A flywheel is retained on a shaft by five bolts, which are specified to each be tightened to a specific torque of 50±5Nm. The population is assumed to be normally distributed.

a. What would the population standard deviation be? (1)

A sample of 20 assemblies was checked for bolt torque, that is, 100 bolts, in order to determine quality characteristics of the tightening process.

b. Determine the appropriate critical values if you wish to be 97% that the sample results truly represent the population. (3)

c. If the torque on a bolt is less than 47Nm, then there is a safety risk to an assembly. What is the probability of accepting a lot of 20 assemblies when the average bolt torque is 47Nm? (3)

d. Describe the step-by-step inspection procedure you would use for this process. (2)

The results from the 100 bolts had a mean of 47.2Nm and a sample standard deviation of 1.38Nm. Determine:

e. whether the process is capable (include a drawing to illustrate/support your answer) (7)
f. the probability of producing a defect based on the current sample (2)

(Total: 18 Marks)

QUESTION 6

A process when in control produces a normally distributed output with a mean of 200 and a mean range of 20. 10 samples of 20 each yield the following means and ranges:

PERIOD	1	2	3	4	5	6	7	8	9	10
X-BAR	200	202	201	204	203	203	201	201	202	201
Range	19	20	20.2	20.7	19.0	21.1	19.0	20.1	20.3	21.7

Answer the following questions. Motivate your answers through calculations and graphs.

a. Do you believe the process is behaving as it has been designed to behave?
b. Do you see any concerning trends in the data?
c. Is the process in or out of control?

(Total: 12 Marks)

QUESTION 7 CONTINUES OVERLEAF/....

PTO/Page 4...

QUESTION 7

It is your responsibility, as the new head of the automotive after sales section of a popular Motor Dealership, to ensure that reorder quantities for all items held in stock are correctly determined. You decide to test one item and choose a well known tyre brand range. After examining previous inventory records you derive the following data:

Cost per tyre	R 256 each
Holding cost	20% of the tyre cost per year
Demand	2 000 per year
Ordering cost	R 150 per order
Delivery lead time	4 days

Assume the demand occurs 365 days per year.

a. What type of inventory model is this? Draw a graph of the model. (2.5)
b. Determine the order quantity. (2)
c. Determine the reorder point. (1.5)
d. What would you need to budget for annually for this range of tyres? (2)
e. Would you classify these tyres as having dependent or independent demand? Why? (1)
f. Draw the graph for the Fixed-order-quantity with usage inventory model. (3)

(Total: 12 Marks)

QUESTION 8

a. Explain the differences between the **Matrix Project and the Functional Project** organizational forms. Use drawings to support your answer. (4)
b. Explain what is meant by a **work breakdown structure** in a project. (2)
c. "As the actual project work is initiated, the **project team** tends to evolve through a series of **developmental stages**". Discuss these stages. (10)

(Total: 16 Marks)

TEM CASE

TEM produces a range of conveyor idlers for the industrial and mining sector. Factory 2 of TEM is involved in the manufacture of the conveyor brackets to hold the idler rolls. This factory produces a range of 4 different types of idler based on customer requirements (Part numbers 101, 201, 301 and 401). They call this group a product family. TEM, Factory 2 produces brackets in an effective 8 hour shift. (This shift is actual working hours and already takes all breaks into account). The production quantity for each type of bracket within this family varies greatly from day to day however the total number of brackets required on an average day is 200 based on customer demand.

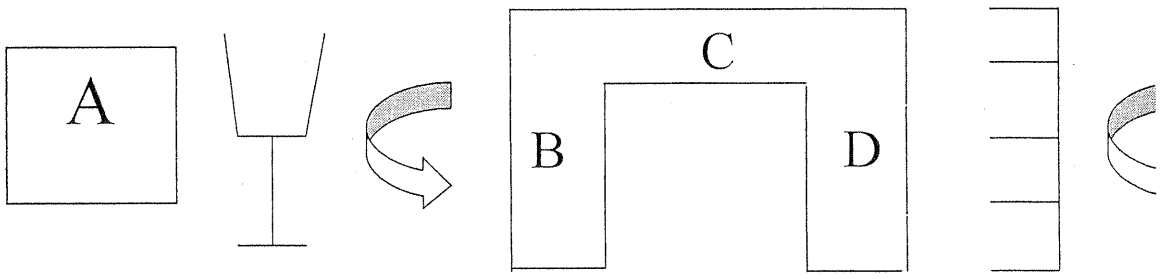
Within Factory 2, one of the sections was reporting a large number of problems recently. This section included Processes A through D. Each product goes through a common process A which produces standard plates. After this depending on the part number to be made, each plate goes through steps B-D. The specifications for these processes varies depending on the actual bracket part number to be produced.

As a result of a recent drive to improve customer service and increase profitability, a Kaizen initiative was performed on this section of Factory 2 and the area was transformed into a design based on Lean principles. Figure 1 shows the new improved process.

In the new design, Process A produces plates to fill a Kanban bin. Processes B-D were arranged into a cell layout. The workers in the cell receive production orders based on actual customer demand. They then remove a plate from the Kanban bin and perform the required processes to transform the plate into the correct part number. After Process D, all parts are then placed into a supermarket where they are withdrawn at a later stage for coating/painting and assembly with the idler rolls from Factory 1.

All changeover times can be assumed to be negligible.

Figure 1: Value Stream Map of the section of Factory 2 which was



changed.

FORMUL

Activity A:	Activity B:	Activity C:	Activity D:
CT = 10 min	CT = 2 min	CT = 4.8 min	CT = 30 sec
Batch size = 10	Batch size = 1	Batch size = 1	Batch size = 1
Machines = 1	Operator = 1	Operator = 2	Operator = 1

$$C_{pk} = \min\left[\frac{\overline{X} - \text{LSL}}{3\sigma}, \frac{\text{USL} - \overline{X}}{3\sigma}\right] \qquad \overline{X} = \frac{\sum_{i=1}^{n} X_i}{n} \qquad Z = \frac{X-\mu}{\sigma}$$

$$CV = \mu \pm z_{\alpha/2}\frac{\sigma}{\sqrt{n}} \qquad \overline{R} = \frac{\sum_{j=1}^{m} R_j}{m} \qquad \overline{\overline{X}} = \frac{\sum_{j=1}^{m} \overline{X}_j}{m}$$

$$TC = DC + \frac{D}{Q}S + \frac{Q}{2}H \qquad EOQ = \sqrt{\frac{2DS}{H}} \qquad R = \bar{d}L$$

$$EOQ = \sqrt{\frac{2DS}{H}\cdot\frac{p}{(p-d)}} \qquad TC = DC + (D/Q)S + (I_{\max}/2)H \qquad I_{\max} = (p-d)(Q/p)$$

$$TC = DC + \frac{D}{Q}S + \frac{(p-d)QH}{2p}$$

$$\lambda(t) = \frac{\beta(t-\gamma)^{\beta-1}}{\eta^{\beta}}$$

$$f(t) = \frac{\beta(t-\gamma)^{\beta-1}}{\eta^{\beta}} e^{-\left(\frac{t-\lambda}{\alpha}\right)^{\beta}}$$

$$R(t) = e^{-\left(\frac{t-\gamma}{\eta}\right)^{\beta}}$$

since $R(t) = e^{-\int_0 h(t)dt}$

for $z(t) = const$

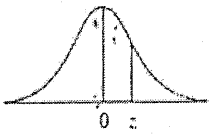
$R(t) = e^{-\lambda t}$

and since $f(t) = R(t)h(t)$

$f(t) = \lambda e^{-\lambda t}$

TABLES

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