UNIVERSITY OF JOHANNESBURG

FACULTY OF ENGINEERING
(SUPLEMENTARY EXAM)

DEPARTMENT OF QUALITY AND OPERATIONS MANAGEMENT

PROGRAMME	:	**BACHELOR OF TECHNOLOGY**
SUBJECT	:	**OPERATIONS MANAGEMENT 4A**
CODE	:	**BPJ44A4**
DATE	:	**18th JULY 2018**
DURATION	:	**180 Minutes**
TIME	:	**11H30-14H30**
TOTAL MARKS	:	**100**
EXAMINER	:	**Mr NDALA YVES MULONGO**
INTERNAL MODERATOR	:	**DR. PULE KHOLOPANE**
EXTERNAL MODERATOR	:	**PROF KEM RAMDASS**
NUMBER OF PAGES	:	**3 PAGES**

INSTRUCTIONS TO CANDIDATES:

- ✓ Answer ALL questions.
- ✓ **THIS IS NOT AN OPEN BOOK TEST.**
- ✓ Write neatly and legibly
- ✓ NOTE: Marks will be awarded for theoretical knowledge, application of the theory and use of relevant examples.
- ✓ The general University of Johannesburg policies, procedures and rules pertaining to written assessments apply to this assessment.

OPERATIONS MANAGEMENT 4 A (BPJ44A4)

QUESTION 1

1.1 Cite example of how operations management works in tandem with other business functions. How can poor operations management affect the entire supply chain management process? **[10]**

1.2 Describe four steps associated with the construction of maintenance plan. **[10]**

1.3 Sketch the entire supply chain management process and identify the contribution of material production and that of service. **[10]**

QUESTION 2

A South African tyre manufacturing plant located in Western Cape, recently adopted Kaizen, a lean process of continuous improvement. Once kaizen was fully implemented every employee is now motivated to evaluate the steps in their job function in order to improve plant efficiency. Employees noticed that for every 100 tyres produced on the manufacturing line; there is a group of 12-14 tyres that end up with treads cut incorrectly. Before kaizen was implemented, employees counted those tyres as defective, assuming it was a usual margin of error. Because, all employees now look for ways to continually improve the process, Overall Equipment Effectiveness is used to assess each step in the tyre manufacturing process to determine where improvements could be made. As an operations manager uses the data provided in the table below to determine the Overall Equipment Effectiveness of the tyre manufacturing plant over 4 months. **[15]**

	(notice: workshift = month)	*January*	*February*	*March*	*April*
tPCS	*Operating work shift time*	*720*	*672*	*720*	*712*
tPRC	*Productive work shift time*	*720*	*672*	*720*	*712*
tOPER	*Operative work shift time*	*591.9*	*551.4*	*594*	*590.3*
tORG	*Productive down-times*	*24*	*24*	*22*	*21.8*
tOSOB	*Personal rest time*	*45*	*45*	*45*	*45*
tPU+tUP	*Maintenance down-times (pl. or not pl.)*	*31.2*	*26.2*	*31.2*	*28.5*
tPS	*Reshuffle down-times*	*18*	*16.2*	*18*	*17.5*
tTP	*Down-time – technological failures*	*9.9*	*9.2*	*9.8*	*8.9*
Wsk	*Substantive performance of machinery*	*35.5*	*36*	*36.4*	*36.7*
Wjm	*Theoretical performance of machinery*	*41*	*41*	*41*	*41*
Qh(tOPER)	*Gross production during shift time*	*21 012*	*19 850*	*21 622*	*21 664*
Qc(tOPER)	*Net production during shift time*	*20 862*	*19 710*	*21 478*	*21 524*

φ	*Number of non-conforming products from production*	*90*	*84*	*89*	*84*
β	*Number of non-conforming products from start production*	*60*	*56*	*55*	*56*

QUESTION 3 **[20]**

The table below lists activities for constructing a bridge over an operational railway line:

Activities	Optimistic time	Most likely time	Pessimistic time	Predecessor
A	15	15	15	-
B	40	45	60	-
C	10	14	30	-
D	2	2	5	-
E	5	7	9	A
F	4	5	8	B,C,D,E
G	1	1	1	F
H	25	30	50	G
I	3	5	10	H
J	3	3	10	I
K	20	30	45	I
L	3	3	5	I
M	3	3	3	J,K,L
N	10	13	20	M
O	10	14	28	M
P	2	2	2	N, O
Q	5	5	5	P

a. Draw an activity network
b. Calculate the expected time for each activity
c. Calculate the variance and standard deviation for each activity
d. Determine the critical path based on the expected time
e. Calculate the number of standard deviation (Z). Knowing that the desired project completion time is 145 days.
f. What deadline is consistent with a 0.7673 probability of on-time completion?

QUESTION 4

4.1 South African National Homebuilders, Inc., plans to purchase new cut-and-finish equipment. Two manufacturers offered the estimates below. Perform the present worth analysis with the costs shown below and select the best economically viable alternative at the MARR is 10% per year. **[15]**

	Vendor A	Vendor B
First cost, R	15 000	18 000
Annual M&O cost, R per year	3 500	3 100
Salvage value, R	1 000	2 000
Lifespan, years	6	5

4.2 Cyril, a University of Johannesburg' student, just received a year-end bonus of R16,000 that will be invested immediately. With the expectation of earning at the rate of 8% per year, Cyril hopes to take the entire amount out in exactly 20 years to pay for a family vacation when the oldest daughter is due to graduate from college. Find the amount of funds that will be available in 20 years. **[10]**

4.3 A university of Johannesburg lab is a research contractor to ESKOM for in-space fuel cell systems that are hydrogen and methanol-based. During lab research, three equal-service machines need to be evaluated economically. Perform the present worth analysis with the costs shown below and select the best economically option at the MARR is 15% per year. **[10]**

	Electric-Powered	**Gas-Powered**	**Solar-Powered**
First cost, R	6 500	5 600	7 100
Annual Operating Cost, R	950	850	200
Salvage value, R	400	500	250
Lifespan, years	10	10	10

Good Luck [100]

OPERATIONS MANAGEMENT 4 A (BPJ44A4)

FORMULA SHEET

A. OVERALL EQUIPMENT EFFECTIVENESS

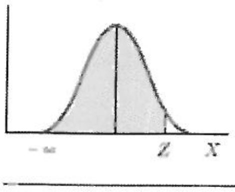
- $\text{OEE} = \frac{t_{pcs} - t_{org} - t_{osob}}{t_{pcs}} \times \frac{t_{prc} - t_{pu} - t_{up} - t_{ps} - t_{tp}}{t_{prc}} \times \frac{W_{sk}}{W_{jm}} \times \frac{Q_H - \varphi - \beta}{QH}$

B. SCHEDULING

- TE = (a + 4m + b)/6
- $\sigma^2 = \left(\frac{b-a}{6}\right)^2$
- $\sigma = \sqrt{\sigma^2}$
- $Z = \frac{(D-\mu)}{\sqrt{\sigma_\mu^2}}$
- $D = \mu + \left(\sqrt{\sigma_\mu^2} \times Z\right)$

Where:

- TE: expected time
- a = optimistic time estimate
- b = pessimistic time estimate
- m = most likely time estimate, the mode
- σ^2 : Variance
- σ : standard deviation
- Z: the number of standard deviations of a normal distribution
- D: the desired project completion time
- μ : the critical time of the project, the sum of the TEs for activities on the critical path
- σ_μ^2 : the variance of the critical path, the sum of the variances of activities on the critical path



Example: the area to the left of Z = 1.34 is found by following the left Z column down to 1.3 and moving right to the .04 column. At the intersection read .9099. The area to the right of Z = 1.34 is 1 − .9099 = .0901. The area between the mean (dashed line) and Z = 1.34 = .9099 − .5 = .4099.

z	00	.01	.02	.03	.04	.05	.06	.97	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8880
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9932	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998