AFRICA UNIVERSITY
(A United Methodist-Related Institution)

"Investing in Africa's Future"

FACULTY OF MANAGEMENT AND ADMINISTRATION

COURSE TITLE: **MMS402 - Production and Operations Management**

SEMESTER 1: **Final Examination (Conventional) November 2014**

LECTURER: **Dr. S. Murairwa**

TIME: **3 Hours**

INSTRUCTIONS

Answer ***all Questions*** *in Section A and* ***any three*** *questions in Section B.*

Start ***each*** *question on a new page in your answer booklet.*

The marks allocated to ***each*** *question are shown at the end of the section.*

Show all your workings.

Credit will be given for logical, systematic and neat presentations.

SETION A: ANSWER ALL QUESTIONS

1. Define the following production and operations management terms:
   a) Assemble-to-order production system [**2 Marks**]
   b) Design capacity [**2 Marks**]
   c) Static plant layout [**2 Marks**]
   d) Statistical quality control [**2 Marks**]
   e) Predictive maintenance [**2 Marks**]

2. The Goodman and Tire and Rubber Company periodically tests its tires for tread wear under simulated road conditions. To study and control its manufacturing processes, the company uses $\acute{x}$ and r charts. Twenty samples, each containing three radial tires were chosen from different shifts over several days of operation.

Sample	Tread wear			Sample	Tread wear		
1	31	42	28	11	26	31	40
2	26	18	35	12	23	19	25
3	25	30	34	13	17	24	32
4	17	25	21	14	43	35	17
5	38	29	35	15	18	25	29
6	41	42	36	16	30	42	31
7	21	17	29	17	28	36	32
8	32	26	28	18	40	29	31
9	41	34	33	19	18	29	28
10	29	17	30	20	22	34	26

   Construct the two charts and interpret. Plot the r- chart on the graph paper [**14 Marks**]

3. State and explain the role and responsibilities of an operations manager within an organization [**8 Marks**]

4. Explain the basic steps of formulating a business strategy [**8 Marks**]

SECTION B: ANSWER ANY THREE QUESTIONS

5. State and explain the various primary and secondary factors based on which plant location decision is taken [**20 Marks**]

6. The pro shop at Skate Ice Arena specialises in custom fitting of boots and blades and draws skaters from as far away as 250 kilometres. The annual demand for one of the top figure skating blades is 60. The blades cost $280 and the shop figures its holding cost rate at twenty-five percent. The cost of ordering from the manufacturer is $30. The manager of the pro shop would like to maintain a high level of customer service by always having the blades in stock but is getting pressure from the owner to reduce costs and considering allowing back orders. The manager estimates that the backorder cost would be $200 per year.

   a) What should the manager do? [**10 Marks**]
   b) Discuss the benefits and challenges associated with the implementation of a material requirement planning system [**10 Marks**]

7. An average attendance figures of customers at a major company's sale has the seven-year pattern shown in the table

Attendance
28 000
30 000
31 500
40 000
30 500
32 200
30 800

   a) Develop the linear trend expression for this time series. Use the trend expression to forecast attendance for year 8 [**6 Marks**]
   b) Suppose 4000 units can be sold on an annual basis. The estimate is based on current trends in the industry and sales projections. Competitive products are priced from $100 to $250 but the company would like to keep the selling price at $150.The engineering and accounting departments have estimated that production costs would be as follows

	Variable costs ($) per unit	Fixed costs ($)
Manufacturing	55	350 000
Selling and administrative	5	100 000

   Determine the total cost and total revenue functions. Calculate the number of units required to breakeven [**6 Marks**]
   c) Briefly explain the phrase "Quality and the pursuit of zero defect" [**8 Marks**]

8. Taylor Paper Company wants to establish an intermediate warehouse to distribute its products to six markets. The data gathered is shown in the table below.

Market	Kilograms/month	x	Y
A	400	58	96
B	300	80	70
C	200	30	120
D	100	90	110
E	300	127	130
F	100	65	40

a) Plot the data on graph the graph paper. Use the appropriate technique to determine the location of the warehouse. Plot the warehouse on the graph [**7 Marks**]

b) Given the additional information below, use the appropriate technique to select the better site for the warehouse [**9 Marks**]

Site	x	Y
U	36	18
V	42	45

c) Explain why the factor rating system is most widely used location selection technique [**4 Marks**]

End of paper

Additional information

1: Capacity Utilisation	$\text{Capacity utilization rate} = \frac{\text{Capacity used}}{\text{Best operating level}}$
2: Moving Average	$MA_n = \frac{\sum_{i=1}^{n} D_i}{n}$
3: Weighted Moving Average	$WMA_n = \frac{\sum_{1=1}^{n} W_i D_i}{n}$
4: Smoothing Model	$F_{t+1} = \alpha D_t + (1-\alpha) F_t$
5: Adjusted Smoothing Model	$AF_{t+1} = F_{t+1} + T_{t+1}$
6	$T_{t+1} = \beta(F_{t+1} - F_t) + (1-\beta)T_t$
7: Linear Model	$y = a + bx$ $b = \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n\bar{x}^2}$ $a = \bar{y} - b\bar{x}$
8: Productivity Measure	$\text{Productivity} = \frac{\text{Outputs}}{\text{Inputs}}$
9: Equation	$y = VC(Q) + FC$
10: Total Cost	$TC = \frac{Q}{2} C_h + \frac{D}{Q} C_o + DC$
11: Location Factor Rating	$LFR = Max\left\{\sum_{i=1}^{n} W_i S_{1i};\ \sum_{i=1}^{n} W_i S_{2i};\ \ldots\ldots;\ \sum_{i=1}^{n} W_i S_{ni}\right\}$
12: Centre of Gravity	$x = \frac{\sum_{i=1}^{n} x_i W_i}{\sum_{i=1}^{n} W_i}, \quad y = \frac{\sum_{i=1}^{n} y_i W_i}{\sum_{i=1}^{n} W_i}$
13: Load Distance	$LD = \sum_{i=1}^{n} l_i d_i$ $d_i = \sqrt{(x_i - x)^2 + (y_i - y)^2}$
14: C-chart	c = Mean # of defects per unit in the population $UCL = c + z\sqrt{c}$ $LCL = c - z\sqrt{c}$ $\bar{c} = \frac{\text{Total \# Defects}}{\text{Total \# of Units Observed}}$
15: $\acute{X}$ -chart	$UCL = \bar{\bar{X}} + A_2 \bar{R}$ $LCL = \bar{\bar{X}} - A_2 \bar{R}$

	or $UCL = \overline{\overline{X}} + z\,\sigma_{\overline{X}}$ $LCL = \overline{\overline{X}} - z\,\sigma_{\overline{X}}$
16: P-chart	p = Percent defect in the population $\sigma_p = \sqrt{\frac{p(1-p)}{n}}$ $UCL = p + z\,\sigma_p$ $LCL = p - z\,\sigma_p$ $\overline{p} = \frac{\text{Total \# Defects}}{\text{Total \# of Observations}}$
17: R-chart	$UCL = D_4\overline{R}$ $LCL = D_3\overline{R}$
18:Centre Limit	$\bar{\bar{x}} = process\ average = \frac{\bar{x}_1 + \bar{x}_2 + \ldots\ldots + \bar{x}_n}{n}$

FACTORS FOR DETERMINING CONTROL LIMITS OF X-BAR AND R-CHARTS

Sample Size	Factors of x-chart	Factors of R-Chart	
n	**A2**	**D3**	**D4**
2	1.88	0	3.267
3	1.023	0	2.574
4	0.729	0	2.282
5	0.577	0	2.114
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777