Program	:	*BACHELOR OF TECHNOLOGY* *MINING ENGINEERING TECHNOLOGY*
Module/Subject	:	*ENGINEERING MANAGEMENT IVB (S6)*
Module code	:	*MGNB411*
Examination	:	*SUPPLEMENTARY SUMMATIVE EXAMINATION*
Date	:	*7th JANUARY 2020*
Duration	:	*180 MINUTES*
Weight	:	*60% TOWARDS FINAL MARK*
Total marks	:	*120*

Examiner	:	*Mr. Maelani Chauke*
Moderator	:	*Mr. Gerald Bosch*
Number of pages	:	*9 Pages (including two pages of formulae)*
Requirements	:	*Answer books*

Instructions to candidates:

1. *Answer **all** questions*
2. *All the sub-questions that appear under the heading of a question must be kept together under the heading of that specific question*
3. *Number all questions, and associated sub-questions **CLEARLY***
4. *A formulae sheet is herein attached*
5. *The use of a calculator is permissible*
6. *All the relevant rules of the University of Johannesburg shall apply*
7. *Question papers **must not** be handed in. However, please ensure that all your answer books are handed in*

Question 1

1.1 Explain the salient aspects regarding the usefulness of a cause-and-effect diagram (also called 'fishbone' diagram)

[10]

1.2 Explain the Quality function deployment (QFD) method and the advantages and benefits that are realized from the QFD process

[5]

1.3 The Quality function deployment (QFD) method has been used successfully in analyzing customer requirements and building these into product designs.

Using your own self-generated data, real or imagined, and excluding the steam iron example that is covered in your prescribed textbook and explained in class, prepare a Voice of the Customer (VOC) chart for an item or project or service of your choice. The VOC chart must clearly indicate what the customer's requirements are; what the customer's highest priorities are; the characteristics of a product or service that are likely to satisfy customer requirements; and which characteristics of a product or service will have the greatest impact on customer requirement

[15]

Question 2

2.1 List at least four resources that are relevant to the maintenance environment

[4]

2.2 List, and explain, three options that exist for the geographical division of maintenance resources

[6]

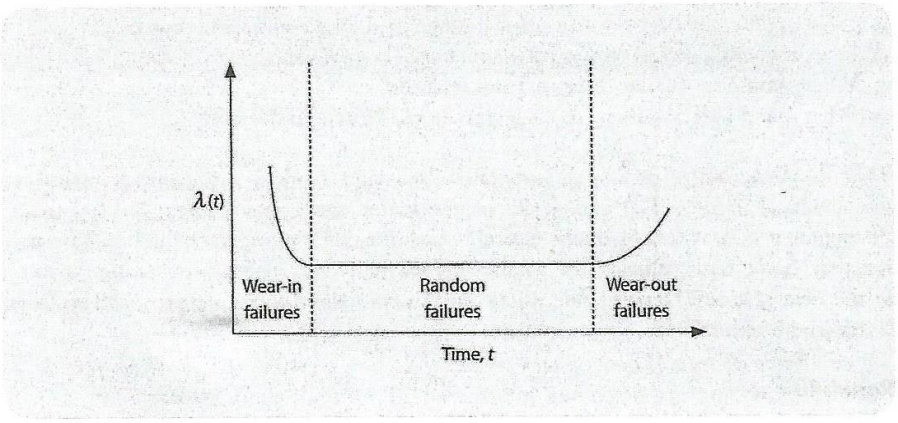
2.3 Explain 'maintainability'.

[2]

2.4 Some complex assemblies or items exhibit early failures, while failures due wear-out have also been observed and recorded. The bathtub curve is commonly used to model and depict probability distributions with time-dependent failure rates.

Answer the questions below regarding the bathtub curve.

Figure 1: The bathtub curve



The bathtub curve is also referred to as the "biological" curve.

2.4.1 Use the biological aspects of the curve to describe the distinct phases of the bathtub (hint: age-related failure of any system/equipment)

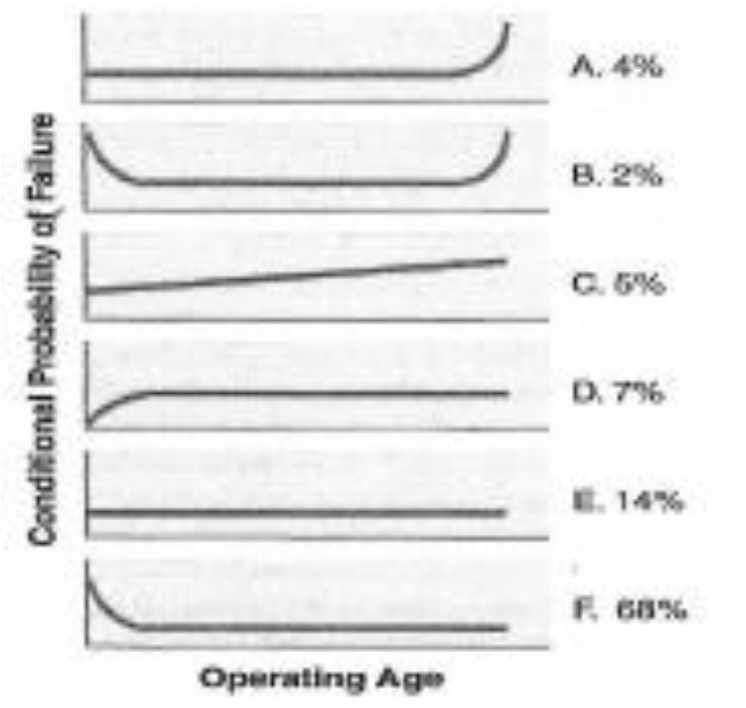
[4]

2.4.2 Comment on the failure modes of systems or equipment that exhibit bathtub failure mode patterns. Give examples

[4]

2.4.3 Recent detailed research (study conducted over a 30-year period in the aeronautical industry) into equipment failures has produced some of the findings that are summarized in figure 2 below.

Figure 2: Conditional probability of failure



In figure 2 above, the vertical axis represents conditional probability of failure and the percentages represent proportion of aircraft components that exhibited these patterns.

Study figure 2, then answer the following questions

2.4.3.1 Comment on the correlation between conditional probability of failure and time (age) in figures D, E, and F

[2]

2.4.3.2 Give short descriptions or explanation of features of systems or equipment that are typically found in categories C, D, E, and F. Give examples

[8]

Question 3

3.1 Give a diagrammatical representation of the 'Standard Risk Model'. Explain the terms used, and the salient aspects of the model

[10]

3.2 List at least five cost elements of an industrial accident

[5]

3.2 Explain 'systems safety'

[5]

Question 4

4.1 Explain the meaning of the following terms within the context of technology management:

4.1.1 Acquisition

4.1.2 Exploitation

4.1.3 Protection

4.1.4 Identification

4.1.5 Learning

4.1.6 Selection

[6]

4.1 The database is the key building block of an organization's information system. There should a strong correlation between data processing and the decision-making needs of an organization, and the structure and composition of its database. Computers are excellent devices for data storage and retrieval because of their excellent speed and storage capacity.

List other entities in which an organization's data may be stored

[5]

4.2 A database contain data only. Database management system (DBMS) software allows users to create, maintain and manipulate data records.

List ways in which databases and database management systems are beneficial to an organization

[4]

4.3 Distinguish between structured and unstructured decisions. List the three phases of decision making.

[5]

Question 5

5.1 Explain the following terms:

5.1.1 Inflation

5.1.2 Escalation

5.1.3 Unit marginal cost

5.1.4 Semi-variable

5.1.5 Direct Cost

[10]

5.1 A mining company plans to purchase an LHD for R 1 780 000, which will be paid back in twelve equal instalments at 15% interest. What will the payment be?

Determine the replacement cost of a piece of equipment in six years' time. The cost of this equipment is now R 590 000 and the escalation is projected at 17,5%. What uniform sum must be set aside each year if you want to establish a sinking fund that will retire this obligation in five years' time. Your company receives 15% from the bank on money invested.

[10]

MGNB411 Formulae

Time value of money	
Simple interest	$I = Pni$
Compound interest	$F = P(1+i)^n \quad P = \frac{F}{(1+i)^n}$
Annuity	$F = A\left[\frac{(1+i)^n - 1}{i}\right] \quad P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$
Return on investment	$ROI = \frac{Average\ annual\ profit}{Original\ investment} \times 100$
Net Present Value	$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+k)^t} - I$
Payback period	*Time taken to gain financial return equal to the original investment.*

Control Charts

$\overline{X_1} = \frac{\sum x}{n}$	: simple average (mean), $\overline{X}$	
$\overline{R} = \frac{\sum R}{k}$	$\overline{R}$, the average (mean) range	k is the number of samples taken
Control limits for the average control charts	Upper control limit $(UCL_{\bar{x}}) = \overline{\overline{X}} + (A_2)(\overline{R})$ Lower control limit $(LCL_{\bar{x}}) = \overline{\overline{X}} - (A_2)(\overline{R})$	
Control limit for the range control charts	Upper control limit $(UCL_R) = (D_4)(\overline{R})$ Lower control limit $(LCL_R) = (D_3)(\overline{R})$	

Process and control chart factors

Sample size	Control limit factor for average control chart	UCL factor for range chart	LCL factor for range chart	Factor for estimating process sigma ($\hat{\sigma} = \overline{R}/d_2$)
(n)	(A_2)	(D_4)	(D_3)	(d_2)
2	1.880	3.267	0	1.128
3	1.023	2.575	0	1.693
4	0.729	2.282	0	2.059
5	0.577	2.115	0	2.326
6	0.483	2.004	0	2.534
7	0.419	1.924	0.076	2.704
8	0.373	1.864	0.136	2.847
9	0.337	1.816	0.184	2.970
10	0.308	1.777	1.223	3.078

Maintenance

Functions used in reliability

Function	Symbol	Unit
Failure density	$f(t)$	
Reliability	$R(t)$	
Cumulative distribution function for failure (CDF)	$F(t)$	
Failure or hazard rate	$\lambda(t)$	$time^{-1}$
Mean time to failure	$MTTF$ ✓	time

$$f(t) = \lambda \cdot \exp(-\lambda t)$$
$$R(t) = \exp(-\lambda t)$$
$$MTTF = \frac{1}{\lambda}$$

Functions used in maintainability

Function	Symbol	Unit
Repair density	$m(t)$	
Maintainability	$M(t)$	
Cumulative distribution function (CDF) for repair	$G(t)$	
Repair rate	$\nu(t)$	$time^{-1}$
Mean time to repair	$MTTR$	time

$$m(t) = v \cdot \exp(-vt)$$
$$M(t) = 1 - \exp(-vt)$$
$$MTTR = \frac{1}{v}$$

Availability

$$A_0 = \frac{\text{uptime}}{\text{uptime} + \text{downtime}}$$