UNIVERSITY OF JOHANNESBURG

PROGRAM	:	B TECH *ENGINEERING INDUSTRIAL*
SUBJECT	:	**SYSTEM DYNAMICS**
CODE	:	**TSH 421**
DATE	:	SUMMER SSA EXAMINATION 2015 7 DECEMBER 2015
DURATION	:	SESSION 1: (8:00-11:00)
WEIGHT	:	40: 60
TOTAL MARKS	:	100

ASSESSOR	:	MR. G. MUYENGWA
MODERATOR	:	DR. K. MPOFU
NUMBER OF PAGES	:	3 PAGES

2434

REQUIREMENTS : COMPUTER LAB WITH ARENA SOFTWARE

INSTRUCTIONS TO STUDENTS

PLEASE ANSWER ALL QUESTIONS.

SECTION A: SYSTEMS DYNAMICS THEORY

QUESTION 1

Using a practical industry example, discuss the combination of feedforward and feedback control system application.

[10 marks]

QUESTION 2

Using examples from a manufacturing environment discuss the difference between an open and a closed system.

[10 marks]

QUESTION 3

A systems analyst can make use of a prototype model to analyse the contents of any situation in terms of a system or he/she can use the structured approach of the 5 W (what-why-whether-which-what)

Discuss how an Industrial Engineer can use the 5 W-procedure in analysing a manufacturing system.

[15 marks]

QUESTION 4

Using stocks and flows discuss how an inventory of a car dealership is affected by 3 factors such as perception delay, response delay and delivery delay.

[10 marks]

QUESTION 5

Construct a causal-loop diagram that shows the feedback structure of a make-to-order system.

[15 marks]

SECTION B: SIMULATION WITH ARENA

QUESTION 5

Electrolytic Forming Process:

An expensive custom built product goes through two stages of operation. The first stage is an electrolytic forming process, served by two independently operating forming machines, where the product is built in a chemical operation that must confine to precise specifications. The second stage is a plating operation in which the product is silver plated. Customer orders arrive with inter-arrival times of Triangular (3, 7, and 14) hours and join a queue in front of the forming process. The electrolytic forming process times is uniformly distributed (8, 12) hours. The silver plating process also has a queue in front of it. Plating time is distributed Uniform (4, 8) hours. The variability in the processing times is due to design variations of the incoming orders.

The two processes do not perform perfectly. In fact, 15 % of the jobs that emerge from the forming process and 12 % of the jobs that emerge from the plating process are defective and have to be reworked. Records also show that 3 % of the jobs that emerge from the forming process and 8 % of the jobs that emerge from plating process are scrapped. Jobs that are successfully completed in both the two processes leave the facility. All defective jobs are sent to a rework buffer bin, where there are kept before being transferred to the rework station. On average the routing time from the rework buffer bin to the rework facility takes Triangular (0.25, 1, and 1.25) hours.

All rework jobs are sent to a single rework facility, where design modifications and corrections are performed manually by four artisans. Normally rework times are uniformly distributed (13, 22) hours. Reworked components undergo inspection which takes Triangular (1, 1.5 and 2.3) hours. Inspection is done by two highly skilled technicians each with his own testing bench. Each of the two technicians has an equal chance of carrying out the inspection process. Records show that 95 % of the reworked parts pass inspection and the remainder are scrapped off.

a) Develop an Arena model of the electrolytic forming process and simulate it for 1 year (24 hours of continuous operation)
b) Animate your model including all resources and a change in the appearance of entities after they are plated.
c) How busy are each of the two operations and the rework facility,
d) What is the average number of parts in both machine queues?
e) What is the expected average part cycle time a part takes in the system.
f) Record the number of parts that leave the facility as completed parts.

[40 marks]

TOTAL = 100
