UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF TECHNOLOGY *ENGINEERING : INDUSTRIAL*
SUBJECT	:	**SYSTEMS DYNAMICS 4**
CODE	:	**TSH 421**
DATE	:	SUMMER EXAMINATION 2014 11 NOVEMBER 2014
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

ASSESSOR	:	MR F CHIROMO
MODERATOR	:	DR O ADETUNJI
NUMBER OF PAGES	:	4 PAGES

INSTRUCTIONS TO STUDENTS:

- ANSWER ALL QUESTIONS.
- A STUDENT IS EXPECTED TO MAKE REASONABLE ASSUMPTIONS FOR DATA NOT SUPPLIED.
- NUMBER YOUR QUESTIONS CLEARLY.
- ANSWERS WITHOUT UNITS WILL BE IGNORED.

QUESTION 1

1.1	Discuss what you understand by the term 'simulation".	(6)
1.2	Discuss circumstances under which simulation is an appropriate tool to use.	(6)
1.3	Discuss situations when simulation is NOT an appropriate tool.	(6)

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QUESTION 2

Items arrive from an inventory-picking system according to an exponential interarrival distribution with a mean 1.1 (all times are in minutes), with the first arrival at time 0. Upon arrival, the items are packed by one of four identical packers, with a single queue "feeding" all four packers. The packing time is TRIA(2.75, 3.3, 4.0). Packed boxes are then separated by type (20%, international and 80% domestic), and sent to shipping. There is a single shipper for international packages and two shippers for domestic packages with a single queue feeding the two domestic shippers. The international shipping time is TRIA(2.2, 3.3, 4.8), and the domestic shipping time is TRIA(1.7, 2.0, 2.7). This packing system works three 8-hour shifts, five days a week. All the packers and shippers are given a 15-minute break, a 30 minute lunch break and a second 15 minute break.

Packers and Domestic Shippers' Schedules
The packer and domestic shipper schedules are staggered so that there are always at least three packers and one domestic shipper working.

The first 15 minute packer break starts one hour into the shift, the 30 minute lunch break three hours into the shift, and the second 15 minute break six hours into the shift.

The first 15 minute break for the domestic shipper starts 90 minutes into the shift, the 30 minute lunch break 3.5 hours into the shift and the second 15 minute break six hours into the shift.

International Shipper
The international shipper is given a 15 minute break two hours into his/her shift, a 30 minute lunch break fours into his/her shift, and a second 15 minute break six hours into his/her shift. Use the wait schedule rule.

2.1	Build the model for the system	(18)
2.2	Animate the model, and take note of the change in the appearance of entities after they have been packed into a box.	(4)
2.3	Run the simulation for two weeks (ten working days) to determine	
2.3.1	the average number of items in each of the three queues;	(2)
2.3.2	the maximum number of items in each of the three queues	(2)

[26]

QUESTION 3

Kits for a dining room table arrive at an assembly station with TRIA(8, 10, 14) interarrival times (all times are in minutes). There are five assembly carpenters and the kits are automatically sent to the first available carpenter for assembly. The dining room table assembly time is carpenter-dependent as given in Table Q3.

Table Q3

Carpenter	Assembly Time
1	TRIA(31, 40, 50)
2	TRIA(33, 42, 53)
3	TRIA(33, 43, 55)
4	TRIA(34, 43, 54)
5	TRIA(30, 39, 48)

Upon completion of the assembly process, the tables are inspected with approximately 11% found defective. A defective table is sent back for repair to the same carpenter who assembled it. These defective tables have priority over incoming kits. Since the fan needs to be disassembled and then reassembled, the repair time is 25% greater than the normal assembly time.

3.1 Develop the approximate model for the system using advanced process modules. (14)

3.2 Run the model for 20 000 minutes. (4)

3.3 Collect statistics on:

3.3.1 carpenter utilisation; (4)

3.3.2 the time in system. (4)

[26]

QUESTION 4

Parts arrive at a two-machine system according to an exponential interarrival distribution with a mean 20 minutes. Upon arrival, the parts are sent to Machine 1 and processed. The processing-time distribution is TRIA(4.5, 9.3, 11) minutes. The parts are then processed at Machine 2 with a processing time distribution as TRIA(16.4, 19.1, 20.8) minutes. The parts from Machine 2 are directed back to Machine 1 to be processed a second time (same processing time distribution but an independent draw from it). The completed parts then exit the system.

Use Sequences to control the flow of parts through the system. The transfer time between arrival and the first machine, between both machines, and between the last machine and the system exit follows a triangular distribution with parameters 7, 9, 14 minutes.

Question 4 Continued

4.1	Develop and animate the model representing the system described.	(16)
4.2	Run the simulation for 100 replications with each 20 000 minutes.	(6)
4.3	give results for average total time in the system;	(4)
4.4	give the average length of each queue;	(4)
		[30]

TOTAL = 100