B.E. PRODUCTION ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2018

MANUFACTURING SYSTEMS SIMULATION

Time : **Three hours** Full marks: **100**

Question number 1 is compulsory and answer any four from the rest.

1. A machine tool processes two different types of parts. The time between arrivals of the first part is triangularly distributed with a mode of 10 minutes, a minimum of 7.5 minutes and a maximum of 12.5 minutes. The inter-arrival time for the second part also follows a triangular distribution with a mode of 25 minutes, a minimum of 18 minutes and a maximum of 37.5 minutes. Processing time for the first part is uniformly distributed, with a minimum of 10 minutes and a maximum of 20 minutes. On the other hand, the processing time for the second part has an exponential distribution with a mean of 13.5 minutes. Processing time includes an inspection of the completed parts. It has been observed that 12% of the manufacturing parts fail inspection and return to the end of the queue of the parts awaiting processing. Assume that the parts which fail inspection have a rework time equal to 80% of the previous processing time. Develop the corresponding Visual SLAM network to collect statistics on the time spent in the system by a part and utilization of the machines. Simulate the system for 1000 minutes. Also develop the related program code. (20)

2.(a) Name several entities, attributes, activities, events and state variables for the following systems: (5×2)
(i) A small appliance repair shop and (ii) a hospital emergency room.

(b) With the help of a neat flowchart, describe the major steps in a simulation study. (10)

3.(a) Define the following terms:
(i) Clock, (ii) Delay, (iii) List, (iv) Event and (v) Activity (5×2)

(b) Describe in details the time advance algorithm. (10)

4.(a) Define the term 'Manufacturing Systems Simulation'. Detail out the areas in manufacturing where simulation techniques can be effectively deployed. (4+6)

(b) The sequence of numbers 0.54, 0.73, 0.98, 0.11 and 0.68 has been generated. Use the Kolmogorov-Smirnov test with α = 0.05 to determine if the hypothesis that the numbers are uniformly distributed on the interval [0, 1] can be rejected. (10)

5.(a) Develop the poker test for four-digit numbers. (10)

(b) Consider the following sequence of 20 two-digit random numbers:
0.40, 0.84, 0.75, 0.18, 0.13, 0.92, 0.57, 0.77, 0.30, 0.71, 0.42, 0.05, 0.78, 0.74, 0.68, 0.03, 0.18, 0.51, 0.10, 0.37
Perform the runs above and below the mean test to assess the independence of the numbers at α = 0.05. (10)

6.(a) Consider the discrete distribution with pmf given by $p(x) = x/k(k+1)$ (for x = 1,2,...,k). Develop the corresponding random number generator. (10)

(b) Develop a generator for a triangular distribution with range (1, 10) and mode at x = 4. (10)

7. Write short notes on the following (any four) (4×5)
(a) COLCT node,
(b) Erlang distribution,
(c) Poisson process,
(d) Test for autocorrelation,
(e) Acceptance-rejection method,
(f) ASSIGN node,
(g) Properties of random numbers.