B.E. PRODUCTION ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2019

MANUFACTURING SYSTEMS SIMULATION

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

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

1. A particular machine tool processes two different types of components. The time between arrivals of the first component is triangularly distributed with mode of 25 minutes, a minimum of 15 minutes and a maximum of 45 minutes. The inter-arrival time of the second component is also a sample from a triangular distribution with a mode of 40 minutes, a minimum of 25 minutes and a maximum of 60 minutes. The processing time for the first component is exponentially distributed with a mean of 17.5 minutes. For the second component, the processing time is uniformly distributed, with a minimum of 12.5 minutes and a maximum of 22.5 minutes. It has been observed that 10% of the manufactured components fail inspection and return to the end of the queue of the components awaiting processing. Assume that the components which fail inspection have a rework time equal to 75% of the previous processing time. Develop the corresponding Visual SLAM network to collect statistics on the time spent in the system by a component and utilization of the consider machine tool. Simulate the system for 1500 minutes. Also develop the related program code. (20)

2.(a) Differentiate between discrete and continuous simulation. (4)

(b) Describe how a queuing problem can be simulated. (6)

(c) State the advantages and disadvantages of simulation. (10)

3.(a) What are the factors to be taken into consideration while developing random numbers. (5)

(b) With numerical examples, describe two techniques for random number generation. (10)

(c) Describe the Poker test. (5)

4.(a) Based on runs up and runs down, determine whether the following sequence of 60 numbers is such that the hypothesis of independence can be rejected where $\alpha = 0.05$. (10)

0.41	0.55	0.75	0.16	0.04	0.23	0.73	0.66	0.08	0.25
0.68	0.62	0.08	0.28	0.74	0.32	0.06	0.02	0.80	0.52
0.89	0.36	0.54	0.18	0.54	0.82	0.83	0.44	0.65	0.76
0.94	0.27	0.02	0.01	0.18	0.53	0.45	0.55	0.41	0.67
0.74	0.19	0.01	0.95	0.83	0.31	0.13	0.21	0.14	0.88
0.91	0.72	0.36	0.69	0.47	0.42	0.57	0.33	0.58	0.91

(b) Consider the following set of generated numbers:

0.34	0.27	0.58	0.66	0.14	0.71	0.49	0.31	0.16	0.86
0.56	0.37	0.48	0.27	0.82	0.07	0.43	0.39	0.15	0.23
0.93	0.62	0.54	0.24	0.38	0.40	0.79	0.57	0.29	0.36

Perform an autocorrelation test with $i = 2$ and $m = 4$. (10)

5. (a) Describe in details the Poisson process. (10)

(b) Write short notes on the followings: (5x2)

(i) Entity, (ii) Event list, (iii) Delay, (iv) Activity and (v) System state.

6.(a) The weekly demand, X, for a slow-moving item has been found to be well approximated by a geometric distribution on the range {0, 1, 2,...} with mean weekly demand of 2.5 items. Generate five values of X, demand per week, using random numbers generated using mid-square technique. (10)

(b) Regular maintenance of a production routine has been found to vary and has been modelled as a normally distributed random variable with mean 27 minutes and variance 2.25 minutes^2.

Generate five random maintenance times, with the given distribution. Assume random numbers are being generated using mid-square technique. (10)

7. Write notes on the followings (any four): (5x4)

(a) Transformation techniques in manufacturing,

(b) Gamma distribution,

(c) QUEUE node,

(d) Monte Carlo simulation

(e) Erlang distribution,

(f) CREATE node.