Anna University, Chennai
B.E. 6th Semester Industrial Engineering
IE 383 Systems Engineering
End-Semester Examination (Arrears), April 2012

Max Time: 3 hours   **Max Marks: 100**

(Part – A: 10 x 2 = 20 marks)

1. What are the products of Value system design and System synthesis steps?
2. Explain the elements of a causal loop diagram with an example.
3. What is the relation between stock and flow variables in system dynamics?
4. How system reliability of a series and parallel configuration is estimated?
5. What are the activities performed by systems engineer in an organization?
6. Why systems engineering is described as a management technology?
7. List the tools used for conducting the functional analysis.
8. List the techniques used for synthesizing activities into viable alternatives.
9. What are the event relationships and connecting modes for coupled events?
10. How reachability matrix is derived from adjacency matrix?

(Part – B: 5 x 16 = 80 marks)

11 (i) Classify multi-criteria decision problems and the techniques used for solving those problems.

(ii)   Describe the decision assessment efforts into five types, illustrating each with the help of a decision tree and payoff matrix.

12 (a) Present the dynamics of stocks and flows w. r. t. predicting the oxygen content of a water stream as the pollutants are dumped into it. Write down the associated difference equations to estimate the level of oxygen in the water.

(OR)

12 (b) Present the dynamics of stocks and flows w. r. t. modeling of epidemics considering the susceptible, infectious, and recovered population as stocks. Present the feed back loops and associated differential/ integral equations of the model. Define the tipping point to control the epidemic.

13 (a) Conduct Cross-Impact analysis for the following two events:
Event-1: Year 2007, Introduction of agricultural crop insurance for farmers
Event-2: Year 2010, Decrease in farmers' suicide rate in the country
Experts estimates of $P(1) = 0.3$, $P(2) = 0.4$, $A_{12} = 0.1$, $A_{21} = 0.8$
Present causal loop diagram, develop event tree for the two event model, and compute probabilities of possible future events. Verify impacted probabilities with Bayes' rule.

(OR)

13. (b) Identify relevant items that comprise the issue formulation elements (problem definition, value system design, and system synthesis) for the issue "Sustainable development and earth systems" or Global warming problem.

14 (a) In a machine shop, each machine operates for an average of 9000 hours between chance failures (MTBF). What is the chance failure rate? A machine has been in operation for 14000 hours without failure. Determine the reliability of the machine for the next 5000 hours.

If the mean time for wear out failures on these machines is 27,000 hours with a standard deviation of 3500 hours, how do you estimate the total reliability?

(OR)

14 (b) Two different routes can be used to travel between two cities. Route-A normally takes 60 minutes, while Route-B normally takes 45 minutes. If traffic problems are encountered on Route-A, the travel time increases to 70 minutes; traffic problems on Route-B increase travel time to 90 minutes. The probability of delay is 0.2 for Route-A and 0.3 for Route-B.

   (i)   Using expected value approach, what is the recommended route?

   (ii)   If utilities are to be assigned to the travel times, what is the appropriate lottery? Note that the smaller times should reflect higher utilities.

   (iii)   Using the lottery of part (ii), assume the decision maker expresses indifference probabilities of

        $p = 0.8$ for 60 minutes

        $p = 0.6$ for 70 minutes

        What route should this decision maker select?

15 (a) Consider a two station production system in which fresh parts arrive at station-1 at a Poisson rate of 10 per hour; production time at stage-1 is exponentially distributed with a mean of 4 min including inspection. If a unit is defective and can be reworked, it is placed at the end of the queue and is reprocessed at station- 1. It is found that 20% of the items inspected are reworked, 10% are rejected and the remaining goes to station-2. Processing time at station-2 is exponentially distributed with a mean of 6 min. All items processed by station-2 leave the system. Determine WIP and MLT. (Apply product form solution of open Q-net).

(OR)

15 (b) A company supplies a single product from two warehouses to three of its customers. The supplies at the warehouses are 120 and 70 units, respectively. The customer demands are 70, 80, and 100 units respectively. The net profit associated with shipping one unit from warehose i to customer j is given below:

	Customer		
	1	2	3
Warehouse-1	7	9	8
Warehouse-2	3	4	6

The company has set the following goals for shipping:

   1. Meet the demand of customer-3

   2. Meet at least 60% of the demand of customers 1 and 2.

   3. Maximize the total profit from goods shipped

   4. Balance the percentage of demands satisfied between customers 1 and 2

Formulate the above problem as a Goal Program

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