

**Anna University, Chennai**  
**B.E. 6<sup>th</sup> Semester Industrial Engineering**  
**IE 383 Systems Engineering**  
**End-Semester (Arrears) Examination, October 2011**

**Max Time: 3 hours**

**Max Marks: 100**

**(Part – A: 10 x 2 = 20 marks)**

1. Present three-gateway model of three life cycles of systems engineering.
2. What are the activities performed by systems engineer in an organization?
3. Why systems engineering is described as a management technology?
4. List the tools used for conducting the functional analysis.
5. What are the event relationships and connecting modes for coupled events?
6. List the techniques used for synthesizing activities into viable alternatives.
7. What are the steps followed in conducting a simulation-study?
8. What are the event relationships and connecting modes for coupled events?
9. How reachability matrix is derived from adjacency matrix?
10. What is the relation between stock and flow variables in system dynamics?

**(Part – B: 5 x 16 = 80 marks)**

11. A sample survey on brand switching pattern of 1000 consumers of a product has revealed the following data:

Number of consumers using a specific brand of the Product as on 1st January

Brand - A	Brand - B	Brand - C
200	500	300

The following table indicates the number of consumers switched over among the three brands during the month of January

From	To (A)	To (B)	To ©
Brand-A	-	35	25
Brand-B	20	-	20
Brand-C	20	15	-

Assuming that the underlying brand switching process is a Markov process, derive the Transition Probability Matrix. Present the associated state Transition diagram. State the Markov assumptions. For steady state analysis, write down the steady state equations. Derive the market shares of the three brands in the long run.

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

(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.

13. (a) Conduct Cross-Impact analysis for the following two events:

Event-1: Year 2004, Introduction of health insurance for rural population

Event-2: Year 2007, Decrease in infant mortality 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) Evaluate alternative project proposals where each project requires initial investment of Rs. 5,00,000. Project-A will return Rs. 15,00,000 in a period of three years, Project-B will return Rs. 10,00,000 in a period of two years, and Project-C will return Rs. 20,00,000 in 4 years. Assuming a discount rate of 20% per year, compare the projects based on Net Present Worth and ROI criteria. How do you use the IRR criterion to evaluate the three alternatives?

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, and  $p = 0.6$  for 70 minutes

What route should this decision maker select? Is the decision maker a risk taker or a risk avoider?

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) What are the steps followed in the application of AHP methodology?

A study comparing four personal computers resulted in the following pair wise comparison matrix for the performance criterion.

	1	2	3	4
1	1	3	7	1/3
2	1/3	1	4	1/4
3	1/7	1/4	1	1/6
4	3	4	6	1

Determine the priorities for the four computers relative to the performance criterion.

Compute the Consistency ratio. Are the judgments regarding performance consistent?

Explain.