Roll #									

Anna University Chennai
B.E. 6th Semester Industrial Engineering
IE 9032 Systems Engineering
End-Semester Examination, April-May 2011

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

(Part – A: 10 x 2 = 20 marks)

1. What is the role of systems engineer in an organization and what are the components of systems engineering knowledge?
2. Compare functional, structural and purpose oriented definitions of Systems Engineering.
3. What are the event relationships and connecting modes for coupled events?
4. When do you opt for simulation approach and what are the steps followed?
5. How business activity models help in refining the problem definition efforts?
6. Define various functions associated with reliability estimation of a product during its useful life period.
7. How causal loops are different from stock and flow variables in system dynamics?
8. What are the tools used for conducting functional analysis?
9. Distinguish common voting systems, with an example.
10. What is the product form solution of an open queuing network?

(Part - B: 5 x 16 = 80 marks)

11 (i) Identify the relevant elements of issue formulation (problem definition, value system design, and system synthesis) taking an example of complex problem for Systems Engineering study.

(ii) What is the role of Systems Engineer to develop viable alternatives from a list of activities and how this is achieved through group dialogue techniques?

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) The MWC company is considering the introduction of a new product that is believed to have a 50-50 chance of being successful. One option is to try out the product in a test market, at a cost of Rs. 5 million, before making the introduction decision. Past experience shows that ultimately successful products are approved in the test market 80 percent of the time, where as ultimately unsuccessful products are approved in the test

market only 25 percent of the time. If the product is successful, the net profit to the company will be Rs. 40 million; if unsuccessful, the net loss will be Rs.15 million.

(i) Discarding the option of trying out the product in a test market, develop a decision analysis formulation of the problem by identifying the alternative actions, states of nature, and payoff table. Then apply Baye's decision rule to determine the optimal decision alternative.

(ii) Find EVPI

(iii) Including the option of trying out the product in a test market, use **decision tree** to solve the problem.

(OR)

13 (b) Present general formulation of goal programming model and explain the terms associated with it.

Industrial Chemicals produces two adhesives used in the manufacturing process for airplanes. The adhesives, which have different bonding strengths, require different amounts of production time: the IC-100 adhesive requires 20 minutes of production time per gallon of finished product, and the IC-200 adhesive uses 30 minutes of production time per gallon. Both products use one Kg of a highly perishable resin for each gallon of finished product. Inventory contains 300 Kgs of resin, and more can be obtained if necessary. However because of the shelf life of the material, any amount not used in the next two weeks will be discarded.
The firm has existing orders for 100 gallons of IC-100 and 120 gallons of IC-200. Under normal conditions, the production process operates 8 hours per day, 5 days per week. Management wants to schedule production for the next two weeks to achieve the following goals.

Priority Level-1 Goals:
Goal-1: Avoid underutilization of the production process.
Goal-2: Avoid overtime in excess of 20 hours for the two weeks.

Priority Level-2 Goals:
Goal-3: Satisfy existing orders for the IC-100 adhesive; that is, produce at least 100 gallons of IC-100.
Goal-4: Satisfy existing orders for the IC-200 adhesive; that is, produce at least 120 gallons of IC-200.

Priority Level-3 Goal:
Goal-5: Use all the available resin.

Formulate a goal programming model for the Industrial chemicals problem. Assume that both priority level-1 goals and priority level-2 goals are equally important.

14 (a) Define the terms: Stochastic networks, Transition probability matrix, Classification of system states, and Markov property.

A machine component is replaced once in 4 weeks. However it has been found to wear out in less than 4 weeks in some cases. It has been found that 25% of the components were replaced at the end of the first week, 30% of the week old components were replaced at the end of the second week, and 45% of the two week old components were replaced at the end of the third week. Setup TPM of the DTMC formulation of the above

situation. Through steady state analysis of the DTMC model, suggest appropriate replacement policy.

(OR)

14 (b) Present details associated with economic appraisal methods for benefits and costs over time.

Evaluate three alternative project proposals where each project requires an 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?

15 (a) What are the steps followed in conducting AHP analysis to rank decision alternatives?

The results of AHP from the responses of six managers in an organization are presented in the following preference orderings of three alternatives, a, b, and c:

Manager-1 = (a, b, c) = Manager-5
Manager-2 = (c, b, a) = Manager-4
Manager-3 = (b, a, c) = manager-6

Derive social preference relation. Obtain the group level of agreement and associated ordering of alternatives.

(OR)

15 (b) Define Utility, how Utility functions are developed? How the Utility function does reflect the risk taking behavior of a decision maker?

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?