Subject: OPERATIONS RESEARCH & ENGINEERING MANAGEMEN
Time: 3 Hours **Max. Marks: 1**

DECEMBER 2010

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after half an hour of the commencement of the examination.**
- **Out of the remaining EIGHT Questions, answer any FIVE Questions. Selecting THREE questions from part A and TWO questions from part B.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. Which of the following statements is true
(A) For every instance of an LP the set of optimal solutions is finite.
(B) For every instance of an LP the set of feasible parts is unbounded.
(C) For every instance of an LP the set of basic feasible solution is finite.
(D) None of these.

b. If in phase I of the simplex method, an artificial variable remains at positive level in the optimal table of phase I, then _____
(A) the solution is unbounded **(B)** there exists an optimal solution
(C) there exists no solution **(D)** None of these

c. In a transportation problem obtaining the starting basic feasible solution by VAM or any other method, a column and a row are satisfied together. This shows that
(A) there is no feasible solution
(B) at least one basic variable is at zero level
(C) there is no optimal solution
(D) solution is unbounded

d. The average number of customers in the system for the queing mode M/M/1: ∞ FCFO system is $\left(\text{where } \rho = \frac{\text{Mean arrival rate}}{\text{Mean service rate}}\right)$

(A) $\frac{\rho^2}{1-\rho}$ **(B)** $\frac{1}{1-\rho}$

(C) ρ **(D)** $\frac{\rho}{1-\rho}$

e. For a LPP, primal maximization problem P with dual Q, which of the following statements is correct?
(A) The optimal values of P and Q exist and are the same.
(B) Both optimal values exist and the optimal value of P is less than the optical value of Q.
(C) P will have an optimal solution if and only if Q also has an optimal solution.
(D) Both P and Q cannot be infeasible.

f. For the queuing model (M/M/1: ∞/FCFS) the average waiting time of customer in the queue is _____ (Where λ : mean arrival rate μ: mean service rate)

(A) $\frac{\lambda}{\mu(\mu-\lambda)}$ **(B)** $\frac{\lambda^2}{\mu(\mu-\lambda)}$

(C) $\frac{1}{\mu-\lambda}$ **(D)** $\frac{\mu}{\lambda(\mu-\lambda)}$

g. For a two person game with players A and B, the minimising and the maximising player respectively, the optimum strategies are:
(A) Minimax for A and Maximin for B
(B) Maximax for A and Minimax for B
(C) Minimin for A and Maximin for B
(D) Maximin for A and Minimax for B

h. The process by which a manager synchronise the activities of different departments is known as _____
(A) coordination **(B)** cooperation
(C) organising **(D)** supervision

i. Which function of management is concerned with finding the right people for the right job?
(A) Planning **(B)** Organising
(C) Staffing **(D)** Directing

j. _____ are routine steps on how to carry out activities.
(A) Policies **(B)** Strategies
(C) Procedures **(D)** Rules

PART A

Answer any THREE Questions. Each question carries 16 marks.

Q.2 a. Define Basic solution. **(4)**

b. Use graphical method to solve the L.P.P.
Maximize $z = 2x_1 + 4x_2$
Subject to
$x_1 + 2x_2 \leq 5$
$x_1 + x_2 \leq 4$ **(4)**
$x_1, x_2 \geq 0$
Is alternate optimal solution exists, if yes find one alternate optimal solution.

c. What is Operations Research? Give role of operations research in engineering. **(8)**

Q.3 a. A firm produces three products A, B and C each of which passes through three departments: Fabrication, Finishing and Packaging. Each unit of product A requires 3, 4 and 2; a unit of product B requires 5, 4 and 4, while each unit of product C requires 2, 4 and 5 hours respectively in the three departments. Everyday 60 hours are available in the fabrication department, 72 hours in the finishing department and 100 hours in the packaging department. The unit contribution of product A is Rs.5 of product B is Rs.10 and of product C is Rs.8
Required:
(i) Formulate the problem as an LPP and determine the number of units of each of the products that should be made each day to maximise the total contribution. (USE SIMPLEX METHOD TO SOLVE IT)
Also determine if any capacity would remain unutilised.
(ii) If the optimal solution obtained does not require the production of same product, explain as to why such product would not be produced. In this context, indicate the quantity (quantities) of other product that would be foregone for producing such product.
(iii) What would be the effect on the solution of each of the following:

a) Obtaining an order for 6 units of product A, which has to be m
b) An increase of 20 percent capacity in the fabrication department.(

b. Obtain the dual of the following LP problem: **(12)**

Maximum $z = 2x_1 + 3x_2 + x_3$

Subject to

$4x_1 + 3x_2 + x_3 = 6$

$x_1 + 2x_2 + 5x_3 = 4$ **(4)**

$x_1, x_2, x_3 \geq 0$

Q.4 a. A company has three plants at locations A, B and C which supply to warehouses located at D, E, F, G and H. Monthly plant capacities are 800, 500 and 900 units respectively. Monthly warehouse requirements are 400, 400, 500, 400 and 800 units respectively. Unit transportation costs (in Rs.) are given below:

		To				
		D	E	F	G	H
From	A	5	8	6	6	3
	B	4	7	7	6	5
	C	8	4	6	6	4

Determine an optimum distribution for the company in order to minimize the total transportation cost.(USE VOGEL'S APPROXIMATION METHOD TO FIND INITIAL BASIC FEASIBLE SOLUTION) **(8)**

b. An organisation producing 4 different products A,B, C and D having 4 operators P, Q, R and S, who are capable of producing any of the four products, works effectively 7 hours a day. The time (in minutes) required for each operator for producing each of the product are given in the cells of the following matrix along with profit (Rs. Per unit):

	Product			
Operator	A	B	C	D
P	6	10	14	12
Q	7	5	3	4
R	6	7	10	10
S	20	10	15	15
Profit (Rs./Unit)	3	2	4	1

Find out the assignment of operators to products which will maximize the profit. **(8)**

Q.5 a. Write short note on: **(4)**

(i) Total float (ii) Independent float

b. A project consists of nine activities whose time estimates (in weeks) and other characteristics are given below:

Activity	**Preceding Activity**	**Time estimates**		
		Most optimistic	**Most likely**	**Most pessimistic**
A	-	2	4	6
B	-	6	6	6
C	-	6	12	24
D	A	2	5	8
E	A	11	14	23

F	B, D	8	10	12
G	B, D	3	6	9
H	C, F	9	15	27
I	E	4	10	16

(i) Show the PERT network for the project.
(ii) Identify the critical activities.
(iii) What is the expected project completion time and its variance?
(iv) What is the probability of completing the project one week before the expected time?
(v) If the project is required to be completed by December 31 of a given year and the manager wants to be 95% sure of meeting the deadline, when should he start the project work?
(vi) A penalty of Rs.15,000 per week is to be imposed on the contractor if the project is not completed in 36 weeks. What is the probability that he has to pay a penalty? A penalty of Rs. 45,000? **(12)**

Q.6 a. Assume that at a bank teller window the customers arrive in their cars at the average rate of 20 per hour according to a Poisson distribution. Assume also that the bank teller spends an average of 2 minutes per customer to complete a service and the service time is exponentially distributed. Customers, who arrive from an infinite population, are served on a first-come-first served basis and there is no limit to possible queue length.
(i) What is the expected waiting time in the system per customer?
(ii) What is the mean number of customers waiting in the system?
(iii) What is the probability of zero customers in the system?
(iv) What value is the utilisation factor? **(8)**

b. Consider a "modified" form of "matching biased coins" game problem. The matching player is paid Rs.8.00 if the two coins turn both heads and Re 1.00 if the coins turn both tails. The non-matching player is paid Rs.3.00 when the two coins do not match. Given the choice of being the matching or non-matching player, which one would you choose and what would be your strategy? **(5)**

c. Determine the range of value of p and q that will make the payoff element a22, a saddle point for the game whose payoff matrix (aij) is given below: **(3)**

$$\begin{array}{c} \\ \textbf{Player A} \end{array} \begin{array}{c} \textbf{Player B} \\ \begin{bmatrix} 2 & 4 & 7 \\ 10 & 7 & q \\ 4 & p & 8 \end{bmatrix} \end{array}$$

PART B
Answer any TWO questions. Each question carries 16 marks.

Q.7 a. What is Management? Who are functional and general managers? **(8)**
b. Explain the concept of Matrix organisation structure. **(8)**

Q.8 a. What is decision-making? Explain any two quantitative techniques of decision-making. **(8)**
b. Explain any two qualitative methods of forecasting. **(8)**

Q.9 a. Explain the different styles of leadership. **(8)**
b. Distinguish between marketing and selling and Explain the Marketing concept. **(8)**