ROLL NO. _____

Code: AE113/AC113/AT113 Subject: OPERATIONS RESEARCH & ENGG. MANAGEMENT

AMIETE – ET/CS/IT (New Scheme)

Time: 3 Hours **JUNE 2017** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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 45 minutes 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 special cases does not require reformulation of the problem in order to obtain a solution?
(A) Alternate optimality
(B) Infeasibility
(C) Unboundedness
(D) Each case requires a reformulation.

b. Media selection problems usually determine
(A) How many times to use each media source.
(B) The coverage provided by each media source
(C) The cost of each advertising exposure.
(D) The relative value of each medium.

c. For the products x and y, which of the following could be a linear programming objective function?
(A) $C = x + 2y$ **(B)** $C = x + 2xy$.
(C) $C = x - 2y^2$ **(D)** $C = x + 2x/y$

d. Activity C has an early start time of 7, an early finish time of 12, a latest start time of 13, and a latest finish time of 18. Its slack is:
(A) 0 **(B)** 1
(C) 4 **(D)** 6

e. An activity has an optimistic time estimate of four days, a most likely time estimate of eight days, and a pessimistic time estimate of fifteen days. The expected duration of this activity is:
(A) 7.0 days **(B)** 7.5 days
(C) 8.0 days **(D)** 8.5 days

f. Which of the following is needed to solve the transportation model?
(A) Capacity of the sources **(B)** Demand of the destinations
(C) Unit shipping costs **(D)** All of these

g. A qualitative forecasting method that obtains forecasts through "group consensus" is known as the
(A) Autoregressive model **(B)** Delphi approach
(C) Mean absolute deviation **(D)** None of these

h. _____ is attributed with the development of the Two-Factor Theory of motivation.
(A) Abraham Maslow **(B)** David McClelland
(C) Frederick Herzberg **(D)** Stacy Adams

i. If everyone who is faced with a similar situation responds in the same way, attribution theory states that the behavior shows
(A) consensus **(B)** similarity
(C) reliability **(D)** consistency

j. Determining how tasks are to be grouped is part of which management function?
(A) Planning **(B)** Leading
(C) Controlling **(D)** Organizing

PART A
Answer any Three Questions. Each question carries 16 marks.

Q.2 a. What are the various applications of 'O*perations Research'* in Engineering? **(4)**

b. A firm manufactures two products *A* and *B* on which the profit earned per unit are Rs.3 and Rs.4, respectively. Each product is processed on two machines M_1 and M_2. Product *A* requires one minute of processing time on M_1 and two minutes of processing on M_2 while processing of product B requires one minute on M_1 and one minute on M_2. Machine M_1 is available for not more than 7 hours 30 minutes while machine M_2 is available for 10 hours during any working day. Find the number of units of products *A* and *B* need to be manufactured to get maximum profit.
Formulate the above problem as LPP and solve it using Graphical method. **(12)**

Q.3 a. Write the dual of the following LPP. **(4)**

$$\text{Maximize } Z = 2x_1 + 5x_2 + 3x_3$$
$$\text{subject to}$$
$$2x_1 + 4x_2 - 3x_3 \le 8$$
$$-2x_1 - 2x_2 + 3x_3 \ge -7$$
$$x_1 + 3x_2 - 5x_3 \ge -2$$
$$4x_1 + x_2 + 3x_3 \le 4$$
$$x_1, x_2, x_3 \ge 0$$

b. Solve the following LPP using Big-M method **(12)**

$$\text{Maximize } Z = x_1 + 5x_2$$
$$\text{subject to}$$
$$5x_1 + 5x_2 \ge 25$$
$$2x_1 + 4x_2 \le 16$$
$$x_1 \le 5$$
$$x_1, x_2 \ge 0$$

Q.4 a. What is Degeneracy in transportation problem? What are the two different ways in which degeneracy occurs? **(4)**

b. An electronic firm produces electronic components, which it supplies to various electrical manufacturers. Quality control records indicate that different employees produce different numbers of defective items. The average number of defects produced by each employee for each of six components is given in the following table. Determine the optimal assignment that will minimize the total average number of defects produced by the firm per month. **(12)**

	Component					
Employee	*A*	*B*	*C*	*D*	*E*	*F*
1	30	24	16	26	30	22
2	22	28	14	30	20	13
3	18	16	25	14	12	22
4	14	22	18	23	21	30
5	25	18	14	16	16	28
6	32	14	10	14	18	20

Q.5 The Honey Textile Mill was inspected by OSHA and found to be in violation of a number of safety regulations. The OSHA inspectors ordered the mill to alter some existing machinery to make it safer (add safety guards, etc.); purchase some new machinery to replace older, dangerous machinery; and relocate some machinery to make safer passages and unobstructed entrances and exits. OSHA gave the Mill only 35 weeks to make the changes; if the changes were not made by then, the mill would be fined Rs.300,000.

The Mill determined the activities in a CPM/PERT network that would have to be completed and then estimated the indicated activity times, as shown in the following table: **(16)**

Activity	**Activity Description**	**Activity Predecessor**	**Time estimates (weeks)**		
			a (optimistic)	**m (most-likely)**	**b (pessimistic)**
A	Order new machinery	-	1	2	3
B	Plan new physical layout	-	2	5	8
C	Determine safety changes in existing machinery	-	1	3	5
D	Receive equipment	A	4	10	25
E	Hire new employees	A	3	7	12
F	Make plant alterations	B	10	15	25
G	Make changes in existing machinery	C	5	9	14
H	Train new employees	D, E	2	3	7
I	Install new machinery	D,E,F	1	4	6
J	Relocate old machinery	D,E,F,G	2	5	10
K	Conduct employee safety orientation	H,I,J	2	2	2

Construct the project network for this project and determine the following:
(i) Expected activity times
(ii) Earliest and latest activity times and activity slack
(iii) Critical path
(iv) Expected project duration and variance
(v) The probability that the mill will be fined Rs.300,000

Q.6 a. Given the following pay-off matrix of a zero-sum game, determine the optimal strategies for the players and the value of the game: **(6)**

	B's strategy			
A's strategy	$\mathbf{b_1}$	$\mathbf{b_2}$	$\mathbf{b_3}$	$\mathbf{b_4}$
$\mathbf{a_1}$	5	-4	5	8
$\mathbf{a_2}$	6	2	0	-5
$\mathbf{a_3}$	7	12	8	7
$\mathbf{a_4}$	2	8	-6	5

b. Customers arrive to a Typist, who is known for quality typing, according to Poisson probability law with an average inter-arrival time of 20 minutes. The customers wait if the typist is not free. The typist completes the typist jobs in an average time of 15 minutes, the time taken being distributed exponentially. From this information determine: **(10)**
(i) What fraction of time is the typist is busy?
(ii) What is the probability of having less than 3 customers with the typist at any time?
(iii) What is the expected number of customers with the typist (in the system)?
(iv) What is the expected number of customers in the queue?
(v) How much time a customer is expected to spend in the queue?

PART B
Answer any Two Questions. Each question carries 16 marks.

Q.7 a. Explain the decision making process in detail. **(5)**

b. Outline the process through which you can test the quality of your strategy. **(5)**

c. Write note on the following: **(2x3)**
(i) Product departmentalization
(ii) Customer departmentalization
(iii) Fundamental departmentalization

Q.8 a. Define leadership. Write the skills which are required for leadership. **(6)**

b. Discuss the fundamentals of an effective control system. **(5)**

c. Explain the different types of control system. **(5)**

Q.9 a. Define management and give functions of management. **(6)**

b. Define scientific management. **(5)**

c. Discuss how the tools of management are applicable to engineering discipline. **(5)**