Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (INDUSTRIAL & PRODUCTION ENGINEERING)

END SEM (MAKE-UP) EXAMINATIONS, JANUARY 2017

SUBJECT: OPERATIONS RESEARCH [PE-III] [MME 453]

REVISED CREDIT SYSTEM
(02/01/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Use of normal tables is allowed.

1A. A company produces two types of valves, gate and conical The profit is ` 18,000 for each gate valve and ` 26,000 for each conical valve. There are 3 main departments at the plant - casting, machining and forging. Each department works two 8-hour shifts per day, 5 days per week. The production rates of the valves in each production department are shown below.

	Production rate of departments (valves/shift)		
	Casting	Machining	Forging
Gate Valve	2.0	1.0	0.0
Conical Valve	1.6	2.0	0.8

The company requires that any valve begun in any week must be completed in the same week so that no in-process inventory can accumulate over week ends. How many gate and conical valves should be produced per week to maximize profits? Formulate as L.P.P. **(Do not solve)** However draw the first Simplex tableau. **5**

1B. Briefly explain the following terms used in Game theory.
Pure and mixed strategy b) Value of the game c) Fair and unfair games. **3**

1C. What are the basic assumption in LP problems? **2**

Q2a A L.P.P. is formulated as given below.

$\text{Max } Z = 4x_1 + 2x_2 + 5x_3$

S.t.

$4x_1 + 2x_2 + 1x_3 \le 430$ (Resource 1)

$3x_1 + 2x_3 \le 460$ (Resource 2)

$1x_1 + 4x_2 \le 450$ (Resource 3)

and $x_1, x_2, x_3 \ge 0$

i. Solve using simplex method.

ii. Give the shadow prices of the 3 resources.

Perform R.H.S. ranging for the resource 2. **5**

Q2b Write a note on the requirements to be met in linear programming. **3**

Q2c What the limitations of Monte Carlo simulation. **2**

Q3a Three reservoirs with daily capacity of 15, 20, and 25 million litres respectively supply fresh water to 4 cities A, B, C, D whose demands are 8, 10, 12 and 15 million litres respectively. The cost of pumping per million litres is given below (in Rs. 1000s).

		Cities			
		A	**B**	**C**	**D**
Reservoir	**1**	2	3	4	5
	2	3	2	5	2
	3	4	1	2	3

Use the transportation algorithm to determine the cheapest pumping schedule if excess water can be disposed off at no cost. What is the total cost at the optimum? **5**

Q3b With an example explain multiple optimal solution in transportation problem. **2**

Q3c How are assignment problems, stated in general L.P. form? Why assignment problems are inherently-degenerate? **3**

Q4a A manufacturer of complex electronic equipment has just received a sizable contract and plans to subcontract part of the job. He has solicited, bids for 5 subcontracts from 3 firms. Any ONE firm can take only one job. The table below shows the bids and cost estimates (in ` 1000s) for doing the job internally. No more than two jobs can be performed internally.

		Subcontracts				
		1	**2**	**3**	**4**	**5**
Firm	**1**	48	72	36	52	50
	2	44	67	41	53	48
	3	46	69	40	55	45
	Internal	50	65	35	50	46

Solve the problem by the Hungarian method, minimizing total costs to complete all the 6 jobs. What is the total cost? **5**

Q4b Find the optimal strategies for the following game and the value of the game. Explain the criteria you have used in solving the problem.

		B			
		b1	b2	b3	b4
A	a1	6	5	1	6
	a2	5	2	3	4
	a3	1	0	3	3
	a4	4	4	0	1

3

Q4c A transport company provides bus services from City A to City B and back. It takes six hours for a single trip. The drivers and conductors (crew) are provided with residential facilities at both the places (i.e. City A and City B). They (crew) require at least four hours of rest before the return trip. From the following time-table prepare Draw the cost matrix for the same using assignment algorithm.

2

Q5a A central tool stores is manned by a single clerk at present. He takes an average of 6 minutes to check and carry tools to each mechanic who requests its tools. The mechanics arrive every 10 minutes on an average. Times between arrivals and time for service are exponentially distributed The mechanics are paid at ` 20 per hour and the clerk is paid at ` 12 per hour. What is the daily tool stores system queueing cost assuming 8 hours of working per day?

The management wants to know if it is worthwhile to replace the clerk by a mechanic who is capable of working at twice the rate of the clerk.

5

Q5b The arrival and service patterns in the service system are shown below:

Arrival Pattern.

Inter arrival Time (Min.)	0	2	4	6	8
Probability	0.10	0.30	0.20	0.30	0.10

Service Pattern

Service time (Min.)	1	4	7
Probability	0.2	0.5	0.3

Conduct a simulation study using the random number given below and determine the clock time at which the 5^{th} customer leaves the system if the service system opens at 8 AM. Also find the average time in the system and waiting time in the queue.

Random Numbers for Arrival:	68	13	90	73	27
Random Numbers for Service:	95	70	03	53	41

5

Q6a The details of a project are shown below:

Activity	Duration (days)	Immediate Predecessors activities
A	12	---
B	10	A
C	15	A
D	9	A
E	6	B
F	12	C,E
G	14	B
H	21	B,D
I	30	B,D
J	10	F,G,H

i. Construct the project network.
ii. Identify the critical activities. What is the duration of the project?
iii. Find the total float and free float for the activity E.
iv. If each activity can be crashed by only one day, what are the activities to be crashed to reduce the project duration by 5 days?

5

Q6b Two paths of a PERT network have mean duration and variance as shown. Find the probability of completing the project by 48 weeks. Which path offers the greatest risk of overrunning a contract dead line of 48 weeks?

Path	Mean duration (Weeks)	Variance (Weeks)
1	45	2.75
2	44	5.50

5