Reg. No.										

Manipal Institute of Technology, Manipal
(A Constituent Institute of Manipal University)

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

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: **OPERATIONS RESEARCH** [MME 453]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.

1A. With an example explain the following with respect to the game theory problems
i) Maximin and Minimax criteria ii) Pure and Mixed strategy game
iii) 2 person and N person game. iv) Rule of dominance vi) Value of the game. **05**

1B. A firm produces an alloy that is made from steel and scrap metal costing $ 50 per ton and $ 20 per ton respectively. The technological requirements for the alloy are (1) a minimum of 1 ton of steel is required for every 2 tons of scrap (2) One hour of processing time is required for each ton of steel and 4 hours of processing time for each ton of scrap (3) Steel and scrap combine linearly to make the alloy. The process loss from the steel is 10% and loss from scrap is 20%. A minimum of 40 tons of alloy must be manufactured. To maintain efficient plant operation, a minimum of 80 hours of processing time must be used. The supply of both scrap and steel is adequate for the production of the alloy. Formulate LPP. **Do not Solve.**
However draw the first Simplex table and identify the Key number and give the physical interpretation of numbers in the Cj – Zj row. **05**

2A A college has six basketball officials, it must assign to three conference games. Two officials must be assigned to each game. The distances each official would have to travel to each game are given below:

		GAMES		
		A	B	C
OFFICIALS	1	20	45	10
	2	40	90	70
	3	60	70	30
	4	30	60	40
	5	70	15	50
	6	80	25	35

The conference office has decided not to assign official 4 to game "A" because of previous conflict with one of the coaches. Determine the optimal assignment that will minimise the total distance travelled by all the six officials using Assignment Algorithm. **05**

2B Give an account of the information requirements, assumptions and applications of any two of the following different types of OR models.
i) Allocation models ii) Transportation models iii) Project Network models iv) Game theory models. **05**

3A (i) Explain any four circumstances where Monte Carlo method of simulation is preferred to Analytical method to analyse Queuing problems.
(ii) Give the merits and weaknesses of simulation models **03+02**

3B The time between the arrivals of oil tankers at an unloading dock is given by the following probability distribution:

Time between arrivals (days)	1	2	3	4	5
Probability	0.06	0.13	0.27	0.32	0.22

The time to unload, clean and prepare any ship for departure is 5 days (Only one ship can be serviced).
Conduct a simulation experiment for 10 ships using the following Random numbers for inter arrival time for the first 10 arrivals. Use the Random numbers starting from the first number on the Left and then proceeding to the right.

84	46	77	61	08	39	74	00	99	24

From the simulation experiment determine:
(i) Mean number of ships waiting.
(ii) Mean number of ships in the system.
(iii) Mean time spent by the ships in the system.
(iv) Probability of busy system. **05**

4A A manufacturer produces three products daily, x_1, x_2 and x_3. The three products are each processed through three production operations with time constraints and then stored. The problem has been formulated as

$$Maximise Z = 40x_1 + 35x_2 + 45x_3 \qquad \text{(Profit, \$)}$$

Subject to

$$2x_1 + 3x_2 + 2x_3 \le 120 \qquad \text{(operation 1, hr.)}$$

$$4x_1 + 3x_2 + x_3 \le 160 \qquad \text{(operation 2, hr.)}$$

$$3x_1 + 2x_2 + 4x_3 \le 100 \qquad \text{(operation 3, hr.)}$$

$$x_1 + x_2 + x_3 \le 40 \qquad \text{(storage, ft.}^2\text{)}$$

$$x_1, x_2, x_3 \ge 0$$

The final optimal tableau for the model is:

			40	35	45	0	0	0	0
Unit profit	Basis	Q_1	x_1	x_2	x_3	s_1	s_2	s_3	s_4
0	s_1	10	-½	0	0	1	0	½	-4
0	s_2	60	2	0	0	0	1	1	-5
45	x_3	10	½	0	1	0	0	½	-1
35	x_2	30	½	1	0	0	0	-½	2
		1500	40	0	0	0	0	5	25
		Cj – Zj	0	0	0	0	0	-5	-25

s_1, s_2, s_3, and s_4 are slack variables for 1, 2, 3 and 4th constraints respectively.

i) Explain to the company, what the optimal production plan is and interpret the numbers in the Cj – Zj row? What is the unit worth of each resource? **02+03**

ii) Is the above solution unique? If not find the alternate optimum.

4B Referring to the above table

i) Conduct sensitivity analysis with respect to RHS values.

ii) Given a choice between securing more hours for operation 3 and more storage space, which should management select? Justify your answer. **03+02**

5A Solve the following LPP Graphically.

$Max\ Z = 24x_1 + 20x_2$

$$S.t.\quad a) x_1 + 2x_2 \le 24;\ \ b) x_1 + x_2 \le 20;\ \ c) \frac{x_1}{16} + \frac{x_2}{24} \le 1;\ d) -3x_1 + 2x_2 \le 0;\ \ x_1, x_2 \ge 0;$$ **05**

5B Given below is the payoff matrix for a 2 person - zero sum game. Recommend optimal strategies and value of the game.

	Company B		
Company A	-2	0	4
	2	-1	2
	1	-1	3
	-1	0	0

If the companies deviate from the strategies recommended by you and company A chooses its strategy using Maximin criteria and company B chooses its strategy using Minmax criteria, what would be loss to company A and to Company B?

05

6A Given below is the optimal solution to the transportation problem of supplying coal from 4 coal mines to 3 power plants daily. The unit cost of shipping is indicating at top left hand corner of each cell. The power plants cater to the needs of 3 different regions.

	Power Plant				Max Output (tpd)
	1	2	3	Dummy	
Mine 1	5	9 **2**	13 **8**	0	10
Mine 2	M	5 **10**	9	0	10
Mine 3	13	17 **5**	M	0 **5**	10
Mine 4	9 **9**	13	17 **1**	0	10
Demand (tpd)	9	17	9	5	

i) At the optimum, which mine will have surplus output? Do you suggest a cut in the output? Why and Why not? Answer both.
ii) Government has ordered closure of mine 3 because of environmental laws. In that case, which mine's capacity is to be built up? By how much? Is there any cost advantage in the change? **05**

6B Given below the precedence relationships and time estimates for the activities involved in a project.

Activity	A	B	C	D	E	F	G
Immediate preceding activity	----	A	A	B	B	C	E,F
Time (days)	2	7	9	4	10	5	4

(i) Construct the network and calculate the Event times for each event.
(ii) Identify the Critical path and calculate Total, Free and Independent float for each activity. **05**