	Reg. No.	
Manipal INSPIRED BY LI	Manipal Institute of Technology, Manipal (A Constituent Institute of Manipal University)	NOVLEDCE IS POWER

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

MAKE UP EXAMINATIONS, DEC 2015

SUBJECT: OPERATIONS RESEARCH [MME 453]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

• Answer **ANY FIVE FULL** questions.

- **1A.** Develop your own LPP with individual set of constraint equations and inequalities. Use them to illustrate graphically each of the following LPP:
 - i) An unbounded problem
 - ii) No feasible solution.
 - iii) A degenerate optimum solution.
- **1B.** Two companies A & B merge. Both produce same products.

V				
Labour p (units/m	oroductivity nan-hours)		Wage rate (R	s./hr) for
Product 1	Product 2	Ē	Product 1	Product 2
1	3		2	3
2	1/2		5	4
_	Labour r (units/m Product 1 1 2	Labour productivity (units/man-hours) Product 1 Product 2 1 3 2 ½	Labour productivity (units/man-hours)Product 1Product 2132½	Labour productivity (units/man-hours)Wage rate (RProduct 1Product 2Product 11322½5

Company A has labour force of 28,000 man-hours per month and Company B has 15,000 man-hours per month.

The combined company wants to consider adjusting its work forces at each of the two plants without changing its wage policy or hiring any new workers; however workers may be laid off or switched from one product to the other. Formulate a linear program that will minimize the labour costs and meet the combined production requirements of 10,000 units of product 1 and 15,000 units of product 2. Formulate LPP. Do not solve.

- **2A** i) List the various phases of an OR study.
 - ii) What are the assumptions underlie the LPP.

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2B Clapper electronics produces 2 models of telephone devices. Model H23 (x_1) and Model (H24) x_2 . The production manager formulates their constraints as: $2x_1 + 1x_2 \le 40$ (max available hours on soldering machine)

 $1x_1 + 3x_2 \le 30$ (max available hours in inspection department)

 $x_1, x_2 \ge 0$

The objective function is

 $MaxZ = 9x_1 + 7x_2$ (Dollars)

- i) Solve using Simplex algorithm.
- ii) The company is considering renting its soldering machine at a cost of \$2.50 per hour. Should it do so?
- iii) The production manager computes that he can hire a part-time inspector for \$1.75 per hour. Should he do so?
- **3A** A company is to sub-contract work on 4 assemblies. The 3 subcontractors have submitted a bid price on each assembly type and a limit on the total number of assemblies (in any combination) for which they are willing to contract. The table below gives the bid price/units, requirements and contract limits.

		A	sseml	Contract		
	1	2	3	4	limits	
	Α	3.4	3.6	3.3	3.1	550
Contractor	В	3.8	3.1	3.0	3.5	480
	С	3.1	3.2	3.1	3.4	470
Requirements		500	300	300	400	

Use transportation algorithm to allocate each assembly type to 3 contractors. The objective is to minimize total bid price.

- **3B** Explain with examples differing character of arrival patterns, queue discipline and service mechanisms in waiting line models. What other factors distinguish types of queuing system?
- **4A** A company presently operates five plants each of which makes a single product. Recently one of the products has become unprofitable and is being dropped from the range. The firm wishes to maintain its one-product-per-plant policy and has now to decide which plant is to be closed. The revenue (in lacs) from the sale of each of the products (regardless of plant) are:

Product	1	2	3	4
Revenue	80	90	100	85

The production costs however, do vary between the plants. The cost data (also in lacs) are given:

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	Product						
		1	2	3	4		
	1	70	80	90	75		
Ħ	2	70	80	85	70		
lar	3	60	80	75	70		
ፈ	4	70	80	85	75		
	5	65	85	90	70		

Closure costs are the same for each plant. Advise the firm on which plant to shut down. Use Assignment Algorithm.

4B i) Solve the following game and determine the optimal strategy for each player and value of the game.

	B1	B2	B3
A1	3	-1	3
A2	-3	4	-1
A3	-5	3	2

- ii) Explain the following with respect to game:
- a) Saddle point b) Maximin and Minimax criteria c) pure strategy and mixed strategy game.
- 5A All trucks travelling on interstate highway are required to stop at a weigh station. They arrive at a mean rate of 200 per 8-hour day according to Poisson fashion. The weighing times are exponentially distributed with a mean rate of 220 trucks per 8-hr day.
 - i) Determine system time, system length, waiting time and queue length.
 - ii) Suppose the passing truck drivers try to bypass the station, on seeing 4 or more trucks at the station. What is the probability that they are being caught?
- **5B** A quality control laboratory for a pharmaceutical company performs tests on samples of a particular drug. Past data shown in the table gives the frequency distribution of the time to process one sample.

Process time (hours)	1	2	3	4	5
Frequency	5	10	20	10	5

If a sample arrives every 2 hours simulate the quality control system for 10 samples. Assume there is only one chemist in the laboratory. From the simulation worksheet, determine the important operating characteristics of the system and given your comments.

Use the following Random numbers for process time:

	28	10	99	00	27	12	73	73	99	12
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6A An assembly operation involves the completion of 9 jobs. The job labels, time required to complete, immediate predecessors are shown in table:

Job	Α	В	С	D	Ε	F	G	Η	
Time required (hours)	8	10	11	9	10	8	6	7	14
Immediate predecessor		А	А	В	С	D,E	С	G	F,H
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i) Draw the network. Which jobs are on the critical path?

ii) Prepare a table of floats on the non-critical jobs. Outline ways in which reductions can be made in network completion time.

- **6B** Write short notes on the following:
 - i) CPM and Project crashing.
 - ii) Significance of total, free and independent float.
 - iii) Three time estimates in PERT.