M. Sc. 4th Semester Examination, 2015

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

(*Lab. on Special Paper*(OR/OM))

(Practical)

PAPER – MTM - 405 (Unit–II)

The figures in the right-hand margin indicate marks

(*Lab. on Special Paper*(OR))

(*Operations Research Using MALAB/LINGO/ MATHEMATICA*)

[*Marks* : 25]

Time : 2 hours

Answer any **one** question : 20×1

1. Write a program in LINGO and MATLAB to solve the following LPP using simplex method

$$\text{Min } Z = -3x_1 + 4x_2$$

$$\text{Subject to, } \quad x_1 + x_2 \le 8$$
$$2x_1 + 5x_2 \le 22$$
$$x_2 \le 4$$
$$x_1, x_2 \ge 0$$

20

2. Write a script in MATLAB and LINGO to solve the following LPP using Revised Simplex Method.

$$\text{Max } Z = x_1 + x_2$$

$$\text{Subject to, } \quad 3x_1 + 2x_2 \le 6$$
$$x_1 + 4x_2 \le 4$$
$$x_1, x_2 \ge 0$$

20

3. Write a program in LINGO and MATLAB to solve the following QPP using Wolfe's modified simplex method.

$$\text{Max } Z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x_2 - 2x_2^2$$

$$\text{Subject to, } \quad x_1 + 2x_2 \le 2$$
$$x_1, x_2 \ge 0$$

20

(Continued)

4. Write a program in LINGO and MATLAB to solve the following Integer Programming Problem using Gomory's cutting plane method.

$$\text{Max } Z = 7x_1 + 9x_2$$

$$\text{Subject to, } -x_1 + 3x_2 \le 6$$

$$7x_1 + x_2 \le 35$$

$$x_1, x_2 \ge 0 \text{ and are integers.} \quad 20$$

5. Write a program in LINGO and MATLAB to solve the following Problem using Dynamic programming technique.

$$\text{Max } Z = y_1 y_2 y_3$$

$$\text{Subject to, } y_1 + y_2 + y_3 = 5$$

$$y_1, y_2, y_3 \ge 0 \quad 20$$

6. **Write a program in LINGO and MATLAB to solve the following Geometric Programming Problem.**

$$\text{Minimize } f(x) = 7x_1x_2^{-1} + 7x_2x_3^{-2} + 5x_1^{-3}x_2x_3 + x_1x_2x_3 \quad 20$$

7. Write a program in LINGO and MATLAB to find the Nash equilibrium strategy and Nash equilibrium outcome of the following bi-matrix game. 20

$$A = \begin{bmatrix} 1 & 0 \\ 2 & -1 \end{bmatrix} \qquad B = \begin{bmatrix} 3 & 2 \\ 0 & 1 \end{bmatrix}$$

8. Write a program in LINGO and MATLAB to solve the following Queuing theorem problem.

Arrivals at a telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of a phone call is assumed to be distributed exponentially with mean 3 minutes.

(*a*) What is the probability that a person arriving at the booth will have to wait ?

(*b*) What is the average length of queues that form from time to time ?

(*c*) The telephone company will install a second booth when convinced that an arrival would expect to have to wait at least 3 minute

for the phone. By how much must the flow of arrivals be increased to justify a second booth ?

(iii) Find the average number of units in the system.

(iv) What is the probability that an arrival has to wait more than 10 minutes before the phone is free ?

(v) Estimate the fraction of a day that the phone will be in use (or busy). 20

9. Write a program in LINGO and MATLAB to solve the following problem of Inventory.

An engineering factory consumes 5000 units of a component per year. The ordering, receiving and handling cost are Rs.300 per order while trucking cost is Rs.1200 per order, internet cost Rs.0.06 per unit per year, Deterioration and obsolence cost Rs.0.004 per year and storage cost Rs.1000 per year for 5000 units. Calculate the economic order quantity and minimum average cost. 20

10. Write a program in LINGO and MATLAB to solve the following Stochastic Programming Problem.

A manufacturing firm produces two machines parts using lathes, milling machines and grinding machines. The machining times available per week on different machines and the profit on machine part are given below. The machining times required on different machines for each part are not known precisely (as they vary from worker to worker) but are known to follow normal distribution with mean and standard deviations as indicated in the following table :

Type of Machine	Machining time required per unit (minutes)				Maximum time available per week (minutes)
	Part I		**Part II**		
	Mean	Standard deviation	Mean	Standard deviation	
Lathes	$\bar{a}_{11} = 10$	$\sigma_{a11} = 6$	$\bar{a}_{12} = 4$	$\sigma_{a12} = 4$	$b_1 = 2500$
Milling machines	$\bar{a}_{21} = 4$	$\sigma_{a21} = 6$	$\bar{a}_{22} = 10$	$\sigma_{a22} = 7$	$b_2 = 2000$
Grinding machine	$\bar{a}_{31} = 1$	$\sigma_{a31} = 2$	$\bar{a}_{32} = 1{\cdot}5$	$\sigma_{a31} = 3$	$b_3 = 450$
Profit per unit (Rs)	$c_1 = 50$		$c_2 = 100$		

(Continued)

Determine the number of machine parts I and II to be manufactured per week to maximize the profit without exceeding the available machining times more than once in 100 weeks 20

11. Write a program in LINGO and MATLAB to solve the following LPP using simplex method.

$$\text{Max } Z = 2x_1 + 3x_2 - x_3$$

$$\text{Subject to, } 2x_1 + 5x_2 - x_3 \leq 5$$
$$x_1 + x_2 + 2x_3 = 6$$
$$2x_1 - x_2 + 3x_3 = 7$$
$$x_1, x_2 \geq 0$$

20

12. Write a script in MATLAB and LINGO to solve the following LPP using Revised Simplex Method.

$$\text{Min } Z = x_1 + x_2$$

$$\text{Subject to, } x_1 + 2x_2 \geq 7$$
$$4x_1 + x_2 \geq 6$$
$$x_1, x_2 \geq 0$$

20

13. Write a program in LINGO and MATLAB to solve the following QPP using Wolfe's modified simplex method.

$$\text{Max } Z = 2x_1 + 3x_2 - x_1^2$$

$$\text{Subject to, } x_1 + 2x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

20

14. Write a program in LINGO and MATLAB to solve the following INTEGER Programming Problem using Gomory's cutting plane method.

$$\text{Max } Z = x_1 + x_2$$

$$\text{Subject to, } 3x_1 + 2x_2 \leq 5$$

$$x_2 \leq 2$$

$$x_1, x_2 \geq 0 \text{ and are integers.}$$

20

15. Write a program in LINGO and MATLAB to solve the following Problem using Dynamic Programming technique.

$$\text{Min } Z = y_1^2 + y_2^2 + y_3^2$$

$$\text{Subject to, } y_1 + y_2 + y_3 \geq 15$$

$$y_1, y_2, y_3 \geq 0$$

20

(Continued)

4. Write a program in LINGO and MATLAB to solve the following Geometric Programming Problem.

Minimize $f(x) = 5x_1x_2^{-1} + 2x_1^{-1}x_2 + 5x_1 + x_2^{-1}$ 20

Write a program in LINGO and MATLAB to find the Nash equilibrium strategy and Nash equilibrium outcome of the following bi-matrix game. 20

$$A = \begin{bmatrix} 8 & 0 \\ 30 & 2 \end{bmatrix} \qquad B = \begin{bmatrix} 8 & 30 \\ 0 & 2 \end{bmatrix}$$

5. Write a program in LINGO and MATLAB to solve the following Queuing theorem problem.

A telephone exchange has two long distance operators. The telephone company finds that, during the peak load long distance all arrive in a poisson fashion at an average rate of 15 per hour. The length of service on this call is approximatelly exponentially distributed with mean length 5 minutes.

(*a*) What is the probability that a subscriber will have to wait for this long distance call during the peak hours of the day ?

(*b*) If the subscriber waits and are serviced in turn, what is the expected waiting time. 20

19. Write a program in LINGO and MATLAB to solve the following problems of Inventory.

A constructer has to supply 10,000 bearing per day to an automobile manufacturer. He find that when he start a production run, he can produce 25,000 bearing per day. The cost of holding a bearing in stock for one year is Rs.2 and set up cost for producing run is Rs 180. How frequently should the production ? 20

20. Write a program in LINGO and MATLAB to solve the following Stochastic Programming Problem.

A manufacturing firm produces two machines parts using lathes, milling machines and grinding machines. The machining times required on different machines for each part and the profit on mchine part are given below. If the machining times available on different machines are probabilistic (normally distributed) with parameters as given in the following table, find the number of machine parts I and II to be manufactured

(*Continued*)

per week to maximize the profit. The constraint have to be satisfied with a probability of least 0·99. 20

Type of Machine	Machining time required per piece (minutes)		Maximum time available per week(minutes)	
	Part I	Part II	Mean	Standard deviation
Lathes	$a_{11} = 10$	$a_{12} = 5$	$b_1 = 2500$	$\sigma_{b1} = 500$
Milling machines	$a_{21} = 4$	$a_{22} = 10$	$b_2 = 2000$	$\sigma_{b2} = 400$
Grinding machines	$a_{31} = 1$	$a_{32} = 1{\cdot}5$	$b_3 = 450$	$\sigma_{b3} = 50$
Profit per unit (Rs)	$c_1 = 50$		$c_2 = 100$	

1. Write a program in LINGO and MATLAB to solve the following LPP using simplex method.

$$\text{Max } Z = 3x_1 + 4x_2$$

Subject to,
$$x_1 + x_2 \le 10$$
$$2x_1 + 3x_2 \le 18$$
$$x_1 \le 8$$
$$x_2 \le 6$$
$$x_1, x_2 \ge 0$$

20

22. Write a script in MATLAB and LINGO to solve the following LPP using Revised Simplex Method.

$$\text{Max } Z = 3x_1 + 5x_2$$

$$\text{Subject to, } x_1 \leq 4$$

$$x_2 \leq 6$$

$$3x_1 + 2x_2 \leq 18$$

$$x_1, x_2 \geq 0$$

20

23. Write a program in LINGO and MATLAB to solve the following QPP using Wolfe's modified simplex method.

$$\text{Max } Z = 2x_1 + x_2 - x_1^2$$

$$\text{Subject to, } 2x_1 + 3x_2 \leq 6$$

$$2x_1 + x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

20

24. Write a program in LINGO and MATLAB to solve the following Integer Programming Problem using Gomory's cutting plane method.

$$\text{Max } Z = 11x_1 + 4x_2$$

Subject to, $-x_1 + 2x_2 \le 4$

$5x_1 + 2x_2 \le 16$

$2x_1 - x_2 \le 4$

$x_1, x_2 \ge 0$ and are integers. 20

5. Write a program in LINGO and MATLAB to solve the following Problem using Dynamic Programming technique.

$$\text{Max } Z = y_1^2 + y_2^2 + y_3^2$$

Subject to, $y_1 y_2 y_3 \le 4$

where y_1, y_2, y_3 are positive integers. 20

6. Write a program in LINGO and MATLAB to solve the following Geometric Programming Problem.

$$\text{Minimize } f(x) = 5x_1 x_2^{-1} x_3^2 + x_1^{-2} x_2^{-1} + 10x_2^2 + 2x_1^{-1} x_2 x_3^{-2}$$ 20

7. Write a program in LINGO and MATLAB to find

waiting time and the average number of cars per hour that cannot enter the station because of full capacity. The arrivals of cars is 1 per min and following poisson distribution. 20

OR. Write a program in LINGO and MATLAB to solve the following problem of Inventory.

The demand for an item in a company is 18000 units per year. The company can produce the item at a rate of 3000 per month. The cost of one set-up is Rs. 500 and the holding cost of one unit per month is Rs. 0.15. The shortage cost of one unit is Rs.20 per month. Determine the optimum manufacturing quantity. Also determine the manufacturing time and the time between setup. 20

39. Write a program in LINGO and MATLAB to approximate the value of π using Monte Carlo simulation technique. 20

[*Laboratory Note Book and Viva* : 5 Marks]

(Lab. on Special Paper(OM))

(Dynamical Meteorology)

[*Marks* : 25]

Time : 2 hours

Answer any one questions from each Group

GROUP – A

1. Calculate the vapor pressure near the science building taking a set of 5 data. 7

2. Find the mixing ratio of the air near the science building measuring of wet and dry bulb temperatures taking a set of 5 data. 7

3. Calculate the wind speed and wind direction near the science building taking a set of 5 data. 7

4. Calculate the saturation vapour pressure near the science building taking a set of 5 data. 7

5. Find the dew point temperature by measuring dry bulb and wet bulb temperature near the science building taking a set of 5 data. 7

6. Find the relative humidity near the science building taking a set of 5 data. 7

GROUP – B

In the chart below you find meteorological data that was taken at several different cities in India. Use this data to create the station models for each city listed in the table : 4

City	Temp (°F)	Dew point	Wind Direction	Wind Speed (K not)	Air Pressure	Sky	Present Weather
Ishapore	69	58	W	50	1016·9	75 %	Light shower
Ghatal	32	30	SE	10	1030·1	overcast	snow
Arambag	70	69	SW	65	900	25%	Drizzle
Kamarpukur	72	72	NW	30	986·4	100%	thunderstorm

8. In the chart below you find meteorological data that was taken at several different cities in India. Use this data to create the station models for each city listed in the table. 4

City	Temp (°F)	Dew point	Wind Direction	Wind Speed	Air Pressure	Sky	Present Weather
Kharagpur	70	68	SW	16	1016·9	overcast	Fog
Panskura	32	32	S	10	1030·1	50%	snow
Kolaghat	70	69	SW	20	990	25%	Clear
Haldia	72	72	W	30	986·4	100%	thunderstorm

9. In the chart below you find meteorological data that was taken at several different cities in India. Use this data to create the station models for each city listed in the table. 4

City	Temp (°F)	Dew point	Wind		Air Pressure	Sky	Present Weather
			Direction	Speed			
Calcutta	69	58	NE	16	1016·9	50%	None
Kashmir	40	37	S	10	1030·1	overcast	snow
Bombay	70	69	SW	20	998·2	25%	drizzle
Chennai	72	72	W	30	986·4	100%	thunderstorm

GROUP – C

(*Using Thermo Diagram*)

10. For an air parcel whose temperature, pressure and dew point are 20° C, 80 kPa and −2·5°C respectively. How this air parcel can be represented on a thermo diagram. Hence determine its relative humidity. 4

11. Determine the new state of the air parcel having initial temperature = 25°C, mixing ratio = 6 gm/kg and pressure = 100 kPa after being lifted dry adiabatically to the pressure level 60 kPa. 4

12. How much liquid water has been condensed out at the height 40 kPa if adiabatic ascent is occurred for an air parcel initially has temperature = 20°C, mixing ratio = 4 gm/kg and pressure = 80 kPa. 4

13. Suppose an air parcel initially temperature = 20°C, mixing ratio = 4 gm/kg and pressure = 80 kPa ascends adiabatically at $P = 40$ kPa and here it is supposed that 1 gm/kg of liquid water falls out leaving the remaining liquid water as cloud droplets that stay with the parcel. If this parcel descends then what is its new LCL and thermo state back at 80 kPa ? 4

14. Plot the following soundings : 4

P(kPa)	T_d(°C)	T(°C)
40	–40	–20
50	–30	–10
60	–5	–5

P(kPa)	T_d(°C)	T(°C)
70	0	0
80	–5	10
90	9	10
99	9	19
100	11	25

Determine the layer of air where probable cloud exists. 4

15. Air initially at 100 kPa has temperature 40°C and dew point temperature of 20°C. It rises to a height where the pressure is 50 kPa. Precipitation reduces the total water by 5 g/kg and the parcel radiatively cools by 11°C while at cloud top. Finally the parcel descends back to 100 kPa. What is the final relative humidity ? 4

16. For the air parcel whose pressure is 70 kPa, temperature being 20°C and mixing ratio being

g/kg, find its lifting condensation level state of the air parcel when it reaches a pressure height of 40 kPa and how much liquid water has been condensed out at that height ?

Field Work

Note Book + Viva