PG/IIIS/MTM-306/18

M.Sc. 3rd Semester Examination, 2018

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER –MTM-306(OR & OM)

Full Marks : 50

Time : 2 hours

The figures in the right-hand margin indicate marks

Special Paper : Operations Research

(*Operational Research Modelling* - I)

Answer **Q.No.1** and **four** from the rest

Calculator may be used

1. Answer any *four* questions : 2 × 4

(*a*) What are the difference between PERT and CPM ?

(*b*) Let us consider the following problem :

Maximize $Z = f_1(y_1) + f_2(y_2) + \ldots + f_n(y_n)$

subject to

$$y_1 y_2 \ldots y_n \geq p$$

$$p > 0, y_j > 0 \text{ for all } j.$$

define the state variables and decision functions to solve this problem by dynamic programming method.

(*c*) What are the differences between analog and computer simulations ?

(*d*) Explain taffic intensity in queuing system.

(*e*) State mortality theorem related to replacement management.

(*f*) What is EOQ ?

2. Solve the following LP problem by dynamic programming method.

Maximize $Z = 8x_1 + 7x_2$

Subject to

$$2x_1 + x_2 \leq 8$$

$$5x_1 + 2x_2 \leq 15$$

$$x_1, x_2 \geq 0.$$

8

3. A project consists of eight activities with the following relevant information.

Activity	Time estimates (days)			Predecessor
	t_0	t_m	t_p	
A	1	1	7	None
B	2	4	7	None
C	2	2	8	None
D	1	1	1	*A*
E	2	5	14	*B*
F	2	5	8	*C*
G	3	6	15	*D, E*
H	1	2	3	*F, G*

(*i*) Draw the network and find the expected project competition time.

(*ii*) If the duration for activity *F* increases to 14 days what will be its effect on this expected project. 8

4. What is simulation ? Describe its advantages in solving the problems. Give its main limitations

with suitable examples. Explain Monte Carlo simulation to find the value of π. 2+ 2 + 2 + 2

5. (*a*) Derive the optimal order quantity for multi-items inventory model without shortages under given specified storage space. 5

(*b*) Derive differential difference equations of $(M/M/1) : (\infty/FCFS/\infty)$ queueing system in transient state. 3

6. A manufacturer is offered two machines A and B. A is priced at Rs.5000 and running cost are estimated at Rs.800 for each of the first five years, increasing by Rs.200 per year in the sixth and subsequent years. Machine B, which has the same capacity as A, costs Rs.2500 but will have running costs of Rs.1200 per year for six years, increasing by Rs.200 per year there after. If money is worth 10% per year, which machine sould be purchased ? (Assume that machines do not have resale value). 8

7. A shopkeeper estimates the annual requirement of an item as 2,000 units. He buys it from his supplier at a cost of Rs.10 per item and the cost of ordering is Rs. 50 each time he orders. If the stock holding costs are 25% per year of stock value, how frequently should be replenish his stocks ? Further, suppose the supplier offers a 10% discount on orders between 400 and 699 items, and a 20% discount on orders exceeding or equal to 700. Can the shopkeeper reduce his costs by taking advantage of either of these discounts ? 8

[*Internal Assessment* : 10 Marks]

Special Paper : OM

(*Dynamical Meteorology* - I)

Answer **Q.No.8** and any **four** from the rest

1. (*a*) Derive the area equivalence of Tephigram and discuss its important features. 7

   (*b*) Explain the Geodynamical Paradox in the atmosphere. 2

2. (*a*) Derive the momentum equation of motion of an air parcel in the atmosphere in spherical co-ordinate system. 7

(*b*) What concept do you have about relative humidity ? 2

3. (*a*) Derive the effect of ascent and descent of an air parcel on lapse rate in terms of pressure changes. 6

(*b*) Derive the hypsometric equation in the atmosphere. 3

4. (*a*) Derive the expression of the pressure gradient force in the atmosphere. 4

(*b*) Derive the adiabatic lapse rate of temperature for moist unsaturated air in the atmosphere. 5

5. (*a*) How a gradient wind is generated in the atmosphere ? Discuss the different cases of its occurrences. 7

(*b*) Derive the stability criteria in terms of potential temperature. 2

6. (*a*) Derive Psychrometric equation to measure the actual vapor pressure interms of dry bulb and wet bulb temperature. 2

(*b*) Prove that

$$e_s = e_0 \exp\left[\frac{1}{R_v}\left(\frac{1}{T_v} - \frac{1}{T}\right)\right],$$

where e_0 is a known vapor pressure at reference temperature T_0, R_v is the gas constant for water vapor. 5

(*c*) An air parcel that has a temperature of 20°C at the 100 mb level is lifted dry adiabatically. What is its density when it reaches the 500 mb level ? 2

7. (*a*) Show that the absolute vorticity at any point of the earth is twice the rate of rotation of the earth about the local vertical at the point. 2

(*b*) Derive the vorticity equation in the atmosphere and interpret each terms. What is conservation of vorticity ? 7

8. Answer any *two* questions : 2 × 2

(*a*) Show that the adiabatic process is more steeper than the siothermal process. 2

(*b*) Defining the specific humidity and mixing ratio, derive the relation between these two. 2

(*c*) What are barotropic and baroclinic atmospheres ? Show that for an ideal gas, the isobaric surfaces will also be isothermal if the atmosphere is barotropic. 2

(*d*) Find the coriolis force in natural co-ordinate system. 2

[*Internal Assessment* : 10 Marks]