M.Sc. Third Semester End Examination, 2023

Applied Mathematics with Oceanology and Computer Programming

PAPER-MTM-306 A&B

Full Marks: 100 ***Time: 02 Hrs***

The figures in the right hand margin indicate marks
Candidates are required to give their answers in their own words as far as practicable
Illustrate the answers wherever necessary
USE SEPARATE ANSWER SCRIPT FOR TWO UNITS

Unit – I
MTM-306A
[Dynamical Meteology - I]
Full Marks - 50

1. Attempt any **four** questions out of six questions: $4 \times 2 = 8$
   a) Write difference between adiabatic cooling and isobaric cooling.
   b) Define 'dew point'?
   c) Derive the required amount of heat transferred per unit mass of air during the isobaric process.
   d) Write the properties of 'tephigram'.

e) Derive the relation between mixing ration and specific humidity.

f) Explain the concept of Coriolis force.

2. Attempt any **four** questions out of six questions: $4 \times 4 = 16$

a) Explain gradient wind generated in the atmosphere? Show that the potential temperature of an air parcel is invariant.

b) Define virtual temperature and show that if T_v is the virtual temperature. Then $T_v = T(1+0.61r)$ where r is the mixing ration..

c) Explain the Geodynamical Paradox. Find the geostrophic wind equation.

d) Derive the hydrostatic equation in the atmosphere. Deduce the dry adiabatic lapse rate.

e) Deduce Clausius-clapeyron equation.

f) The horizontal convergence under an average thunderstorm is $10^{-3}s^{-1}$. Theoretically, what will be the vertical velocity at 10 m above the ground?

3. Attempt any **two** questions out of four questions: $2 \times 8 = 16$

a) Write notes on (i) horizontal mixing of air masses; (b) Vertical mixinig of air masses. 4+4

b) Derive the momentum equation of motion of an air parcel in the atmosphere in carteaian co-ordinate system. 8

c) Derive the effect of ascent and desent of an air parcel on lapse rate in terms of preasere changes 8

d) i) Derive the expression of the pressure gradient force in the atmosphere.

ii) Derive an expression for the density ρ of an air parcel at pressure p if it is adiabatically expands from a level where pressure and density are p_s and ρ_s respectively. 4+4

Internal Assessment - 10

Unit – II
MTM-306B
[Operation Research]
Full Marks – 50

Answer Q. 1 and any four from rest of questions.

Answer Q. 1 and any four from rest of questions.

1. Answer any four questions $4 \times 2 = 8$

(a) Let us consider the following problem:

Maximize $z = f_1(y_1) + f_2(y_2) + \cdots + f_n(y_n)$

Subject to $y_1 y_2 \cdots y_n \geq p, p > 0, y_j > 0$ for all j

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

(b) What are the critical paths and critical activities in network analysis?

(c)What is lead time and carrying cost in inventory.

(d) Explain the six parameters a, b, c, d, e, f in the queue system $(a/b/c):(d/e/f)$.

(e) Explain with examples the group replacement and individual replacement.

(f) Write the mid square method to generate random numbers.

2. Solve the LP problem by dynamic programming method.

Maximize $z = 8x_1 + 7x_2$

Subject to

$2x_1 + 2x_2 \leq 10$

$x_1 + 3x_2 \leq 20$

$x_1, x_2 \geq 0$ 8

3. It is given that initially there are 1000 type writes and the distribution of length of service is given below :

Service duration	1	2	3	4	5 or more
Prob,	0.3	0.4	0.2	0.1	0

Assuming that an employ leaving each replace by another at the end of the year then determine.

a) The number of staff who leave in each of first 8 year

b) The number of leaving each year when the steady state situation is reached.

c) The total annual cost of recruiting staff in the steady state if replacement of each new typist cost Rs. 200. Then find the optimal replacement cost. 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. In an inventory model, the uniform demand rate is D unit of quantity per unit time, production rate is finite, say K(K>D), shortages are allowed and fully backlogged, lead time is zero and inventory planning horizon is infinite. Find the optimum production quantity and minimum cost. 8

6. A machine owner finds from his past records that the costs per year of maintain a machine whose purchase price is Rs. 6000 are given below.

Year	1	2	3	4	5	6	7	8
Maintain cost	1000	1200	1400	1800	2500	2800	3400	4000
Resale price	3000	1500	750	375	200	200	200	200

7. A trader stocks a particular seasonal product at the beginning of the season and can not re order. The item costs him Rs. 25 and he sells it at Rs. 50 each. For any item that cannot be made on demand the trader had estimated a goodwill cost of Rs. 15. Any item unsold will have a slavage value of Rs. 10. The holding cost during the period is estimated to be 10% of the price. The probability demand is follows:

Units	2	3	4	5	6
Prob.	0.35	0.25	0.20	0.15	0.05

Determine the optimal number of item would be stocked. 8

Internal Assessment - 10