M.Sc. Third Semester End Examination, 2022

Applied Mathematics with Oceanology and Computer Programming

PAPER-MTM-306

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) What is pseudo adiabatic change?
   b) Write two uses of aerological diagram.
   c) What is gestrophic wind?
   d) What is hydrostatic equilibrium in the atmosphere?
   e) Explain stability of dry air in the atmosphere.
   f) What is lifting condensation level?

2. **Attempt any four questions out of six questions:$4 \times 4 = 16$**
   a) Derive adiabatic lapse rate of temperature for moist unsaturated air in the atmosphere.
   b) Show that in an isothermal atmosphere, the pressure decreases exponentially with height. What is the pressure at a scale height in the isothermal atmosphere?
   c) Define due-point. Write notes on satuaration by isobaric cooling.
   d) Explain the terms: wet-bulb temperature; wet-bulb potential temperature;
   e) Is there any difference gravitational fource and gravity? Explain it.
   f) Derive hypsometric equation in the atmosphere.
3. **Attempt any two questions out of four questions:$2 \times 8 = 16$**
   a) Give physical concept of thermal wind in the atmosphere and then deduce its mathematical form.
   b) Derive the momentum equation of motion of an air parcel in the atmosphere in carteaian co-ordinate system.
   c) Show that the sum of kinetic energy, potential energy and enthalpy of an air parcel is constant in a steady, adiabatic and frictionless flow in the atmosphere.
   d) Write notes on (any two)
      i) Vertical shear of geostrophic mind;
      ii) Purpose and use of ofacrological diagram;

      iii) Horizontal and vertical mixing of air mabes in the atmosphere.

Internal Assessment - 10

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

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

1. **Answer any four questions** **$4 \times 2 = 8$**
   (a) What is simulation ? Describe its advantages in solving the problems.
   (b) Explain the 'Activity' in the context for project management.
   (c)What are the categories of cost that associated with in developing a inventory model?
   (d)What are the new components in supply chain management over inventory control?
   (e) What are the differences between PERT and CPM?.
   (f) State Bellman's principle of optimality.

2. Records of 100 truck loads of finished jobs arriving in a department's check-out area show the following: Checking out 5 minutes and takes care of only one truck at a time. The data is summarized in following table.

Truck inter-arrival time (min)	1	2	3	4	5	6	7	8	9	10
Frequency	1	4	7	17	31	23	7	5	3	2(total=100)

As soon as the truck are checked out, the truck driver takes them to the next department. Using Monte-Carlo simulation,determine: What is the average waiting time before service? And What is likelyto be the longest wait.(two digit random variable are given by : 12, 81, 36, 82, 21, 74, 90, 55, 79, 70, 14, 59) 8

3. Obtain the minimum cost of the EOQ model with constant rate of demand with scheduling time constant.8

4. (a) Find the optimum order quantity for a product for which the price breaks are as follows:

Quantity	Unit Cost (Rs.)
$0 \leq q_1 \leq 500$	10
$500 \leq q_2$	9.25

The monthly demand for a product is 200 units, the cost of storage is 2% of unit cost and the cost of ordering is Rs. 100.

b) Explain the Monte Carlo simulation. Sate different mathematical steps in the Monte-Carlo method.

4+4=8

5. a) Obtain the functional equation for solving the following problem by dynamic programming problem: 4

Maximize $z = g_1(x_1) + g_2(x_2) + ... + g_n(x_n)$

Subject to $x_1 + x_2 + ... + x_n = c$

$x_1, x_2, ..., x_n \geq 0$ 4

(b) The following table gives data for a project : 4

Activity	Time (days)
1 – 2	6
1 – 3	4
2 – 4	5
2 – 5	3
3 – 4	6
4 – 6	8
5 – 6	4
6 – 7	3

Draw the network and the minimum completion time of the project.

6. Solve the following linear programming problem by dynamic programming method.

Maximum $z = 8x_1 + 7x_2$

Subject to $2x_1 + x_2 \leq 8$

$5x_1 + 2x_2 \leq 15$

$x_1, x_2 \geq 0$ 8

7. (a) Find the expression for expected queue length L_q for $(M|M|1):(\infty|FCFS)$ model. 4

(b) 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 assumes to be distributed exponentially with mean 3 minutes. Then,

(i) What is the Probability that a person arriving at the booth will have to wait.

(ii) What is the average length of queues that forms from time to time2+2

Internal Assessment - 10