M.Sc. Third Semester End Examination, 2022

Applied Mathematics with Oceanology and Computer Programming

PAPER-MTM-303

Full Marks: 50 ***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
[Dynamical Oceanology and Meteorology]
Full Marks - 25

1. Answer any two questions: **2x2=4**

a) Define salinity and sigma-t for sea water.

b) Write down first law of thermodynamics.

c) Write Poisson equation in term of pressure and temperature.

d) What is Tephigram and Emagram in meterological system ?

e) Define virtual temperature. Also draw the diagram of isobar and isothermal.

f) Write the concentration of a solution quantitatively in four possible ways.

2. Answer any two questions: **2x4=8**

a) Prove that a given volume of moist air is lighter than an equal volume of dry air at the same pressure and temperature for the relation $\rho = \frac{p}{R_d T}\left(1-(1-\varepsilon)\frac{e}{p}\right)$ where symbols have their usual meaning.

b) Define entropy for a perfect gas. Derive the expression for a geopotential distance between two levels z_1 and z_2

c) Define Gibbs general thermodynamical relation for sea water. What is Gibbs potential function.

d) Discuss how to satisfy the equation of continuity of volume for "estuarine flow" at a long, narrow coastal inlet which has a river at the inland end.

3. Answer any one question: **1x8=8**

a) Define potential temperature. Also, derive hypsometric formula. Define relative vorticity and if wind rotates as a soild body about the center of a low pressure system and the tangential velocity is 10 m/s at radius 300 km, find the relative vorticity. 2+2+4 8

b) Derive the equation of motion in oceanography and write down the boundary conditions for obtaining solutions to this equation. 5+5

Unit - II
[Operation Research]
Full Marks - 25

1. Answer any two questions: **2x2=4**

a) Define a saddle point and indicate its significance.

b) Discuss different types of inventory.

c) What are transient and steady states in queuing model analysis.

2. Answer any two questions: **2x8=16**

a) Formulates a single-item economic lot-size model with the assumption that the demand of the item is deterministic and uniform, production rate is finites, shortages are allowed and lock logged. Hence find optimum order quantity, storage quantity and minimum cost. Find the minimum cost if production is instantaneous.

b) Find the optimal value of

Maximize $f = 8x_1 + 4x_2 + x_1x_2 - x_1^2 - x_2^2$

Subject to $2x_1 + 3x_2 \le 24$

$-5x_1 + 12x_2 \le 24$

$x_2 \le 5$

By applying Kuhn-Tucker condition

c) Arrivals at a telephone booth are considered to be Poisson, with an average time of 10 minutes between one arrived and the next. The

length of a phone call assumed to be distributed exponentially with mean 3 minutes. Then

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

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

c) The telephone department will install a second booth when convinced that an arrival would expect to have to wait at least three minutes for the phone. By how much must be flow of arrivals be increased in order to justify a second booth?

Internal Assessment - 10