M.Sc. 3rd Semester Examination, 2023

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER – MTM-303(Old)

Full Marks : 50

Time : 2 hours

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

PAPER — MTM-303(Unit-1)

(*Dynamical Oceanology and Meteorology*)

1. Answer any *two* of the following questions : 2×2

(*a*) Write down the basic physical laws used in oceanography.

(*b*) Define the term 'dry adiabatic lapse rate' and write its value.

(*c*) Write down a short note on "thermohaline motion".

(*d*) Describe the temperature distribution in the atmosphere.

2. Answer any *two* of the following questions : 4×2

(*a*) Write down the physical principle for continuity of volume. Derive the equation of continuity of volume.

(*b*) Define potential temperature and show that a parcel of dry air moving adiabatically will conserve its potential temperature.

(*c*) Classify the forces in the sea and write down its physical significance.

(*d*) Derive the basic statical relationship of meterology. Hence find out the pressure variation with altitude for temperature (T) is constant with height (z) and T decreases at a constant rate with increasing z.

3. Answer any *one* of the following questions : 8×1

(*a*) (*i*) Explain the Humidity Variables: 'Mixing Ratio' and 'Specific Humidity'. 3

(*ii*) Explain adiabatic process. Derive Poisson's equation and further find out a relationship between temperature and specific volume during adiabatic process. $1 + 4$

(*b*) (*i*) Derive the equation of motion in oceanography. 5

(*ii*) If wind rotates as a solid body about the center of a low pressure system,

and the tangential velocity is 10m/s at radius 300 km, find the relative vorticity. 3

PAPER – MTM-303(Unit-2)

(*Operations Research*)

1. Answer any *two* questions of the following : 2×2

(*a*) Write the meaning of each symbol of the notation (*a*/*b*/*c*): (*d*/*e*/*f*) used to represent a queue model.

(*b*) Write the sufficient conditions for the non-linear optimization problem with inequality constraints.

(*c*) What is EOQ ?

(*d*) Define the terms : 'Lead time' and 'Planning horizon'.

2. Answer any *two* questions of the following : 4×2

(*a*) Derive the EOQ formula of purchasing inventory model without shortages, infinite replenishment rate and zero lead time system.

(*b*) Solve the following Non-linear programming problem

Maximize $f(x_1, x_2) = 4x_1 - x_1^2 + 8x_2 - x_2^2$

subject to $x_1 + x_2 = 2;\ x_1, x_2 \geq 0$

(*c*) Find the optimum order quantity for a single product of which the price breaks are as follows :

Range of quantity	Unit price(Rs)
$0 < Q < 50$	20.00
$50 \leq Q < 120$	16.00
$120 \leq Q$	14.5

The monthly demand for the product is 450 units. The carrying cost is 20% of the unit price of the product and cost of ordering is Rs. 30.50 per month.

(*d*) Explain single-phase single server and single phase multiple server queue models.

3. Answer any *one* question of the following : 8×1

(*a*) A company produces three items has limited storage space of averagely 750 items of all types. Determine the optimal production quantities for each item separately, when the following information is given :

Item	I	II	III
Set-up cost (Rs.)	50	40	60
Holding cost (Rs.)	0.5	0.6	0.4
Demand rate (units)	100	120	80

(*b*) Obtain the steady state equation for the model (M/M/1 :∞/FCFS/∞) and derive the formula for

(*i*) Average number of units in the queue.

(*ii*) Average waiting time of an arrival in the queue.

[Internal Assessment – 10 Marks]
