

**Full Marks: 40****Time: 2 Hours****Write the answer for each unit in separate sheet****MTM 303.1: Dynamical Oceanology and Meteorology****Marks: 25****1. Answer any TWO questions from the following: 2×2=4**

- a) Derive the work done in respect of change of temperature during the adiabatic process.
- b) Show that the potential temperature is invariant during adiabatic process.
- c) Define equipotential surface.
- d) Discuss the variation of density of sea water with salinity and temperature.

2. Answer any TWO questions from the following: 2×4=8

- a) Discuss the stability criteria in terms of potential temperature.
- b) Derive the expression of pressure gradient force for an air parcel.
- c) Determine the relation between pressure and height in isothermal process for a Homogeneous atmosphere.
- d) Write down the physical principle for continuity of volume. Derive the equation of continuity of volume.

3. Answer any ONE questions from the following: 1×8=8

- a) i) Define the Humidity Variables: 'Mixing Ratio' and 'Specific Humidity'.
- ii) Explain adiabatic process. Derive Poisson's equation and further find out a relationship between temperature and specific volume during adiabatic process. 3+(2+3)
- b) What are the basic physical laws in the study of the dynamics of the ocean? Classify the forces and the motion and their effects in sea water.

[P. T. O]

MTM 303.2: Operations Research**Marks: 25****4. Answer any TWO questions from the following:****2×2=4**

- a) Discuss 'steady state' & 'transient state' in queuing system.
 b) Define the following terms in connection with inventory
 i) Replenishment
 ii) Time horizon
 c) Define traffic intensity.
 d) Define saddle point with an example.

**5. Answer any TWO questions from the following:****2×4=8**

- a) The demand for an item in a company is 18000 units per year. The company can produce the item at a rate 3000 per month. The cost of one set-up is Rs. 500 and the holding cost of one unit per month is Rs. 0.15. The shortage cost of one unit is Rs. 20 per month. Determine the optimum manufacturing quantity and the shortage quantity. Also determine the manufacturing time and time between setups.
 b) A telephone exchange has two long distance operators. The telephone company finds that during the peak hour, long distance calls arrive in a Poisson process at an average rate of 15 per hour. The length of service on these calls is approximately exponentially distributed with mean length of 5 mins.
 I. What is the probability that a customer, on arrival, will have to wait for the long distance?
 II. What is the expected waiting time of a customer in the system?
 c) Prove that the sufficient condition for a function $F(X)$ subject to the constraints $g_j(X) = 0, j = 1, 2, \dots, m$ to have a relative minimum at a point X^* is that the quadratic, Q , defined by

$$Q = \sum_{i=1}^m \sum_{j=1}^m \frac{\partial^2 L}{\partial x_i \partial x_j} dx_i dx_j$$
 calculated at $X = X^*$ must be positive definite for all values of dX for which the constraints are satisfied.
 d) Find the dimension of a cylindrical tin (with top and bottom) made up of sheet metal to maximize its volume such that the total surface area is equal to $A_0 = 24\pi$.

[P. T. O]

[2]

6. Answer any ONE question from the following:**1×8=08**

- a) i) Describe the necessary assumptions to be considered by you, design the multi-item inventory model.
 ii) Considering a shop which produces three items. The items are produced in lots. The demand rate for each item is constant and can be assumed to be deterministic. Back orders are not allowed. The relevant data for the items is given in the following Table: Determine the EOQ, when the total value of the average inventory levels of three items is Rs. 1000. 4+4

Unit	I	II	III
Holding cost (Rs.)	20	20	20
Cost per unit (Rs.)	6	7	5
Set-up cost (Rs.)	50	40	60
Yearly demand rate (Rs.)	10000	12000	7500

- b) Derive the differential equations for steady state for the queuing model $(M/M/1): (N/FCFS/\infty)$.



[3]