2015

M.Sc.

3rd Semester Examination

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—MTM-303

Full Marks : 50

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Special Paper

(*Dynamical Oceanology and Meteorology / Operational Research*)

(For the students of OM Special)

Operational Research

Answer *Q. No. 1* and any *two* from the rest.

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

(i) What is the difference between local and global optima ?

(ii) What do you mean by uni-modal function ?

(iii) Write the Kuhn-Tucker conditions for the following problem :

Maximize $Z = 5 + 8x_1 + 12x_2 - 4x_1^2 - 4x_2^2 - 4x_3^2$

Subject to $x_1 + x_2 \leq 1$

$2x_1 + 3x_2 \leq 6$

(iv) Define convex function.

(v) State the Bellman's principle of optimality.

(vi) What do you understand by the term 'Post-optimality analysis' ?

2. (a) Solve by Dynamic Programming Technique :

Maximize $Z = y_1 + y_2 + \ldots + y_n$

Subject to $y_1 . y_2 . \ldots . y_n = b$

$y_1, y_2, \ldots, y_n \geq 0.$ 8

(b) Describe Gomory's mixed integer programming algorithm to find the integer solution. 8

3. (a) Find the range of the cost component c_j of the LPP :

LPP $\quad$ Maximize $Z = \sum_{j=1}^{n} c_j x_j$

Subject to $\quad \sum_{j=1}^{n} a_{ij} x_j \leq b_i \ (i = 1....m)$
with $x_j \geq 0$

in such a way that the optimality remain unchanged. 8

(b) Use Beale's method for scaling the QPP :

Max $Z = 4x_1 + 6x_2 - 2x^2_1 - 2x_1x_2 - 2x_2{}^2$

subject to $x_1 + 2x_2 \leq 2$

$x_1, x_2 \geq 0$ 8

4. (a) Use Golden section method to minimize the following objective function :

$$f(x) = \begin{cases} \frac{x^2-6x+13}{4}, & x \leq 4 \\ x-2, & x > 4 \end{cases}$$

in the interval [2, 5], upto five experiments. 8

(b) Solve the following problem by revised simplex method :

Maximize $Z = x_1 + x_2 + 3x_3$

subject to $3x_1 + 2x_2 + x_3 \leq 3$

$2x_1 + x_2 + 2x_3 \leq 2$

$x_1, x_2, x_3 \geq 0$ 8

(Internal Assessment — 10 Marks)

(For the students of OR Special)

Dynamical Oceanology and Meteorology

Answer *Q. No. 1* and any *four* from the rest.

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

(a) What do you mean by the geodynamical paradox ?

(b) What is Cyclone ?

(c) Define 'relative humidity'.

(d) What do you mean by moist air ?

(e) Explain the term 'small amplitude oceanian wave'.

(f) Write down the boundary conditions at the free ocean surface.

2. Define the vertical temperation of moist air. Prove that $T^* > T$, where T^* and T are respectively the vertical temperature and the temperature of the moist air. 8

3. Deduce the equations of conservation of moving sea water. 8

4. (a) Show that the specific entropy is a function of temperature and pressure.

(b) Define mixing ratio and specific humidity and show that they are nearly equal. 4+4

5. Show that under usual notions :

$$T = -\frac{1}{\lambda},\ \mu_s = -U - \frac{\lambda s}{\lambda} + \frac{\bar{q}^2}{2}$$

$$\mu_w = -U - \frac{\lambda w}{\lambda} + \frac{\bar{q}^2}{2}$$

$$\vec{q} = -\frac{\vec{a}}{\lambda} - \frac{1}{\lambda}\left(\vec{b} \times \vec{r}\right)$$

are the necessary conditions of thermo-dynamical equilibrium of a finite volume of sea water. 8

6. Obtain the expression of Brunt-Vaisala frequency in terms of c_p and c_v. Give the physical interpretation of this frequency. 6+2

7. (a) What do you mean by the 'Geostrophic balance'?

(b) Discuss Geostrophic and Thermal wind. 2+6

(Internal Assessment — 10 Marks)