2016

M.Sc. 4th Seme. Examination

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—MTM-405 (Unit-I)

Full Marks : 25

Time : 1 Hour

The figures in the 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 Meteorology-II / Operational Research Modelling-II)*

Dynamical Meteorology—II

[Marks : 25]

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

1. (a) How does the storm surge occur ? 2

Or

(b) What is cyclogenesis and what are the criteria for it ? 2

(Turn Over)

2. (a) Explain the pressure distribution near the front.

   (b) Derive the slope of a front in the atmosphere.

   (c) What do you mean by the frontal surface ? 2+5+2

3. Derive the general equations of horizontal motion of an air parcel including the effect of frictional forces resulting from turbulent air motion according to the Prandtl theory. 9

4. Derive the perturbation equations for a homogeneous incompressible fluid having a free surface. Hence deduce the wave travelling speed of a pure gravity wave. 9

[Internal Assesment : 05 Marks]

Operational Research Modeling—II

[Marks : 25]

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

1. Answer any *two* questions : 2×2

   (a) Draw a general structure of an information communication system and explain it.

(b) Define entropy function and explain its importance.

(c) What are MTBF and MTTF in connection with the reliability system.

2. An electrochemical system is characterized by the ordinary differential equation $\frac{dx_1}{dt} = x_2$ and $\frac{dx_2}{dt} + x_2 = u$, where u is the control variable chosen in such a way that the cost functional $\frac{1}{2}\int_0^a \left(x_1^2 + 4u^2\right) dt$ is minimized. Show that, if the boundary conditions satisfied by the state variables are $x_1(0) = a$, $x_2(0) = b$, where a, b are constants and $x_1 \to 0$, $x_2 \to 0$ as $t \to \infty$, the optimal choice for u is

$$u = -\frac{1}{2}x_1(t) + \left(1 - \sqrt{2}\right) x_2(t).$$ 8

3. (a) Let X_n be a particular event with probability p_n is divided into m mutually exclusive sub-events $Y_1, Y_2, \ldots, Y_m$ with probabilities $q_1, q_2, \ldots, q_m$ respectively, such that $p_n = q_1 + q_2 + \ldots + q_m$, then
$H(p_1, p_2, \ldots, p_{n-1}, q_1, q_2, \ldots, q_m) = H(p_1, p_2, \ldots, p_{n-1}, p_n)$
$+ p_n H(q_1/p_n, q_2/p_n, \ldots, q_m/p_n)$.

(b) Determine the optimal sequence of jobs that minimizes the total elapsed time based on the following information :

job	:	1	2	3	4	5	6	7
Machine A	:	7	8	11	14	21	17	8
Machine B	:	6	3	1	2	5	4	1
Machine C	:	10	9	15	13	18	11	9

Processing time on machines is given in hours and passing is not allowed. 4+4

4. (a) If f(t) is the failure density function of reliability, R(t) is the reliability, Q(t) is the unreliability and Z(t) is the Hazard rate, then find the relations between

(i) f(t) and R(t)

(ii) f(t) and Q(t)

(iii) Z(t) and R(t)

(iv) Z(t) and f(t).

(b) In a system, there are n number of components connected in series with reliability $R_i(t) = n$, $i = 1, 2, ..., n$. Find reliability of the system.
If $R_1(t) = R_2(t) = ... = R_n(t) = e^{-\lambda t}$ then find the reliability of the system. 4+4

[Internal Assesment : 05 Marks]

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