Register Number: …………………….

M.E. DEGREE EXAMINATIONS: JANUARY 2011

First Semester

STRUCTURAL ENGINEERING

MAT501: Applied Mathematics for Structural Engineering

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:

PART A (10 x 2 = 20 Marks)

1. What is the Laplace transform of $t\sin 2t$?
2. Using Laplace transform solve $y^1 - y = e^{3t}$, y(0) = 2.
3. State Euler-Lagrange equation for a functional to be extremum.
4. What are geodesics?
5. The mean and variance of a binomial distribution are 4 and 4/3 respectively. Find $P(X \geq 1)$, if n = 6.
6. What you mean by memoryless property of the exponential distribution?
7. When an estimator is said to be consistent?
8. Distinguish between multiple and partial correlations.
9. What are the basic fuzzy operations?
10. Define the composition of fuzzy relations using max-min composition.

PART B (5 x 16 = 80 Marks)

11. (a) Solve the following initial value problem using the Laplace transform method $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y = \cos 2t$ given that $y = 2$ and $\frac{dy}{dt} = 1$ when $t = 0$.

(OR)

(b) Solve the initial boundary value problem described by

PDE : $u_{tt} = u_{xx}$, $0 < x < 1$, $t > 0$

BCs : $u(0,t) = u(1,t) = 0$ $t > 0$

ICs : $u(x,0) = \sin \pi x$, $u_t(x,0) = -\sin \pi x$ $0 < x < 1$.

12. (a) Prove that the sphere is the solid figure of revolution which for a given surface area has maximum volume.

(OR)

(b) Find an approximation solution by Ritz method, of the differential equation $\frac{d^2u}{dx^2} - u = x$, $0 \leq x \leq 1$ with boundary conditions $u(0) = u(1) = 0$. Verify the solution by any direct method. (Use only two basic functions.)

13. (a) The equations of two regression lines got in a correlation analysis are $3x + 12y = 19,\ 3y + 9x = 46.$ Obtain the correlation coefficient between x and y, the mean values of x and y and the ratio of the coefficient of variation of x to that of y.

(OR)

(b) A car hire firm has two cars which it hires out day by day. The number of demands for a car on each day follows a Poisson distribution with mean 1.5. Calculate the proportion of days on which (i) neither car is used and (ii) some demand is not fulfilled.

14. (a) Let X be the number of flaws in the paint of new cars. We suppose that X~ Poisson (λ).

We constructed the following table with the help of a random sample of 100 cars.

Number of flaws	0	1	2	3
Number of cars	40	36	20	4

(i) Calculate the maximum likelihood estimator of the parameter λ, based on the above data.

(ii) Give a Poisson fit to the data.

(OR)

(b) Measured quantities x and y are known to be connected by the formula $y = \dfrac{ax}{x^2 + b}$,

where a and b are constants. Pairs of values obtained experimentally are

x	2.0	3.0	4.0	5.0	6.0
y	0.32	0.29	0.25	0.21	0.18

Use these data to make best estimates of the values of y that would be obtained for

(i) $x = 7.0$ and (ii) $x = -3.5.$ As measured by fractional error, which estimate is likely to be the more accurate?

15. (a) The task is to recognize English alphabetical characters (F,E,X,Y,I,T) in an image processing system. Define two fuzzy sets $\bar{I}$ and $\bar{F}$ to represent the identification of characters I and F,

$$\bar{I} = \{(F,0.4),(E,0.3),(X,0.1),(Y,0.1),(I,0.9),(T,0.8)\}$$
$$\bar{F} = \{(F,0.99),(E,0.8),(X,0.1),(Y,0.2),(I,0.5),(T,0.5)\}$$

(i) Find the following: $\bar{I} \cup \bar{F}$, $\bar{I} - \bar{F}$, $\bar{F} \cup \bar{F}^{\,c}$

(ii) Verify De Morgan's law $(\bar{I} \cup \bar{F})^{c} = \bar{I}^{c} \cap \bar{F}^{c}$.

(OR)

(b) Briefly write a note on (i) Neural networks and (ii) genetic algorithms.

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