KUMARAGURU
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M.E. DEGREE EXAMINATIONS: JAN 2015

(Regulation 2014)

First Semester

STRUCTURAL ENGINEERING

P14MAT101: Applied Mathematics for Structural Engineers

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1.   [K₁]

    1) $L\left(\dfrac{\partial u}{\partial t};s\right)=sU(x,s)-u(x,0)$ 2) $L\left(\dfrac{\partial^2 u}{\partial t^2};s\right)=s^2U(x,s)-\dfrac{d}{dx}u(x,0)$

    3) $L\left(\dfrac{\partial u}{\partial t};s\right)=sU(x,s)-u(x,t)$ 4) $L\left(\dfrac{\partial^2 u}{\partial x\partial t};s\right)=s\dfrac{d}{dx}U(x,s)-\dfrac{d}{dx}u(x,0)$

    The correct statements are

   a) 1,2,4   b) 3,4

   c) 1,4   d) 1,3,4

2. Match list I with list II and select the correct answer using the codes given below.   [K₁]

List I	List II
A. $L\left(f(t)=\begin{cases}0, & 0\le t\le 1\\ 4, & t>1\end{cases}\right)$	1. $\displaystyle\int_s^\infty F(s)\,ds$
B. $L(tf(t))$	2. $F(s-a)$
C. $L\left(\dfrac{f(t)}{t}\right)$	3. $4\dfrac{e^{-s}}{s}$
D. $L(e^{at}f(t))$	4. $-\dfrac{d}{ds}F(s)$

           A   B   C   D

   a)   2   4   3   1

   b)   3   4   1   2

   c)   4   3   1   2

   d)   2   3   4   1

3. The steps involved to find the differential equation $x''=1, y''=0$ is　　[K₄]

   1) Complementary function of $x''=1$ is $At+B$ and $y''=0$ is $Ct+D$

   2) Auxiliary equations are $m^2=0\ and\ m^2=0$.

   3) The solution is $x=At+B+\dfrac{t^2}{2}$ and $y=Ct+D$

  a)　1,2,3　　　　　　　　　　　　　b)　3,2,1

  c)　2,3,1　　　　　　　　　　　　　d)　2,1,3

4. **Assertion (A) :** Euler's equation is $\dfrac{\partial f}{\partial y}-\dfrac{d}{dx}\left(\dfrac{\partial f}{\partial y'}\right)=0$.　　[K₄]

  Reason (R) : The extremum of the Brachistochrone problem can be solved using Euler's equation.

  a)　Both A and R are wrong　　　　　　b)　Both A and R are correct

  c)　A is correct and R is wrong　　　　d)　A is wrong and R is correct

5. If the moment generating function of exponenetial distribution is $\dfrac{\lambda}{\lambda-t}$, then mean is　　[K₂]

  a)　$\dfrac{2}{\lambda}$　　　　　　　　　　　　b)　$\dfrac{1}{\lambda}$

  c)　$\dfrac{1}{\lambda^2}$　　　　　　　　　　　　d)　$\dfrac{2}{\lambda^2}$

6. 1) If $Var(X) = 3$, then $Var(2+3X)$ is 4.　　[K₂]
  2) If the mean and variance of Binomial distribution are 4 and 2, then p=1/2, q=1/2, n = 8.
  3) If X and Y are random variables then $E(X+Y) = E(X).E(Y)$
   Which of these statements are correct?

  a)　1,2,3　　　　　　　　　　　　　b)　2,3

  c)　1,3　　　　　　　　　　　　　　d)　1,2

7. One of the normal equation to fit a parabolic curve is　　[K₁]

  a)　$\sum xy=a\sum x+b\sum x+c\sum x$　　　　b)　$\sum xy=a\sum x^3+b\sum x^2+c\sum x$

  c)　$\sum x^2 y=a\sum x^3+b\sum x^2+c\sum x$　　d)　$\sum xy=a\sum x^3 y+b\sum x^2+c\sum xy$

8. Match list I with list II and select the correct answer using the codes given below.　　[K₁]

List I	List II
A. $r_{12}=0.8, r_{13}=0.7, r_{23}=0.6$	1. $b_{12.3}=0.4107$
B. $R_{3.12}$	2. $(1-r_{12}^2)(1-r_{13.2}^2)$
C. $\sigma_1=3, \sigma_2=4, w_{12}=-0.46, w_{11}=0.84$	3. $r_{12.3}=0.6651$
D. $1-R_{1.23}^2$	4. $\sqrt{\dfrac{r_{31}^2+r_{32}^2-2r_{31}r_{32}r_{12}}{1-r_{12}^2}}$

	A	B	C	D
a)	2	4	3	1
b)	2	3	4	1
c)	4	3	1	2
d)	3	4	1	2

9. **Assertion (A) :** The membership function values in fuzzy sets may be discrete or continuous. [K$_2$]
   Reason (R) : Fuzzy set $\tilde{A}=\{(a,0),(b,1),(c,0),(d,0)\}$. Then $\sup p(\tilde{A})= \{b\}$.
   a) Both A and R are wrong
   b) Both A and R are correct
   c) A is correct and R is wrong
   d) A is wrong and R is correct

10. Arrange in a sequence of selecting the pair of chromosomes in Genetic algorithms. [K$_1$]
    1) fitness evaluation   2) cross over
    3) generation of solution set   4) selection
    a) 1,2,4,3
    b) 3,1,4,2
    c) 2,3,1,4
    d) 2,1,4,3

PART B (10 x 2 = 20 Marks)

11. Obtain the solution of $y(t)=a\sin t - 2\int_0^t y(u)\cos(t-u)du$ using Laplace transform. [K$_2$]

12. Find the Laplace transform of $\sin\sqrt{t}$. [K$_2$]

13. On which curve can the functional $\int_0^{\pi/2}(y'^2-y^2+2xy)dx$ with $y(0)=0, y(\pi/2)=0$ be extremised? [K$_3$]

14. Solve $\int_0^1[2x+\left(\dfrac{dx}{dt}\right)^2+\left(\dfrac{dy}{dt}\right)^2]dt, x(0)=1, x(1)=1.5, y(0)=1, y(1)=1$ [K$_2$]

15. Find the moment generating function of the pdf $f(x)=1/4$ *where* $-2<x<2$. [K$_1$]

16. Find the mean and variance of x, given the probability function [K$_3$]

x:	0	1	2	3
P(x):	0.1	0.3	0.5	0.1

17. Prove that $b_{12.3}b_{23.1}b_{31.2}=r_{12.3}r_{23.1}r_{31.2}$. [K$_2$]

18. Find the maximum likelihood estimate of θ of exponential distribution. [K$_2$]

19. Define genetic algorithms. What are the operators of genetic algorithm. [K$_1$]

20. Implement the logic functions AND, OR using Artificial Neural Network. [K$_1$]

PART C (6 x 5 = 30 Marks)

21. Obtain the solution of the initial value problem $t y''+2ty'+2y=2, y(0)=1, y'(0)$ is an arbitrary constant. [K$_3$]

22. A string is stretched and fixed between two points $(0,0)$ and $(l,0)$. Motion is initiated by displacing the string in the form $u = \lambda \sin \dfrac{\pi x}{l}$ and released from rest at time $t=0$. Find the displacement of any point on the string at any time t. [K₅]

23. Find the curve passing through the points (x_1, y_1) and (x_2, y_2) which when rotated about the x-axis gives the minimum surface area. [K₄]

24. Estimate the correlation coefficient for the following data: [K₄]

Sales :	15	18	25	27	30	35
Advertising Expenditure:	50	65	82	95	110	120

25. Fit a curve of the form $y = ab^x$ for the data [K₃]

x :	2	3	4	5	6
y :	144.0	172.8	207.4	248.8	298.5

26. Fuzzy sets $\tilde{A} = \{(2,1),(3,0.5),(4,0.3),(5,0.2)\}$ and $\tilde{B} = \{(2,0.5),(3,0.7),(4,0.2),(5,0.4)\}$, determine $\tilde{A} \cup \tilde{B}, \tilde{A} \cap \tilde{B}, \tilde{A} \oplus \tilde{B}$, CON(A), DIL(B). [K₃]

PART D (4 x 10 = 40 Marks)

27. A beam is simply supported at its end $x=0$ and is clamped at the other end $x=l$. It carries a load w at $x=l/4$. Find the resulting deflection at any point. [K₃]

28. Demonstrate that the sphere is the solid figure of revolution which for a given surface area has maximum volume. [K₃]

29. a) Calculate moment generating function, mean and variance of Geometric distribution and also state and prove memoryless property of this distribution. (7) [K₄]

   b) If X is normally distributed with mean $\mu=12$ and SD $\sigma=4$ then find the probability of (i) $X \geq 20$ (ii) $X \leq 20$ (iii) $0 \leq X \leq 12$. (3)

30. Conclude the estimates of m_1 and m_2 by the method of moments for the double Poisson distribution. [K₄]

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