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M.E. DEGREE EXAMINATIONS: DECEMBER – 2008

First Semester

POWER ELECTRONICS AND DRIVES

P07MA104 Applied Mathematics for Electrical Engineers

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

Answer ALL Questions:-

PART A (20 x 1 = 20 Marks)

1. Which one of the following is a norm for the set of all real square matrices of order 2?

   A. determinant of A B. trace of A C. $\min(a_{11}, a_{12}, a_{21}, a_{22})$ D. $\sqrt{(a_{11}^2 + a_{12}^2 + a_{21}^2 + a_{22}^2)}$

2. Which one of the following is in Jordan canonical form?

   A. $\begin{pmatrix} 0 & 1 & 0 \\ 0 & 1 & 1 \\ 0 & 0 & 0 \end{pmatrix}$ B. $\begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$ C. $\begin{pmatrix} 0 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ D. $\begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

3. Singular values exists

   A. only for square matrices A B. only for non-singular square matrices A
   C. only for singular square matrices A D. for any rectangular matrices A

4. Eigenvalues of AA^T (where A is a real matrix) are

   A. always positive B. always non-negative
   C. always negative D. always non-positve

5. Which one of the following is a functional?

   A. $\int_0^x y(t)dt$ B. $\int_0^1 y(t)dt$ C. $y(x)$ D. $y'''(x)+1$

6. The problem of finding the path on which a particle in the absence of friction will slide from one point to another point in the shortest time under gravity is called

   A. geodesic problem B. isoperimetric problem
   C. Hamilton problem D. brachistochrone problem

7. The Ritz method is used to obtain an approximate solution of

   A. variational problem B. integral equation
   C. algebraic equation D. difference equation

8. The line of minimum length connecting two given points on a surface $\phi(x, y, z) = 0$ is

   A. brachistochrone B. envelope
   C. circle D. geodesic

4

9. Consider the following set of two equations in four unknowns: $x_1 + 4x_2 - 2x_3 + 8x_4 = 2$, $5x_1 + 2x_2 + 3x_3 + 4x_4 = 1$. The maximum number of possible basic solutions is
   A. 24   B. 12   C. 6   D. 48

10. The transportation model is a special class of
   A. assignment model   B. LP model   C. NLP model   D. DP model

11. The Hungerian method is used to solve
   A. assignment problem   B. LP problem   C. NLP problem   D. DP problem

12. In an LP model, if the objective function assumes the same optimal value at two solution points, then the solutions are
   A. degenerate   B. unbounded   C. infeasible   D. infinite in number

13. The Principle of optimality is due to
   A. Feller   B. Bellman   C. Dantzig   D. Taha

14. The number of variables optimized at a time in a four variable DP problem is
   A. 1   B. 2   C. 3   D. 4

15. DP is more suitable if the number of states is
   A. large   B. infinite   C. less   D. moderate

16. DP make use of
   A. only forward recursion   B. only backward recursion
   C. both forward and backward recursion   D. no-recursion

17. The number of telephone calls received in a interval (0, t) is a
   A. discrete random sequence   B. discrete random process
   C. continuous random process   D. continuous random sequence

18. $R(\tau) = 2 - e^{-\tau}$ is not an autocorrelation function, since
   A. it is an even function   B. it is an odd function
   C. it is neither odd nor even   D. it attains maximum at $\tau = 0$

19. The average power of a WSS process $\{X(t)\}$ is
   A. $E(X(t))$ B. $R_{xx}(0)$ C. $R_{xx}(\infty)$ D. $(E(X(t)))^2$

20. Guassian process is
   A. always wide sense stationary (WSS)   B. always strictly stationary (SSS)
   C. SSS if it is WSS   D. also a Poisson process

(ii) Consider the problem of assigning five jobs to five persons. The assignment profits for the company are as follows:

Persons	Jobs 1	2	3	4	5
A	8	4	2	6	1
B	0	9	5	5	4
C	3	8	9	2	6
D	4	3	1	0	3
E	9	5	8	9	5

Determine the maximum profit assignment.

(10+6)

(OR)

23\. (b) Obtain initial basic feasible solutions to the following transportation problem:

From \ To				Available
	7	3	4	2
	2	1	3	3
	3	4	6	5
Demand	4	1	5	

using (i) North-West corner rule
(ii) Row minima method and
(iii) Vogel's approximation method.

Also, check for the optimality of the solutions.

(4+4+4+4)

24\. (a) (i) State the principle of optimality in DP.

(ii) Write down the characteristics of DP.

(iii) Using DP, divide a length L in to 3 parts, so as to maximize their products.

(2+6+8)

(OR)

24\. (b) The owner of a chain of four grocery stores has purchased six crates of fresh strawberries. The estimated probability distribution of potential sales of the strawberries before spoilage differ among the four stores. The following table gives the estimated total expected total profit at each store, when it is allocated to various number of crates.

PART B (5 x 16 = 80 Marks)

21. (a) Obtain the eigenvalues, eigenvectors, minimal polynomial, Jordan form and hence generalized eigenvectors of the matrix $A = \begin{pmatrix} 2 & 1 & 3 \\ -4 & -3 & -3 \\ 2 & -1 & 1 \end{pmatrix}$.

(16)

(OR)

21. (b) (i) Show that $\max_{i,j} |a_{ij}|$ is a norm for square matrix $A = (a_{ij})$ of order 4.

(ii) Show that $B = \frac{1}{3}\begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ -1 & 1 & 0 \end{pmatrix}$ is the pseudo-inverse of $A = \begin{pmatrix} 1 & 0 & -1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{pmatrix}$.

(iii) Write down the steps in QR-algorithm.

(4+8+4)

22. (a) (i) Determine the extremal of $J = \int_0^{\pi/2} (y''^2 - y^2 + x^2)\,dx$, satisfying $y(0) = 0, y'(0) = 1, y(\pi/2) = 1$ and $y'(\pi/2) = 0$.

(ii) Find a function y(x) for which $\int_0^{\pi} (y'^2 - y^2)\,dx$ is an extremum if $\int_0^{\pi} y\,dx = 1$, $y(0) = 0$ and $y(\pi) = 1$.

(8+8)

(OR)

22. (b) (i) Find the extremals by minimizing the functional $J = \int_{x_1}^{x_2} y\sqrt{1 + y'^2}\,dx$.

(ii) Find an approximate extremal of the functional $J = \int_0^1 (y'^2 - y^2 - 2xy)\,dx$, satisfying $y(0) = 0$ and $y(1) = 0$ by Ritz method. Compare with the exact solution at x = ½ .

(6+10)

23. (a) (i) Maximize $Z = 3x_1 + 2x_2$, subject to: $2x_1 + x_2 \le 2$, $3x_1 + 4x_2 \ge 12$, $x_1, x_2 \ge 0$ using the Big-M method. Also, justify your answer using graphical method.

Number of Crates	Store 1	Store 2	Store 3	Store 4
0	0	0	0	0
1	4	2	6	2
2	6	4	8	3
3	7	6	8	4
4	7	8	8	4
5	7	9	8	4

For administrative reasons, the owner does not wish to split crates between stores. However, he is willing to distribute zero crates to any of his stores. Find the allocation of five crates to four stores so as to maximize the expected profit.

(16)

25. (a) (i) Consider the process $X(t) = A\cos\lambda t + B\sin\lambda t$, where A and B are random variables. Under what conditions on $E(A), E(B), E(A^2), E(B^2)$ and $E(AB)$,the process $X(t)$ is a WSS process?

(ii) Obtain the power spectral density of random process $X(t)$, given its autocorrelation function $R_{xx}(\tau) = e^{-s|\tau|}\cos\tau$, s > 0.

(8+8)

(OR)

25. (b) (i) A stationary ergodic process $X(t)$ with no periodic components has $R_{xx}(\tau) = a + \frac{b}{1+c\tau^2}$, $E(X(t)) = 4$ and $Var(X(t)) = 4$. Find the constants a, b & c.

(ii) If the input to a time-invariant, stable linear system is a WSS process then show that the output is also a WSS process.

(8+8)

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