NATIONAL INSTITUTE OF TECHNOLOGY - CALICUT
MA6003D - Mathematical Methods for Power Engineering
End Semester Examination - Monsoon 2019-20

M Tech., Power System, H V E, Power Engineering, IPA — Max Marks: 50
Date: 16-11-2019, — Time: 9:30 AM to 12:30 PM

ANSWER ALL THE QUESTIONS

1. Explain whether the map $T : R^2 \to R$ defined by $T(x,y) = |x-y|$ is linear or not. **(2 marks)**

2. Consider the linear transformation $T : R^3 \to R^3$ defined by $T(x,y,z) = (2x, 4x-y, 2x+3y-z)$. Show that T is invertible. **(2 marks)**

3. Show that the vectors $u = (1+i, 2i)$, $v = (1, 1+i) \in C^2$ are linearly dependent over C, but linearly independent over R. **(3 marks)**

4. Find the coordinates of the vector $(3,1,-4) \in R^3$ relative to the basis $v_1 = (1,1,1)$, $v_2 = (0,1,1)$ and $v_3 = (0,0,1)$ using the change of basis matrix. Verify your answer. **(3 marks)**

5. Use simplex method to solve the following linear programming problem (L.P.P)
Maximize $Z = 7x_1 + 6x_2$ subject to **(4 marks)**

$$\begin{aligned} 3x_1 + x_2 &\leq 120 \\ x_1 + 2x_2 &\leq 160 \\ x_1 &\leq 35 \\ x_1,\ x_2 &\geq 0. \end{aligned}$$

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6. Convert the following L.P.P. into standard form **(2 marks)**
Minimize $Z = 2x_1 + 3x_2 - 2x_3$ subject to

$$\begin{aligned} x_1 - x_2 + 2x_3 &\leq 5 \\ 2x_1 + 3x_2 - 2x_3 &\geq 7 \\ x_1 + 2x_2 - 3x_3 &= 12 \\ x_1 \geq 0,\ x_2 &\leq 0,\ x_3 \text{ is unrestricted.} \end{aligned}$$

7. Use dual simplex method to solve the following L.P.P.
Maximize $Z = -x_1 - x_2 - x_3$ subject to **(4 marks)**

$$\begin{aligned} x_1 - 2x_2 - x_3 &\leq -2 \\ -2x_1 + 2x_2 + x_3 &\leq 3 \\ x_1 - x_2 - 2x_3 &\leq -3 \\ x_1,\ x_2,\ x_3 &\geq 0. \end{aligned}$$

$-1/3 \quad -4/3$
$-5/3$

8. Minimize $f(x,y) = x + y$ subject to $x^2 + y^2 \leq 1$ using Kuhn Tucker Method. **(3 marks)**

9. Optimize the function $f(x,y) = 2x^2 + 3y^2$ subject to $2x + 2y = 1$ using Lagrange Multiplier method. **(2 marks)**

10. Minimize $f(x) = 4\sin x(1+\cos x); x \in [0, \frac{\pi}{2}]$ and $\varepsilon = 0.05$ using Golden Section search method. **(5 marks)**

8°, 3.14

11. Minimize $f(x) = x^2 - \sin x; x \in [0,1]$ with tolerance $l = 0.01$ and distinguishability constant $e = 0.01$ using Fibonacci search method. **(5 marks)**

12. The probability distribution function of a random variable X is given by

$$f(x) = \begin{cases} 0 & ; x \leq -a \\ \frac{1}{a^2}(a+x) & ; -a < x \leq 0 \\ \frac{1}{a^2}(a-x) & ; 0 < x \leq a \\ 0 & ; x \geq a \end{cases}$$

i. Verify that $\int_{-\infty}^{\infty} f(x)dx = 1$.

ii. Compute the cumulative distribution function $F(x)$. **(4 marks)**

13. Find the moment generating function (mgf) of $p(x) = pq^{x-1}; x = 1,2,3,\ldots$. Also calculate the mean and variance using mgf. **(4 marks)**

14. The joint probability distribution function of two random variables X and Y is given by

$$f(x,y) = \begin{cases} 24x(1-y) & ; 0 < x < y < 1 \\ 0 & ; otherwise \end{cases}$$

Find the marginal probability distributions of X and Y. **(4 marks)**

15. If $f(x,y) = x + y;\ 0 < x < 1,\ 0 < y < 1$, find $E(X|Y)$. **(3 marks)**

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National Institute of Technology Calicut

Department of Mathematics

M.Tech Degree Monsoon End Semester Examination, November-2017

MA6003, Mathematical Methods for Power Engineering

(Common to High Voltage Engineering, Industrial Power and Automation, Power Electronics and Power Systems)

Time: 3 Hours   Max. Marks: 50

ANSWER ALL QUESTIONS

1. (a) Define subspace. Prove that a non-empty subset W of V is a subspace of V if and only if for each pair of vectors α, β in W and each scalar c in F the vector $c\alpha + \beta$ is again in W. (3 Marks)

(b) V is the vector space of all 2×2 real matrices. Prove that the set $S = \left\{ \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix} \right\}$ is a basis of V. (2 Marks)

2. Let $(\alpha_1, \alpha_2, \alpha_3)$ and (β_1, β_2) be ordered bases of the real vector spaces V and W respectively. A linear mapping $T : V \longrightarrow W$ maps the basis vectors as $T(\alpha_1) = \beta_1 + \beta_2$, $T(\alpha_2) = 3\beta_1 - \beta_2$, $T(\alpha_3) = \beta_1 + 3\beta_2$. Find the matrix of T relative to the ordered bases

(a) $(\alpha_1, \alpha_2, \alpha_3)$ of V and (β_2, β_1) of W;

(b) $(\alpha_1 + \alpha_2, \alpha_2, \alpha_3)$ of V and $(\beta_1, \beta_1 + \beta_2)$ of W. (4 Marks)

3. (a) A firm products three products. These products are processed on three different machines. The time required to manufacture one unit of each of the three products and the daily capacity of the three machines are given in the following table.

Machine	Time per unit (minutes)			Machine Capacity
	Product 1	Product 2	Product 3	(minutes/ day)
M_1	2	3	2	440
M_2	4	–	3	470
M_3	2	5	–	430

It is required to determine the daily number of units to be manufactured for each product. The profit per unit for Product 1, 2 and 3 is $Rs.4$, $Rs.3$ and $Rs.6$ respectively. It is assumed that all the amounts produced are consumed in the market. Formulate the mathematical model for the problem. (4 Marks)

(b) If $\overline{X}$, $\overline{Y}$ and $\overline{Z}$ are linearly independent vectors in a vector space, prove that $\overline{X}+\overline{Y}$, $\overline{X}+\overline{Y}+2\overline{Z}$ and $2\overline{X}+\overline{Y}+\overline{Z}$ are also linearly independent. **(2 Marks)**

4. Construct the dual of the following primal problems

(a) Maximize $Z = 2x_1 + x_2 + x_3$, subject to

$$\begin{aligned} x_1 + x_2 + x_3 &\geq 6, \\ 3x_1 - 2x_2 + 3x_3 &= 3, \\ -4x_1 + 3x_2 - 6x_3 &= 1, \\ x_1, x_2, x_3 &\geq 0. \end{aligned}$$

(b) Minimize $Z = 3x_1 - 2x_2 + x_3$, subject to

$$\begin{aligned} 2x_1 - 3x_2 + x_3 &\leq 5, \\ 4x_1 - 2x_2 &\geq 9, \\ -8x_1 + 4x_2 + 3x_3 &= 8, \\ x_1, x_2 \geq 0, x_3 &\text{ is unrestricted.} \end{aligned}$$

(4 Marks)

5. Use dual simplex method to solve the following linear programming problem:

Minimize $Z = 3x_1 + 2x_2 + x_3 + 4x_4$ subject to

$$\begin{aligned} 2x_1 + 4x_2 + 5x_3 + x_4 &\geq 10, \\ 3x_1 - x_2 + 7x_3 - 2x_4 &\geq 2, \\ 5x_1 + 2x_2 + x_3 + 6x_4 &\geq 15, \\ x_1, x_2, x_3, x_4 &\geq 0. \end{aligned}$$

(4 Marks)

6. Obtain the necessary and sufficient conditions for the optimal solution of the problem given below. What is the optimal solution?

Maximize $Z = 2e^{3x_1+1} + e^{2x_2+3}$, subject to the constraint

$$\begin{aligned} x_1 + x_2 &= 10, \\ x_1, x_2 &\geq 0. \end{aligned}$$

(2 Marks)

7. (a) What are the Kuhn-Tucker conditions for general non-linear programming problem given below. Explain it for maximization and minimization Problem.

(b) Solve the non-linear programming problem:

Maximize $Z = 4x_1 - x_1^3 + 2x_2$, subject to the constraint

$$\begin{aligned} x_1 + x_2 &\leq 1, \\ x_1, x_2 &\geq 0. \end{aligned}$$

(5 Marks)

8. Given the joint probability density function of (X, Y) as

$$f(x,y) = \begin{cases} \frac{K}{(1+x+y)^3}, & \text{for } x > 0,\ y > 0, \\ 0 & \text{Otherwise.} \end{cases}$$

$(6+y)^{-1}/2 = \frac{(6+y)^{-2+1}}{-2+1}$

$\left(\frac{-1}{6+y}\right)$

(a) Find the value of K,
(b) Obtain the probability density function of X given $Y = y$,
(c) Obtain $P(X < 5,\ 1 < Y < 2)$.

(5 Marks)

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9. If the distribution of the random variable (X, Y) is given by

$$f(x,y) = \begin{cases} \frac{1}{4}[1 + xy(x^2 - y^2)], & \text{for } |x| \leq 1,\ |y| \leq 1, \\ 0 & , \text{Otherwise.} \end{cases}$$

Show that X and Y are not independent. (2 Marks)

10. Show that the expected number of failiures proceeding the first success in a series of Bernoulian trails with a constant probability of success p is $\frac{1-p}{p}$. (3 Marks)

11. A distribution function is defined as

$$F(x) = \begin{cases} 0 & , x \leq 1 \\ \frac{1}{16}(x-1)^4, & 1 \leq x \leq 3, \\ 1 & , x > 3. \end{cases}$$

Find the density function and the mean of X. (3 Marks)

12. (a) Define moments and moments generating function.

(b) Show that if a random variable X has the probability density $f(x) = \frac{1}{2}e^{-|x|}$ for $-\infty < x < \infty$ then its moment generating function is given by $M_X(t) = \frac{1}{1-t^2}$. Hence, find mean and variance of X. (5 Marks)

13. Define stochastic process. Write a note on the general classification of stochastic process. (2 Marks)

$(a+b)^3 = a^3+b^3+3a^2b+3ab^2$

$(x-1)^3 = x^3-1+3x^2(-1)+3x(1)$

$= x^3-1-3x^2+3x$

$\frac{A}{1+t} + \frac{B}{1-t}$

$A(1-t)+B(1+t) = 1$

$A-At+B+Bt = 1$

$A+B=1$

$-At+Bt=0$

David

Roll No.:.................... Name:........................

National Institute of Technology Calicut

Department of Mathematics

MA6003D, Mathematical Methods for Power Engineering

Interim Test I, Monsoon Semester, September 2018

(Common to High Voltage Engineering, Industrial Power and Automation, Power Electronics, Power Systems)

Time: 1 Hour Max. Marks: 20

ANSWER ALL QUESTIONS

1. (a). Find the matrix A whose eigen values are 1 and 4, whose eigen vectors are (3,1) and (2,1) respectively.

   (b). Find all the eigen values of matrix A, where A is given by

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

(3 Marks)

2. Let S be a non-empty set in a vector space V, then prove that the set of all linear combinations of elements of S forms a subspace of V. (2 Marks)

3. Find a basis and the dimension of the subspace W of $\mathbb{R}^4$, where $W = \{(x, y, z, t) \in \mathbb{R}^4,\ x + 4z + t = 0, x + y + 2z - 4t = 0\}$. (2 Marks)

4. Find the range and kernel of $T : \mathbb{R}^3 \longrightarrow \mathbb{R}^3$ represented by

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 2 \\ 2 & 1 & 3 \end{bmatrix}$$

(3 Marks)

5. Let V be a real vector space with $\{\alpha, \beta, \gamma\}$ as a basis. Prove that the set $\{\alpha+\beta+\gamma, \beta+\gamma, \gamma\}$ is also a basis of V. (2 Marks)

6. Let V and W be vector spaces over a field F. Let $T : V \longrightarrow W$ be a linear mapping, then prove that $I_m T$ is a subspace of W. (2 Marks)

(P.T.O.)

7. Consider following bases of $\mathbf{R}^2$: $S = \{(1,-2),(3,-4)\}$ and $S' = \{(1,3),(3,8)\}$. Find the change of basis matrix $\mathbf{P}$ from S to S' and verify that $\mathbf{Q} = \mathbf{P}^{-1}$, where $\mathbf{Q}$ is the change of basis matrix from S' to S. **(3 Marks)**

8. Let $(\alpha_1, \alpha_2, \alpha_3)$ and (β_1, β_2) be ordered bases of the real vector spaces V and W respectively. A linear mapping $\mathbf{T} : \mathbf{V} \longrightarrow \mathbf{W}$ maps the basis vectors as $T(\alpha_1) = \beta_1 + \beta_2$, $T(\alpha_2) = 3\beta_1 - \beta_2$ and $T(\alpha_3) = \beta_1 + 3\beta_2$. Find the matrix of T relative to the ordered bases

(a). $(\alpha_1, \alpha_2, \alpha_3)$ of V and (β_1, β_2) of W

(b). $(\alpha_1 + \alpha_2, \alpha_2, \alpha_3)$ of V and $(\beta_1, \beta_1 + \beta_2)$ of W. **(3 Marks)**

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

DEPARTMENT OF MATHEMATICS

First Semester M.Tech Interim Test II, October 2016

MA6003 MATHEMATICAL METHODS FOR POWER ENGINEERING

Time: 1 Hour Max. Marks:. 20

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1. Two dice are rolled. Let X denote the random variable which counts the total number of points on the upturned faces.

x	2	3	4	5	6	7	8	9	10	11	12
$P(x)$	1/36	2/36	3/36	4/36	5/36	6/36	5/36	4/36	3/36	2/36	1/36
$F(x)$	1/36	3/36	6/36	10/36	15/36	21/36	26/36	30/36	33/36	35/36	36/36

   (a) Construct a table giving the non zero values of the probability mass function.

   (b) Find the distribution function of X. (2)

2. The diameter of an electric cable, say X, is assumed to be a continuous random variable with probability density function,

   $f(x) = kx(1-x)$, $0 \le x \le 1$.

   (a) Determine the constant k such that $f(x)$ is a valid probability density function. $k=6$

   (b) Compute $P(X \le 0.5)$. 0.5

   (c) Find the mean and variance of X. 0.5, 0.05 (4)

3. The cumulative distribution function of a continuous random variable X is

$$\text{given by } F(x) = \begin{cases} 0, x < -1 \\ \frac{1}{2} + \frac{3}{4}\left(x - \frac{x^3}{3}\right), -1 \le x \le 1 \\ 1, x > 1 \end{cases}$$

$$f(x) \begin{cases} 0 \; ; x < -1 \\ 3/4(1-x^2) \; ; -1 \le x \le 1 \\ 0 \; ; x > 1. \end{cases}$$

Find (a) the probability density function of X. (2)

(b) $P(-0.5 < X < 0.7)$. 0.7829

4. Derive the moment generating function of a random variable having density function $f(x) = \frac{e^{-\lambda}\lambda^x}{x!}$, $x = 0, 1, 2...$
and hence obtain its mean and variance. (3)

5. For any random variable X, show that $V(aX + b) = a^2V(X)$, where a and b are constants. (2)

6. Suppose that two-dimensional continuous random variable (X, Y) has the joint probability density function given by

$$f(x,y) = \begin{cases} ax^2y, 0 < x < 1, 0 < y < 1 \\ 0, \text{elsewhere} \end{cases}$$

(a) Determine the constant a such that ~~$f(x)$~~ $f(x,y)$ is a valid joint probability density function. $a = 6$

(b) Compute $P(X < 0.5, Y < 0.5)$. $(0.5)^5$

(c) Compute $P(X + Y < 1)$.

(d) Find the marginal density function of X and Y. $g(x) = \frac{6x^2}{2}$, $h(y) = 2y$.

(e) Examine whether they are independent. (5)

7. Define stochastic process and explain the classification of general stochastic process. (2)

NATIONAL INSTITUTE OF TECHNOLOGY - CALICUT

MA6003D - Mathematical methods for Power Engineering

Second Interim Test

1

M Tech., Power System, H V E, Power Engineering, IPA

Date: 05-10-2018,

Max Marks: 20

Time: 7:45 AM to 8:45 AM

ANSWER ALL THE QUESTIONS

1. The manager of an oil refinery must decide on the optimum mix of two possible blending process of which the inputs and outputs production run are as shown below:

Process	Input		Output	
	Crude A	Crude B	Gasoline X	Gasoline B
1	6	4	6	9
2	5	6	5	5

The maximum amounts available of crude A and B are 250 units and 200 units respectively. market demand shows that at least 15 units of gasoline X and 130 units of gasoline Y must be produced. The profit per production run from process 1 and 2 are Rs 4 and Rs 5 respectively. Formulate an appropriate linear programming problem for maximizing profit. **(2 marks)**

2. Use simplex method to solve the following linear programming problem (L.P.P)

Maximize $Z = x_1 + 2x_2$ subject to **(4 marks)**

$x_1 = 14$
$x_2 = 11$
$S_1 = 0$
$S_2 = 4$
$Max(z) = 36$

$$\begin{aligned} -x_1 + 2x_2 &\leq 8 \\ x_1 + 2x_2 &\leq 12 \\ x_1 - x_2 &\leq 3 \\ x_1,\, x_2 &\geq 0 \end{aligned}$$

3. Obtain the dual of the following L.P.P. **(4 marks)**

a) Maximize $Z = x_1 - 2x_2 + 3x_3$ subject to

$$\begin{aligned} -2x_1 + x_2 + 3x_3 &= 2 \\ 2x_1 + 3x_2 + 4x_3 &= 1 \\ x_1,\, x_2,\, x_3 &\geq 0 \end{aligned}$$

b) Minimize $Z = x_1 - 3x_2 - 2x_3$ subject to

$$\begin{aligned} 3x_1 - x_2 + 2x_3 &\leq 7 \\ 2x_1 - 4x_2 &\geq 12 \\ -4x_1 + 3x_2 + 8x_3 &= 10 \\ x_1,\, x_2 &\geq 0, \text{ } x_3 \text{ is unrestricted} \end{aligned}$$

4. Use dual simplex method to solve the following L.P.P.
Maximize $Z = -2x_1 - 2x_2 - 4x_3$ subject to

(4 marks)

$$\begin{aligned} 2x_1 + 3x_2 + 5x_3 &\geq 2 \\ 3x_1 + x_2 + 7x_3 &\leq 3 \\ x_1 + 4x_2 + 6x_3 &\leq 5 \\ x_1,\ x_2,\ x_3 &\geq 0 \end{aligned}$$

Max $Z = -\frac{4}{3}$
$x_1 = 0$
$x_2 = 2/3$
$x_3 = 0$
$S_1 = 0$
$S_2 = 7/3$, $S_3 = 7/3$

5. Solve the given Non linear programming problem.
Maximize $Z = 3.6x_1 - 0.4x_1^2 + 16x_2 - 0.2x_2^2$ subject to

(2 marks)

$$\begin{aligned} 2x_1 + x_2 &= 10 \\ x_1,\ x_2 &\geq 0 \end{aligned}$$

$x_1 = -8.5$, $x_2 = 27$
226.7

6. Determine x_1, x_2 and x_3 so as to
Maximize $Z = -x_1^2 - x_2^2 - x_3^3 + 4x_1 + 6x_2$ subject to

(4 marks)

$$\begin{aligned} x_1 + x_2 &\leq 2 \\ 2x_1 + 3x_2 &\leq 12 \\ x_1,\ x_2,\ x_3 &\geq 0 \end{aligned}$$

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NATIONAL INSTITUTE OF TECHNOLOGY - CALICUT

MA6003D - Mathematical methods for Power Engineering

End Semester Examination, Monsoon Semester 2018-19

(Common to M.Tech.- Power System, H V E, Power Engineering, IPA)

Time: 3 hours | Max Marks: 50

ANSWER ALL THE QUESTIONS

1. Consider the space $M_2(R)$ of real 2×2 matrices, and define the matrix $B=\begin{pmatrix}1 & 2\\ 0 & 3\end{pmatrix}$. Find the dimension and a basis for the kernel of the linear transformation $T: M_2(R)\to M_2(R)$ defined by $T(A)=AB-BA$. **(3 marks)**

2. Justify your answer for the following questions **(4 marks)**

   a Does there exist a linear transformation $T: R^3\to R^2$ with the property that $T(1,-1,1)=(1,0)$ and $T(1,1,1)=(0,1)$?

   b What is the dimension of the vector space R over the field Q, the set of all rational numbers.

   c Is it possible for the matrix $A=\begin{pmatrix}3 & 1 & 0 & 0\\ -1 & -3 & 0 & 0\\ 0 & 0 & 2 & 1\\ 0 & 0 & 3 & 7\end{pmatrix}$ to have the eigenvalues -1,2,3,and 5?

3. The matrix of a linear transformation $T: R^3\to R^3$ with respect to the ordered basis $\{(0,1,1),(1,0,1),(1,1,0)\}$ of R^3 is given by $\begin{pmatrix}0 & 3 & 0\\ 2 & 3 & -2\\ 2 & -1 & 2\end{pmatrix}$ Find T and its matrix relative to the ordered basis $\{(2,1,1),(1,2,1),(1,1,2)\}$ of R^3. **(3 marks)**

4. A plant manufactures washing machines and dryers. The major manufacturing departments are the stamping department, motor and transmission department, and assembly department. The first two departments produce parts for both the products while the assembly lines are different for the two products. The monthly department capacities are

Department	Washer	Dryer
Stamping	1000	1000
Motor and Transmission	1600	7000
Washer assembly line	9000	0
Dryer assembly line	0	5000

Profit per piece of washer and dryer are Rs 270 and Rs 300 respectively. Formulate Linear Programming model to maximize the profit. (L.P.P) **(2 marks)**

5. Use Duality and simplex method to solve the following linear programming problem (L.P.P) **(4 marks)**

Minimize $Z = x_1 + x_2$ subject to

$$\begin{aligned} 0.12x_1 + 0.04x_2 &\geq 600 \\ 0.1x_1 + 0.4x_2 &\geq 1000 \\ x_1,\, x_2 &\geq 0 \end{aligned}$$

6. Use dual simplex method to solve the following L.P.P.
Minimize $Z = 10x_1 + 6x_2 + 2x_3$ subject to **(4 marks)**

$$\begin{aligned} -x_1 + x_2 + x_3 &\geq 1 \\ 3x_1 + x_2 - x_3 &\geq 2 \\ x_1,\, x_2,\, x_3 &\geq 0 \end{aligned}$$

$x_1 = 3/4$
$x_2 = 7/4$
Min = -18

7. Minimize $f(x) = 4x^3 + x^2 - 7x + 14$ in the interval $[0, 1]$ using Golden section method. **(4 marks)**

8. Obtain the necessary and sufficient conditions for the optimal solution of the following problem using Lagrange's method. **(2 marks)**
Maximize $Z = 3e^{5x_1+2} + e^{2x_2+4}$ subject to $x_1 + x_2 = 6,\ x_1,\, x_2 \geq 0.$

9. Use the Kuhn-Tucker conditions to solve the following non-linear programming problem. **(4 marks)**

Maximize $Z = 2x_1 + x_1^2 + x_2$ subject to

$$\begin{aligned} 2x_1 + 3x_2 &\leq 6 \\ 2x_1 + x_2 &\leq 4 \\ x_1,\, x_2 &\geq 0 \end{aligned}$$

10. Let X and Y be independent random variables with the same density function

$$f(x) = \begin{cases} c(2-x), & 0<x<1; \\ 0, & \text{otherwise.} \end{cases}$$

(i) Determine the constant c. (ii) Compute $P(Y \leq 2X)$. **(3 marks)**

c=2/3

11. A joint probability mass function of X and Y is given by the following table. **(3 marks)**

X \Y	0	1	2	3
0	1/32	2/32	1/32	0
1	2/32	5/32	4/32	1/32
2	1/32	4/32	5/32	2/32
3	0	1/32	2/32	1/32

(i) Are X and Y independent? Give reasons.

(ii) Compute the conditional probability $P(X \geq 2 | X \geq Y)$

12. Assume that in a box there are five items in which two are defective. Draw the items one by one and inspect to defective. Let X be the number of inspections needed to find the first defective item and Y the number of additional inspections needed to find the second defective item. Find the joint probability mass function of X and Y. **(3 marks)**

13. Roll a die and then toss as many coins as shown up on the die. Compute the expected number of heads. **(3 marks)**

14. If the density function of a continuous random variable X is given by **(3 marks)**

$$f(x) = \begin{cases} ax, & 0 \leq x \leq 1; \\ a, & 1 \leq x \leq 2; \\ 3a - ax, & 2 \leq x \leq 3; \\ 0, & \text{elsewhere.} \end{cases}$$

(i) Find the constant a. (ii) Find the cumulative distribution function of X.

15. Let the moments of a discrete random variable X be given by $E[x^k] = 0.2^k$, $k = 1, 2, 3 \cdots$ Find the moment generating function of X. **(2 marks)**

16. Define and classify the random process with suitable example. **(3 marks)**

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NATIONAL INSTITUTE OF TECHNOLOGY - CALICUT
MA6003D - Mathematical Methods for Power Engineering
Mid-Term Test

Max Marks: 30

M Tech., Power System, II V E, Power Engineering, IPA

ANSWER ALL THE QUESTIONS

1 Let $V = M_{2\times2}(R)$, and W_1, W_2 be the subspaces of V. $W_1 = \left\{\begin{pmatrix} a & b \\ c & a \end{pmatrix} \in V, a, b, c \in R\right\}$ and $W_2 = \left\{\begin{pmatrix} 0 & a \\ -a & b \end{pmatrix} \in V, a, b \in R\right\}$. Find the dimension of $W_1 \cap W_2$. **(2 marks)**

2 Is there a linear transformation $T : R^3 \to R^2$ such that $T(1,0,3) = (1,1)$ and $T(-2,0,-6) = (2,1)$?. Justify your answer. **(1 mark)**

3 Let $T : P_2(R) \to P_2(R)$ be a linear transformation such that $T(f(x)) = xf'(x) + f(2)x + f(3)$. Find the matrix representation of T with respect to basis $\{1, x, x^2\}$ and $\{1, 1+x, 1+x^2\}$. **(2 marks)**

4 Let $T : P_2(R) \to R$ be a linear transformation defined by $T(f(x)) = \int_0^1 f(x)dx$. Find a basis for the null space(T) and also verify the Rank-Nullity theorem. **(3 marks)**

5 Find all the eigenvectors of the matrix $\begin{pmatrix} 1 & 1 \\ 4 & 1 \end{pmatrix}$ **(3 marks)**

6 Let $T : V \to W$ be a one-one linear transformation. Prove that if $\{x_1, x_2, \ldots, x_n\}$ is a linearly independent set, then $\{T(x_1), T(x_2), \ldots, T(x_n)\}$ is also a linearly independent set. **(2 marks)**

7 Find the change of basis matrix P from the standard basis E of R^2 to a basis S and the coordinates of $v = (a, b)$ relative to basis $S = \{(1,2),(3,5)\}$. **(2 marks)**

8 A factory manufactures two products A and B. To manufacture one unit of A, 1.5 machine hours and 2.5 labour hours are required. To manufacture B, 2.5 machine hours and 1.5 labour hours are needed. In a month 300 machine hours and 240 labours are available. Profit/unit for A is Rs.50 and that of B is Rs.40. Formulate a linear programming problem which maximizes the profit and solve it using graphical method. **(3 marks)**

9 Use simplex method to solve the following linear programming problem (L.P.P)

Maximize $Z = 11x_1 + 16x_2 + 15x_3$ subject to

$$\begin{aligned} x_1 + 2x_2 + \tfrac{3}{2}x_3 &\leq 12000 \\ \tfrac{2}{3}x_1 + \tfrac{2}{3}x_2 + x_3 &\leq 4600 \\ \tfrac{1}{2}x_1 + \tfrac{1}{3}x_2 + \tfrac{1}{2}x_3 &\leq 2400 \\ x_1,\ x_2, x_3 &\geq 0 \end{aligned}$$

(5 marks)

10 Obtain the dual of the following LPP:

$$\text{Maximize } Z = 5x_1 + 6x_2 - 7x_3 \text{ subject to}$$

$$\begin{aligned}
3x_1 + x_2 &\leq 5 \\
4x_1 - x_2 + x_3 &\leq 3 \\
x_1 + x_2 + x_3 &= 5 \\
x_1, x_3 &\geq 0, x_2 \text{ is unrestricted.}
\end{aligned}$$

(2 marks)

11 Use dual simplex method to solve the following L.P.P.

$$\text{Maximize } Z = -2x_1 - x_2 \text{ subject to}$$

$$\begin{aligned}
-3x_1 - x_2 &\leq -3 \\
-4x_1 - 3x_2 &\leq -6 \\
-x_1 - 2x_2 &\leq -3 \\
x_1, x_2 &\geq 0
\end{aligned}$$

(5 marks)

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KOH

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

DEPARTMENT OF MATHEMATICS

M.Tech. (First Semester) End Semester Examination, November 2016

MA6003 Mathematical Methods for Power Engineering

Duration : 3 hrs. Max Marks: 50

Answer all the questions

1. Determine the linear transformation $T : \mathbb{R}^3 \to \mathbb{R}^4$ that maps the basis vectors $(0,1,1)$, $(1,0,1), (1,1,0)$ of $\mathbb{R}^3$ to the vectors $(0,1,1,1), (1,0,1,1), (1,1,0,1)$ of $\mathbb{R}^4$ respectively. (3)

2. Let $F : \mathbb{R}^3 \to \mathbb{R}^3$ be a linear mapping defined by

$$F(x,y,z) = (x+2y-z, y+z, x+y-2z)$$

Find a basis and dimension of (2)

(a) the range of F, (1)

(b) the kernel of F, (1)

(c) and verify Rank-Nullity theorem.

3. Consider the following bases of $\mathbb{R}^2$

$$S = \{(1,-2),(3,-4)\}\ ,\ S' = \{(1,3),(3,8)\}$$

(a) Find the transition matrix P from S to S'. (1)

(b) Find the transition matrix Q from S' to S. (1)

(c) Verify that $Q = P^{-1}$. (1)

4. A company makes two kinds of leather belts A and B where A is a high quality belt, and B is of lower quality. The respective profits are Rs 40 and Rs 30 per belt. The supply of leather is sufficient for only 800 belts per day (both A and B combined). Belt A requires a fancy buckle, and only 400 per day are available. There are only 700 buckles a day available for belt B. Formulate the linear programming problem to determine the daily production of each type of belt? (3)

5. Solve the following linear programming problem by using Big - M method.

$$\text{Maximize } z = 3x_1 - x_2$$

subject to the constraints

$$\begin{aligned} 2x_1 + x_2 &\geqslant 2 \\ x_1 + 3x_2 &\leqslant 3 \\ x_2 &\leqslant 4 \\ x_1, x_2 &\geqslant 0. \end{aligned}$$

(5)

6. Solve the following linear programming problem by using Simplex Method.

$$\text{Minimize } z = x_1 - 3x_2 + 2x_3$$

subject to the constraints

$$\begin{aligned} 3x_1 - x_2 + 2x_3 &\leqslant 7 \\ -2x_1 + 4x_2 &\leqslant 12 \\ -4x_1 + 3x_2 + 8x_3 &\leqslant 10 \\ x_1, x_2, x_3 &\geqslant 0. \end{aligned}$$

(5)

7. Form the dual of the following primal problem.

$$\text{Minimize } z = 4x_1 + 5x_2 - 3x_3$$

subject to the constraints

$$\begin{aligned} x_1 + x_2 + x_3 &= 22 \\ 3x_1 + 5x_2 - 2x_3 &\leq 65 \\ x_1 + 7x_2 + 4x_3 &\geq 120 \end{aligned}$$

$x_1, x_2 \geqslant 0$ and x_3 unrestricted in sign.

(3)

8. Solve the following nonlinear programming problem by golden section method.
Max $f(x) = x\sin 4x$, $2.75 \leq x \leq 3$ and $\epsilon = 0.01$. (5)

9. Solve the following non-linear programming problem using Lagrange's multiplier

$$\text{Minimize } z = x_1 + x_2 + x_3$$

subject to the constraints

$$\begin{aligned} x_1^2 + x_2 &= 3 \\ x_1 + 3x_2 + 2x_3 &= 7 \\ x_1, x_2, x_3 &\geq 0. \end{aligned}$$

$x_1 = -1/2$, $x_2 = 11/4$
$x_3 = 31/8$
$\lambda_1 = +1/2$, $\lambda_2 = 1/2$

(4)

10. Use KKT condition to derive an optimal solution to the nonlinear constrained optimization problem

$$\text{Minimize } z = x_1^2 + x_2^2$$

subject to the constraints:

$$2x_1 + x_2 \leq 2$$
$$x_1, x_2 \geqslant 0.$$

(4)

11. The life in hours of a certain radio tube has the probability density function given by

$$f(x) = \begin{cases} \frac{100}{x^2}, & \text{for } x > 100 \\ 0, & \text{for } x \leq 100 \end{cases}$$

Find

(a) the distribution function $F(x)$. (1)

(b) the probability that none of three such tubes in a given radio tube will have to be replaced during the first 150 hours. (1)

(c) the probability that all the three original tubes would have been replaced during the first 150 hours. (1)

12. The distribution of a continuous random variable X has a p.d.f. $f(x) = 3x^2, 0 \leq x \leq 1$. Find a and b such that

(a) $P(X \leq a) = P(X > a)$ (1)

(b) $P(X > b) = 0.05$ (1)

13. A continuous distribution of a random variable X is defined by

$$f(x) = \begin{cases} \frac{1}{16}(3+x)^2, & -3 \leq x \leq -1 \\ \frac{1}{16}(6-2x^2), & -1 \leq x \leq 1 \\ \frac{1}{16}(3-x)^2, & 1 \leq x \leq 3 \end{cases}$$

Verify that the area under the curve is unity. Show that the mean is zero. (3)

14. The joint p.d.f. of two random variables X and Y is given by :

$$f(x,y) = \frac{9(1+x+y)}{2(1+x)^4(1+y)^4}, 0 \leq x < \infty, 0 \leq y < \infty$$

Find the marginal distributions of X and Y, and the conditional distribution of Y for $X = x$. (3)

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$\frac{1}{s\omega^2+}$ $\frac{-j\omega}{(\omega^2+}$

EED/TKS/300919

National Institute of Technology Calicut
Department of Electrical Engineering
Monsoon Semester 2019-20
Mid Term Test Series, September-October 2019

Roll No..........

EE 6403D Computer Controlled System

Time: 90 min (Answers all questions) Max. Marks: 30

1. The loop gain matrix for a two-input, two output system is:

$$L(s)=\begin{bmatrix} \frac{1}{s+2} & -\frac{1}{s+1} \\ \frac{1}{2(s+2)} & \frac{1}{s(s+1)} \end{bmatrix}$$

(a) Calculate sensitivity and complementary sensitivity transfer function matrices. (3 Marks)

(b) Compute largest and smallest singular values of L(s) in dB at frequency 0.5 rad/sec. (3 Marks)

(c) Compute largest and smallest singular values of $L^{-1}(s)$ in dB at frequency 0.5 rad/sec. (2 Marks)

2. State the properties of singular values (3 marks)

3. Explain the concept of large and small loop gain in a MIMO system. (3 Marks)

4. Define Frobenius norm of a matrix and obtain Frobenius norm for following matrix: (3 Marks)

$$A=\begin{bmatrix} -2 & 3 & 4 \\ 1 & 4 & 3 \\ 3 & 2 & 5 \end{bmatrix}$$

5. Calculate H_2 norm of G(s) : (3 Marks)

$$G(s)=\frac{1}{s^2+9s+20}\begin{bmatrix} (s+2) & -(s+1) \\ -2s & (s+3) \end{bmatrix}$$ $\Rightarrow L_2$ norm

the form given

6. A minimal realization for a transfer function matrix G(s), is given as:

$$\begin{bmatrix} \frac{d}{dt}x_1 \\ \frac{d}{dt}x_2 \end{bmatrix}=\begin{bmatrix} 0 & 1 \\ -5 & -6 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}+\begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix}=\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

compute H_2 norm of G(s). (4 Marks)

7 If

$$M = \begin{bmatrix} A & BB^T \\ -C^T C & -A^T \end{bmatrix}$$

where (A , B, C) is a state space realization of a strictly proper transfer function matrix, G(s), then proof following relation: (3 Marks)

$$\left[I - G^T(-s)G(s)\right]^{-1} = I + \begin{bmatrix} 0 & B^T \end{bmatrix}(sI - M)^{-1}\begin{bmatrix} B \\ 0 \end{bmatrix}$$

8. State and explain the importance of Parseval's theorem (3 marks)

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EED/TKS/140918

Roll No...........

National Institute of Technology Calicut
Department of Electrical Engineering
Monsoon Semester 2018-19
First Test Series, September 2018

EE 6403D Computer Controlled System

Time: 1 Hour

(Answers all questions)

Max. Marks: 15

1. The loop gain matrix for a two-input, two output system is:

$$L(s)=\begin{bmatrix}\frac{1}{s+1}, & -\frac{2}{s+1}\\ \frac{1}{2(s+2)} & \frac{1}{s(s+2)}\end{bmatrix}$$

(a) Calculate sensitivity and complementary sensitivity transfer function matrices. (2 Marks)

8 (b) Compute largest and smallest singular values of L(s) in dB at frequency 0.5 rad/sec. (3 Marks)

2. Calculate L_2 norm of G(s) : (2 Marks)

$$G(s)=\frac{1}{s^2+2s+1}\begin{bmatrix}s+1 & -s\\ -2s & s(s+1)\end{bmatrix}$$

3. A minimal realization for a transfer function G(s), is given as:

$$\dot{x}=\begin{bmatrix}0 & 1\\ -5 & -6\end{bmatrix}x+\begin{bmatrix}1 & -1\\ 0 & 1\end{bmatrix}u$$

$$y=\begin{bmatrix}1 & 0\end{bmatrix}x$$

compute H_2 norm of G(s). (3 Marks)

$\max \|A\|_F = \sum_{i} \sum_{j} \|A_{ij}\|^2$

4. Define Frobenius norm of a matrix. (2 Marks)

5. If a system (A, B, C) is stabilizable and detectable, proof that the realization equation given by:

$$\begin{bmatrix}\frac{d}{dt}x_1\\ \frac{d}{dt}x_2\end{bmatrix}=\begin{bmatrix}A & BB^T\\ -C^TC & -A^T\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}B\\ 0\end{bmatrix}u$$

$$y=u+\begin{bmatrix}0 & B^T\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

may not have un-observerable or uncontrollable modes on the j-axis. (3 Marks)

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EED/TKS/161018

National Institute of Technology Calicut
Department of Electrical Engineering
Monsoon Semester 2018-19
Second Test Series, October 2018

Roll No...........

EE 6403D Computer Controlled System

Time: 1 Hour

(Answers all questions)

Max. Marks: 15

1. Obtain augmented state space representation for a system, represented by block diagram in Figure-1, taking error signal e(t) as measured output. Given:

$$P(s)=\frac{1}{s^2+3s+4};\quad H(s)=\frac{s+2}{s(s+10)};\quad W_1(s)=\frac{s+1}{s(s+5)};\quad W_2(s)=\frac{1}{s+1};\quad W_3(s)=\frac{s+4}{s^2+4s+5}$$

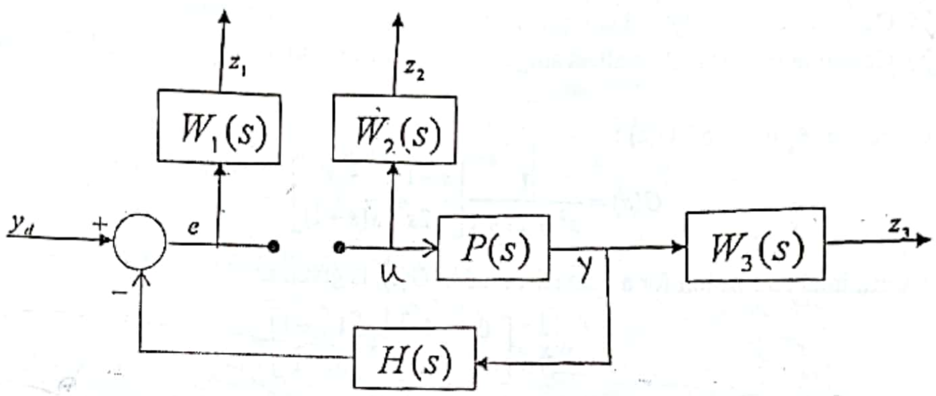

Figure-1

(3 Marks)

2. Explain the following ways of representing uncertainty in system with block diagrams:
   a. Multiplicative uncertainty referred to input
   b. Multiplicative uncertainty referred to output
   c. Additive uncertainty

(3 Marks)

3. For a system with state space realization given as:

$$\dot{x}=Ax+B_1w+B_2u$$
$$z=C_1x+D_{11}w+D_{12}u$$
$$y=C_2x+D_{21}w+D_{22}u$$

Mention assumptions, with reasons, required for obtaining H_2 solution in a form of standard linear quadratic (LQ) problem setup.

(2 Marks)

4. Mention basic functions carried out by a SCADA system and explain block schematic representation of a SCADA system

(4 Marks)

5. Explain channel scanning process in a SCADA system.

(3 Marks)

****

EED/TKS/140918

National Institute of Technology Calicut
Department of Electrical Engineering
Monsoon Semester 2018-19
First Test Series, September 2018

Roll No...........

EE 6403D Computer Controlled System

Time: 1 Hour | (Answers all questions) | Max. Marks: 15

1. The loop gain matrix for a two-input, two output system is:

$$L(s)=\begin{bmatrix}\dfrac{1}{s+1} & -\dfrac{2}{s+1}\\ \dfrac{1}{2(s+2)} & \dfrac{1}{s(s+2)}\end{bmatrix}$$

(a) Calculate sensitivity and complementary sensitivity transfer function matrices. (2 Marks)

(b) Compute largest and smallest singular values of L(s) in dB at frequency 0.5 rad/sec. (3 Marks)

2. Calculate L_2 norm of G(s) : (2 Marks)

$$G(s)=\frac{1}{s^2+2s+1}\begin{bmatrix}s+1 & -s\\ -2s & s(s+1)\end{bmatrix}$$

3. A minimal realization for a transfer function G(s), is given as:

$$\dot{x}=\begin{bmatrix}0 & 1\\ -5 & -6\end{bmatrix}x+\begin{bmatrix}1 & -1\\ 0 & 1\end{bmatrix}u$$

$$y=\begin{bmatrix}1 & 0\end{bmatrix}x$$

compute H_2 norm of G(s). (3 Marks)

3. Define Frobenius norm of a matrix. (2 Marks)

4. If a system (A, B, C) is stabilizable and detectable, proof that the realization equation given by:

$$\begin{bmatrix}\dfrac{d}{dt}x_1\\ \dfrac{d}{dt}x_2\end{bmatrix}=\begin{bmatrix}A & BB^T\\ -C^TC & -A^T\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}B\\ 0\end{bmatrix}u$$

$$y=u+\begin{bmatrix}0 & B^T\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

may not have un-observerable or uncontrollable modes on the j-axis. (3 Marks)

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If matrix is defined

$$M=\begin{bmatrix}A & BB^T\\ -C^TC & -A^T\end{bmatrix}$$

A,B,C realization & [illegible] property G(s)

$$\left(I-G^T(-s)G(s)\right)^{-1}=I+\begin{bmatrix}0 & B^T\end{bmatrix}(sI-M)^{-1}\begin{bmatrix}B\\ 0\end{bmatrix}$$

EED/TKS/161018

Roll No...........

National Institute of Technology Calicut
Department of Electrical Engineering
Monsoon Semester 2018-19
Second Test Series, October 2018

EE 6403D Computer Controlled System

Time: 1 Hour

(Answers all questions)

Max. Marks: 15

1. Obtain augmented state space representation for a system, represented by block diagram in Figure-1, taking error signal e(t) as measured output. Given:

$$P(s)=\frac{1}{s^2+3s+4};\quad H(s)=\frac{s+2}{s(s+10)};\quad W_1(s)=\frac{s+1}{s(s+5)};\quad W_2(s)=\frac{1}{s+1};\quad W_3(s)=\frac{s+4}{s^2+4s+5}$$

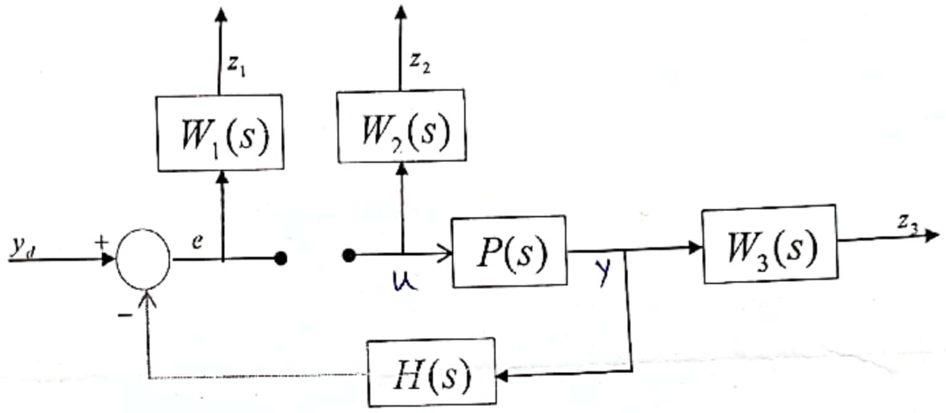

Figure-1

(3 Marks)

2. Explain the following ways of representing uncertainty in system with block diagrams:
   a. Multiplicative uncertainty referred to input
   b. Multiplicative uncertainty referred to output
   c. Additive uncertainty

(3 Marks)

3. For a system with state space realization given as:

$$x = Ax + B_1 w + B_2 u$$
$$z = C_1 x + D_{11} w + D_{12} u$$
$$y = C_2 x + D_{21} w + D_{22} u$$

Mention assumptions, with reasons, required for obtaining H_2 solution in a form of standard linear quadratic (LQ) problem setup. (2 Marks)

4. Mention basic functions carried out by a SCADA system and explain block schematic representation of a SCADA system (4 Marks)

5. Explain channel scanning process in a SCADA system. (3 Marks)

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EED/TKS/300919

National Institute of Technology Calicut
Department of Electrical Engineering
Monsoon Semester 2019-20
Mid Term Test Series, September-October 2019

Roll No............

EE 6403D Computer Controlled System

Time: 90 min (Answers all questions) Max. Marks: 30

1. The loop gain matrix for a two-input, two output system is:

$$L(s)=\begin{bmatrix} \frac{1}{s+2} & -\frac{1}{s+1} \\ \frac{1}{2(s+2)} & \frac{1}{s(s+1)} \end{bmatrix}$$

(a) Calculate sensitivity and complementary sensitivity transfer function matrices. (3 Marks)

(b) Compute largest and smallest singular values of L(s) in dB at frequency 0.5 rad/sec. (3 Marks)

(c) Compute largest and smallest singular values of $L^{-1}(s)$ in dB at frequency 0.5 rad/sec. (2 Marks)

2. State the properties of singular values (3 marks)

3. Explain the concept of large and small loop gain in a MIMO system. (3 Marks)

4. Define Frobenius norm of a matrix and obtain Frobenius norm for following matrix: (3 Marks)

$$A=\begin{bmatrix} -2 & 3 & 4 \\ 1 & 4 & 3 \\ 3 & 2 & 5 \end{bmatrix}$$

5. Calculate H_2 norm of G(s): (3 Marks)

$$G(s)=\frac{1}{s^2+9s+20}\begin{bmatrix} (s+2) & -(s+1) \\ -2s & (s+3) \end{bmatrix}$$

6. A minimal realization for a transfer function matrix G(s), is given as:

$$\begin{bmatrix} \frac{d}{dt}x_1 \\ \frac{d}{dt}x_2 \end{bmatrix}=\begin{bmatrix} 0 & 1 \\ -5 & -6 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}+\begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} u_1 \\ u_2 \end{bmatrix}$$

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix}=\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

compute H_2 norm of G(s). (4 Marks)

7. If

$$M = \begin{bmatrix} A & BB^T \\ -C^TC & -A^T \end{bmatrix}$$

where (A , B, C) is a state space realization of a strictly proper transfer function matrix, G(s), then proof following relation: (3 Marks)

$$\left[I - G^T(-s)G(s)\right]^{-1} = I + \begin{bmatrix} 0 & B^T \end{bmatrix}(sI - M)^{-1}\begin{bmatrix} B \\ 0 \end{bmatrix}$$

8. State and explain the importance of Parseval's theorem (3 marks)

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Parseval's theorem

EED/TKS/201119

National Institute of Technology Calicut
Department of Electrical Engineering
Monsoon Semester 2019-20
End Term Examination, November 2019

Roll No...........

EE 6403D Computer Controlled System

Time: 3 Hour

(Answers all questions)

Max. Marks: 40

1). If a system, having state space representation of (A, B, C), be stabilizable and detectable. Proof that the realization equation:

$$\begin{bmatrix} \frac{d}{dt}x_1 \\ \frac{d}{dt}x_2 \end{bmatrix} = \begin{bmatrix} A & BB^T \\ -C^TC & -A^T \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} B \\ 0 \end{bmatrix}u$$

$$y = u + \begin{bmatrix} 0 & B^T \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

may not have un-observerable or uncontrollable modes on the imaginary axis of s-plane. (4 Marks)

2). Obtain a augmented state space representation for system, whose block representation is shown in Fig 1, where individual transfer functions are given as: (4 Marks)

$$P(s) = \frac{1}{s^2 + 0.2s + 1}; \quad W_1(s) = \frac{s+1}{s(s+10)}; \quad W_2(s) = 1; \quad W_3(s) = \frac{s+2}{s^2 + 3s + 2}$$

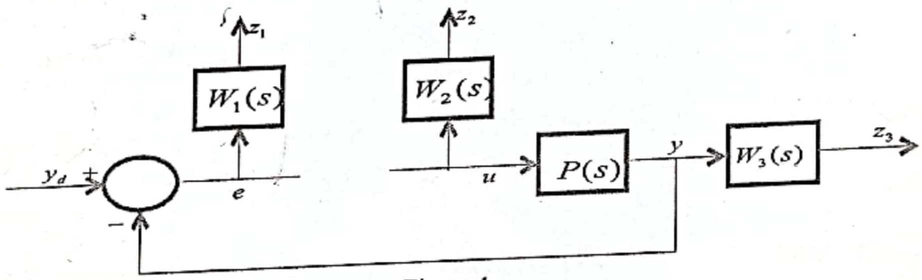

Figure 1

3). Obtain transfer function matrix G(s) in standard feedback representation with as given in Fig. (2b) for a closed loop system, given in Fig. (2a). (4 Marks)

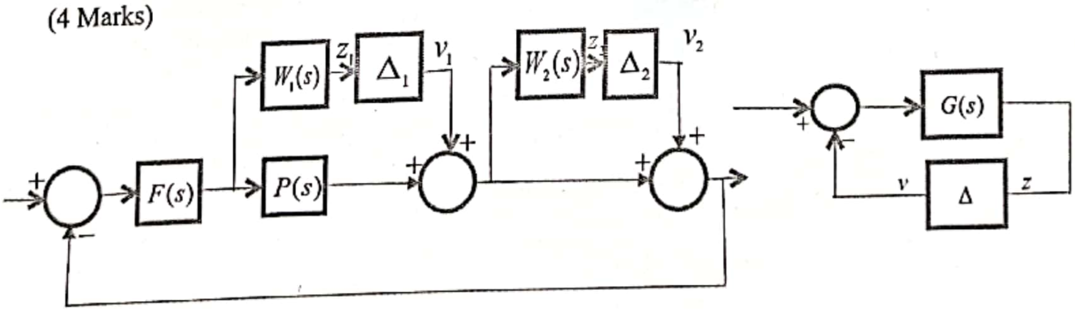

Figure 2a

Figure 2b

5). Explain, with neat diagram, lay out of programmable logic controller (3 Marks)

6). Construct a ladder diagram to implement following Boolean expressions: (2 Marks)

$AB\bar{C}\bar{D} + \bar{A}B\bar{C}D + A\bar{B}C + \bar{B}\bar{C}D$

7). Explain process of conversion to engineering units. Obtain conversion factor for an 8 bit ADC having input range of 0-5 V in unipolar mode, if upper and lower limit of a measured signal from transducer are 510 and zero respectively. (4 Marks)

8). Explain three special software facilitates required in a remote terminal unit to be used in a distributed control system. (3 Marks)

9).Explain interfacing of SCADA systems with central computer in star and daisy chain configurations with diagram. (3 Marks)

10) Explain the configuration of a distributed SCADA system with a diagram. (3 Marks)

11) Explain the process of channel scanning carried in a SCADA system example and flowcharts.

(3 Marks)

$B+A\bar{B}$

$(B+A)(B+\bar{B})$

12).Explain objective and lay-out of distributed control system, giving the details regarding following terminology associated with it: (a) Control network (b) Protocols used. (4 Marks)

13). Explain independent processes of a real-time system with diagram with examples. (3 Marks)

****

$AB\bar{C}\bar{D} + A\bar{B}C + \bar{B}\bar{C}D[\bar{A}+1]$

$\Rightarrow AB\bar{C}\bar{D} + A\bar{B}C + \bar{B}\bar{C}D$

LAN

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Name ....P. Nagamani................

Reg. No.....M190436EE..................

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

M.TECH. DEGREE EXAMINATIONS NOVEMBER 2019

EE 6401D ENERGY AUDITING & MANAGEMENT

Time: Three Hours   Maximum: 50 Marks

Answer all questions

Make assumptions wherever necessary with justifications

1. Answer briefly in a word or one or two sentences (10x1= 10 marks)
   a) Write 2 advantages of IRR method over SPP
   b) Discount rate in techno-economic studies reflects------
   c) LED lamps are less polluting than CFL lamps. Why?
   d) Energy efficient motors will have air gaps in the order of --- 2-3 mm
   e) Is it true that TOU tariff reduces energy consumption?
   f) Flat belt is preferred for power transmission because ----
   g) Discuss the effect of voltage on power factor improving capacitors.
   h) Write 2 methods of energy saving in blowers
   i) Specific energy consumption analysis is used as -----
   j) Loss load factor in a distribution system refers to ----

2. a) In a steel process industry with 3 identical electric arc furnaces each with maximum capacity 3 T/h, have the energy consumption – production data as follows;

Sl no.	1	2	3	4	5	6	7
MWh	2.8	3.4	4.02	5.87	3.86	5.2	3.21
Production (T/h)	2.47	3.78	5.94	8.32	4.55	7.25	3.00

a = -2.836
b = 1.9453
r = 0.979
r^2 = 0.950

Comment on the energy consumption and suggest conservation measures. If the production requirement remains constant at 75% of the total capacity. (8 Marks)

(2 marks)

b) Write short notes any two:

a) Delamping & relamping   b) End user efficiency   c) Energy star programme

3. a) Discuss the significance of piping in energy conservation (2 marks)

b) A chemical plant operates a cooling water pump for 14 hours/day for process pumping with following parameters: Direct coupled motor- 50 kW,1450 rpm, 440 V, 50 Hz, automatic star-delta starter. Centrifugal Pump rated: 50 m head, 200 m^3/h, 250 mm diameter Impeller, 1450 rpm.

Efficiency-output characteristics: Pump efficiency = $-0.008 (Q^2) + 1.49 (Q)$; Motor efficiency = $-0.01 (P^2) + 1.5 (P)$. The required process flow (Q): 120 m^3 / h for 3 hours, 100 m^3 / h for 5 hours and 80 m^3 / h for 6 hours is now controlled by valve; Static system head 20m. Suggest energy saving opportunities with justification. (6 marks)

Is there in change in the suggestion if the process flow requirement is constant at 50 m^3 /h?

(2 marks)

4. a) Discuss the significance of electronic ballast in the life of lighting sources (2 marks)

b) Evaluate the economics of replacing 60 W incandescent lamp by Fluorescent or LED lamps for 8 hours of daily operation in street lighting application for a municipality. Electricity cost: Rs 5/kWh; Efficacy: incandescent lamp – 12 lumens / Watt, CFL – 54 lumens / Watt, FTL – 50 lumens / Watt. LED- 60 lumens/watt; Cost & life: 15 W CFL – with electronic ballast Rs 180/-, 8000 burning hours, 36 W FTL tube with electronic ballast Rs 150/-, 5000 burning hours for FTL and 1 year warranty for electronic ballast , 15 W LED with driver circuit- Rs 240/-,50000 hours; FTL fitting costs - Rs 650/- and LED fitting costs Rs 1120/-. There are 750 lamps in the area. (8 marks)

5. a) Discuss the standards/bench level of solar water heater system? (2 marks)

b) Workout the feasibility of (1) Steam generator or (2) Solar water heater for a textile industry with following water requirement: 1000 lit/day at 70° C for preheating and 2700 lit/day at 80 ° C for bleaching. At present, storage electric heating is used (Rs 5/ kWh) with 93% efficiency. Steam generator - fuel: LSHS- NCV 9400 kcal/kg, cost Rs 10400/MT, operating efficiency of boiler 75%. Average solar radiation for 8 months: 5.1 kWh/sqm. Cost of 2X1 m standard panel: Rs 14800/-. Piping/installation/ accessories:40% extra. ~~40~~40% additional cost. SWH efficiency 40%. No subsidy.

(8 marks)

Name: ....

Roll No: ....

DEPARTMENT OF ELECTRICAL ENGINEERING

I M TECH, MIDF SEMESTER EXAMINATION, Monsoon Semester 2019

EE6410D Energy Auditing & Management

Time: 90 Minutes **Maximum: 50 Marks**

Answer all questions, Assumptions shall be made wherever necessary with justifications

Appropriate weightage of marks will be considered in the semester assessment

Part A

10 X 1 = 10 Marks

1. What is meant by "balance of payments" under national economic policy?
2. Discuss two examples of impact of local pollution on energy consumption.
3. How DSM differ from SSM?
4. How 'scarcity of energy' reflected to the end user?
5. What is meant by flared energy?
6. How frequent energy audit is preferred in an industry?
7. Discuss drawbacks of SPP method?
8. Distinguish between the terms implicit discount and explicit discount.
9. Explain the impact of leading pf for an industry.
10. Give the reasons for TOU tariff rates by utility companies.

Part B

4 X 10 = 40 Marks

11. Evaluate the economics of replacing a 100W incandescent bulb working 6hours average/day for street lighting by a municipality (D=10%) , when fused with different options below:

    100 W new incandescent bulb- Rs 15, 1000 burning hours, 12 lumens/watt
    40W LED bulb built-in ballast - Rs 400, 40000 burning hours, 45 lumens/watt
    40W FTL- Rs 40 (tube), Rs 200 (fitting), Rs 60 (e- ballast), 5000 burning hours for tube, 1 year warranty for e-ballast, 60 lumens/watt
    Tarff rate: Rs 5/kWh.

12 An industry with a load demand of 1.2 MW working in 2 shifts for 25 days/month has 2 options from electric utility company for supply:

    HT – Rs 200/kW/month +Rs 3/kWh
    LT- Rs 300/kW/month + Rs 6/kWh

    For HT supply, annual share of cost of transformer with switch gear –Rs 300/kW. Losses in transformer & switch gear-4%. Interest & depreciation- 12%

13 Is there any relation between GDP and car production? Find out the relationship if any.

year	2011	2012	2013	2014	2015	2016	2017	2018
Car production cost in lakhs	26	26.6	25.03	26.01	27.9	30.5	32.87	36.95
GDP	6.2	6.5	5.48	6.54	7.18	7.93	8.01	8.03

14 A car, 15 years old taking 9 km/lit of petrol, whose true value is Rs 50,000. It is to be replaced by a new car: Which is the best option, if both found suitable in other aspects? Take running cycle 44 km/day for all days. D= 40%. Next replacement will be after 5 years.

Model 1: Rs 10.5 Lakhs, 20 km/lit of petrol
Model 2: Rs 6 lakhs, 12 km/lit of diesel

NITC/EE/V.K/21/11/2019

Name P.Nagamani

Roll No M190436EE

DEPARTMENT OF ELECTRICAL ENGINEERING, NIT CALICUT

I SEMESTER M.TECH – END SEM EXAMINATION WINTER SEMESTER 2019-20

INDUSTRIAL POWER AUTOMATION

EE 6434 D INTERNET OF THINGS AND APPLICATIONS

Time: 3 Hours **Max. Marks: 50**

Answer __all__ questions

1. a) Define IoT technology and write down in short the history of IoT. (2)

   b) Explain the major elements utilized in IoT. (2)

   [*You are expected to cover: (i) detailed explanations of each major component involved in IoT with example*]

   c) Explain the typical IoT applications at today's market, 2025 and beyond?

   [*You are expected to cover: (i) detailed explanations of each sector with example (ii) humans life style in feature with IoT technology*] (3)

2. a) Distinguish important features between M2M and IoT technologies. (2)

   b) What are the popular wireless technologies available in the market and which is more suitable for long distance data transmission? (1)

3. a) Explain the operation of IoT enabled Home Automation System (HAS).

   [*You are expected to cover: detailed block diagram of HAS to satisfy the following features a) Android app based light and fan control b) Electricity bill notification and payment*] (4)

   b) Mention the latest IoT supported gateway products and write the technical key features of Arduino and Node MCU. (2)

   c) Explain the operation of traffic control when it is enabled with IoT and M2M technology. (2)

   d) Define Web of Things (WoT). (1)

4. a) Write short notes on hubs and switches and routers.

   [*You are expected to cover: (i) purposes, features and functions of each with diagram (ii) mention the main difference between each technology*] (2)

   b) Explain in short about three types of switches and routers in wireless networking equipment. (3)

5. Why WAP is required? And also explain the different types of wireless access point with typical structure.

   [*You are expected to cover: (i) detailed explanations of any two WAP configurations with neat diagram (ii) mention the maximum possible distance coverage*] (4)

6. a) Explain in detail about various sensor nodes. (3)

b) Write short notes on the basic operation of analogue and digital sensors. (2)

7. Explain the operation principle for the following sensors

i) PIR Motion detectors ii) Optical and tacho-generators iii) DHT-22 iv) GPS sensor (2)

8. Explain the M2M enabled automatic water cooling mechanism for power transformer in substation.

[*You are expected to cover: (i) explanation with detailed block diagram consists of M2M structure (ii) detailed program with description to control the relay driver to maintain the temperature between 25 to 135 degree*] (6)

9. If it is planned to upload the status of water level of Kaveri DAM, Karnataka in IoT cloud to know the status of water availability, If 10 samples are required to produce digital count, what will be the digital output and conversion time when an accurate analogue liquid level sensor is connected to Node MCU through 8-bit 10 MHz ADC? Write the program to display the status of water level at every 10 minutes interval in IoT platform. (5)

10. a) Explain various XBee module antennas. (2)

b) Explain XBee mesh network structure. (2)

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Things do not happen. Things are made to happen.

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NITC/EE/V.K/03/10/2019

Name ______________

Roll No______________

DEPARTMENT OF ELECTRICAL ENGINEERING, NIT CALICUT

I SEMESTER M.TECH – INTERIM TEST EXAMINATION WINTER SEMESTER 2019-20

INDUSTRIAL POWER AUTOMATION

EE 6434 D INTERNET OF THINGS AND APPLICATIONS

Time: 1.5 Hours **Max. Marks: 20**

Answer all questions

1. Define IoT technology. (1)

2. What are the popular wireless technologies available in the market and which is more suitable for long distance data transmission? (1)

3. Explain the operation of Home Automation Control when it is enabled with IoT.

   You are expected to cover: Human's life style in feature with IoT technology (2)

4. Compare the M2M and IoT technologies. (2)

5. Explain the major elements utilized in IoT. (2)

   [*You are expected to cover: (i) detailed explanations of each major component involved in IoT with example*]

6. Whether the following applications are belongs to IoT or M2M categories? And explain why?

   i) Automatic Water Level controller ii) Vehicle Tracking management system iii) Automatic street light control iv) Home Automation Control v) Vending machine vi) ATM (3)

7. Write short notes on hubs and switches and routers.

   [*You are expected to cover: (i) purposes, features and functions of each with diagram (ii) mention the main difference between each technology*] (2)

8. What are three types of routers in wireless networking and explain each of them in short? (2) omni sector

9. Explain in detail about different types of wireless access point with typical structure

   [*You are expected to cover: (i) detailed explanations of any two one WAP configurations with neat diagram (ii) mention the maximum possible distance coverage*] (2)

10. What are the major six problems of IoT Technology and explain them. (3) Walled of internet cloud storage security lack of confidence understanding IoT

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Life is ten percentage what you experience and ninety percentage how you respond to it

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