2010-2011
M.TECH. (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING) ACTION
POWER SYSTEM & DRIVES/ INSTRUMENTS & CONTROL
ADVANCED MATHEMATICS
(AM – 621)

Maximum Marks: 75
Duration: Three Hours

Note:
(i) Answer five questions by selecting any two questions from Section A and any three questions from Section B.
(ii) Statistical tables will be provided.

SECTION – A

1 (a) (i) Define random variable and its types with at least one example of each type.

(ii) Which conditions for the binomial distribution, if any, fail to hold in the following situation.

"A DVD player will be tested for 1000 hours and the outcomes are failure or no failure. Each new DVD player coming off a production line will be tested for 1000 hours. DVD players will be tested one after another until one fails"

(iii) The following table gives the probabilities that a certain computer will malfunction 0,1,2,3,4,5 and 6 times on any given day:

<table>
<thead>
<tr>
<th>Number of malfunction: x</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability : p(x)</td>
<td>0.17</td>
<td>0.29</td>
<td>0.27</td>
<td>0.16</td>
<td>0.07</td>
<td>0.03</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Find the standard deviation of this probability distribution.

(b) (i) The probability that the noise-level of a wide-band amplifier will exceed 2dB is 0.05. Use appropriate table to find the probabilities that among 12 such amplifiers the noise level of

(A) one will exceed 2dB

(B) at most two will exceed 2dB

(C) two or more will exceed 2dB

(ii) The number of flaws in a fibre cable follows a Poisson process with an average of 0.6 per 100 feet.

(A) Find the probability of exactly 2 flaws in a 200-foot cable.

(B) Find the probability of exactly one flaw in the first 100 feet and exactly one flaw in the second 100 feet.

(7+8)

Contd....2
2. (a) In a certain city, the daily consumption of electric power (in millions of kilowatt hours) is a random variable having the probability density
\[ f(x) = \begin{cases} \frac{1}{9} xe^{-x/3} & x > 0 \\ 0 & x \leq 0 \end{cases} \]

If the city's power plant has a daily capacity of 12 million kilowatt hours, what is the probability that the power supply will be inadequate on any given day?

(b) Use the normal approximation to the binomial distribution and solve the following problem:

"A safety engineer feels that 30% of all industrial accidents in his plant are caused by failure of employees to follow instructions. If this is correct, find approximately the probability that among 84 industrialized accidents in the plant anywhere from 20 to 30 (inclusive) will be due to failure of employees to follow instructions.

(c) If two random variables have the joint density
\[ f(x, y) = \begin{cases} \frac{6}{5}(x^2 + y^2) & 0 < x < 1, 0 < y < 1 \\ 0 & \text{elsewhere} \end{cases} \]
find the probabilities that

(i) \( 0.2 < X < 0.5 \)
(ii) \( 0.4 < Y < 0.6 \)

3. (a) Define

(i) a stochastic process with at least two examples
(ii) a stationary process
(iii) a wide-sense stationary process
(iv) an autocorrelation of a stochastic process \( X(t) \)

(b) (i) The integral \( S = \int_{\xi}^{\tau} X(t) \, dt \) of a stochastic process \( X(t) \) is a random variable \( S \) and its value \( S(\xi) \) for a specific outcome \( \xi \) is the area under the curve \( x(t, \xi) \) in the interval \( (a, b) \). Find the expression for \( E\{ S \} \).

(ii) If \( X(t) = ae^{bt} \), where \( a \) is a random variable, find \( R(t_1, t_2) \).

(c) Establish the necessary and sufficient conditions for the stationarity of the stochastic process \( X(t) = a \cos \omega t + b \sin \omega t \),

where \( a \) and \( b \) are random variable.

(4+4+7)

Contd...
SECTION – B

4 (a) Solve the following differential equations:
   (i) \( x^2 y'' + xy' + y = 0 \)
   (ii) \( x^2 y'' - 2xy' + 2y = 0 \)
   (iii) \( x^2 y'' + 5xy' + 13y = 0 \)
(b) A tightly stretched string with fixed end points at \( x = 0 \) and \( x = l \), is initially at rest i.e. \( u(x,0) = 0 \) in its equilibrium position. If it is set vibrating by giving to each of its points a velocity \( x(l-x) \) i.e. \( \left. \frac{\partial u}{\partial t} \right|_{t=0} = x(l-x) \). Find the displacement of the string at any point \((x,t)\) for \( 0 < x < l \) and \( t \geq 0 \).

5 (a) An insulated rod of length \( l \) has its ends \( A \) and \( B \) maintained at \( 0^\circ C \) and \( 10^\circ C \) respectively until steady state conditions prevail. If \( B \) is suddenly reduced to \( 0^\circ C \) and maintained at \( 0^\circ C \). Find the temperature \( u(x,t) \) at a distance \( x \) from \( A \) at time \( t \geq 0 \).
   (b) Find the series solution of the differential equation:
   \[ 2x^2 y'' + xy' - 3y = 0 \]
   by Frobenius method.

6 (a) State the values of \( \frac{d}{dx} \left[ x^n J_n(x) \right] \) for \( n = k, -k \), where \( k \) is a positive integer.
   Using these results show that
   \[ 2J_k^1(x) = J_{k-1}(x) - J_{k+1}(x) \]
   and \( \frac{2k}{x} J_k(x) = J_{k-1}(x) + J_{k+1}(x) \)
   (b) Show that \( e^{\frac{2}{x} \left( e^{-x} \right)} = \sum_{n=-\infty}^{\infty} t^n J_n(x) \).

7 (a) Using the generating function, show that
   \( n P_n(x) = xp_n(x) - P_{n-1}(x) \), where \( P_n(x) \) is the Legendre polynomial.
   (b) State the result for the orthogonality of Legendre Polynomials and prove it.

8 (a) State the two shifting theorem for Fourier transform and prove any one of them.
   (b) Show that \( \mathcal{J} \left[ t^n f(t) \right] = i^n F^{(n)}(\omega) \) for \( n = 1, 2, \ldots \).
   (c) State the result \( \mathcal{F} \left[ t^n \right] \) and prove it for \( n = 1, 2, \ldots \).

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M.TECH. (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
ADVANCE ELECTRICAL DRIVES-1
(EE-611)

Maximum Marks: 75

Duration: Three Hours

Answer FOUR questions only. Question No. 1 is compulsory.
Symbols have their usual meanings.
Assume suitable data, if not given.

1. (a) How can regenerative braking operation be achieved in a separately excited dc motor fed by a fully controlled rectifier? (5)
(b) What are the advantages and disadvantages of simultaneous control over non-simultaneous control in a dual converter controlled dc drive? (5)
(c) Explain why a permanent magnet dc motor is preferred in solar photovoltaic drives. (5)

2. A 2.4 kW, 220 V, 480 rpm, 12.8 A separately excited motor has the armature resistance and inductance of 2.2 Ω and 40 mH, respectively. This motor is controlled by a single-phase fully-controlled rectifier with an ac source voltage of 240 V, 60 Hz. Identify the modes of operation and calculate the motor speeds for the following conditions:
   (a) θ = 60°, Ta = 80 N-m (20)
   (b) θ = 60°, Ta = 10 N-m

3. (a) A separately excited dc motor is controlled by a three-phase fully controlled rectifier and operating in motoring mode. Draw the waveforms of armature voltage and armature current both for continuous and discontinuous modes of operation. Clearly indicate the conduction interval of each thyristor. Find the expressions for average armature voltage in each case. (10)
   (b) With the help of neat diagram, explain the working of a dual converter controlled dc drive with non-simultaneous control. (10)

4. With the help of a neat diagram and suitable waveforms explain the working of a chopper circuit that can be used for regenerative braking of a dc separately excited motor. Obtain the expressions of the current both for energy storage interval and energy feedback interval. Also derive the expression for regenerated power. (20)
5. (a) Draw the circuit of a chopper that can be used to operate a separately excited dc motor in all the four quadrants. Explain how the circuit can be used to obtain (i) I & II quadrants operation (ii) III & IV quadrants operation. Draw the waveforms of armature voltage and current for forward motoring operation, clearly indicating the conduction intervals of the different semiconductor switches. Assume the load to be high enough to cause unidirectional flow of armature current.

(b) A 230 V, 500 rpm, 90 A separately excited motor has the armature resistance and inductance of 0.115 Ω and 11 mH, respectively. The motor is controlled by a class C chopper at 400 Hz, with a source voltage of 230 V.

(i) Calculate the motor speed when it is operating in forward motoring mode at duty ratio $\delta = 0.5$ and half the rated torque.

(ii) What will be the motor speed when regenerating at $\delta = 0.5$ and rated torque.

6. With the help of block diagrams, explain the working of a single-quadrant, closed-loop dc drive employing (i) current limit control (ii) cascade control. Explain the advantages of cascade control over current limit control. Why are these schemes preferred in applications with large load torques?
2010-2011
M.TECH. (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
ADVANCED POWER ELECTRONICS
(EE-621)

Maximum marks: 75
Duration: Three Hours

Answer four questions only. Question No.1 is compulsory.

1. (a) What are the drawbacks of phase controlled converters? Explain with the help of waveforms. 04
(b) A single-phase full converter is operated with pulse-width-modulation control. If the load current with average value of $I_a$ is continuous, find the average output voltage due to $p$ number of pulses per half cycle and the instantaneous input current.
11

2. (a) Explain the working of a Fly-back converter. Draw the voltage and current waveforms. 15
(b) Describe briefly a scheme for the control of switch mode power supplies. 05

3. (a) Derive the expression for transfer function $\left( \frac{V_o(s)}{d(s)} \right)$ of forward converter. 08
(b) The average d.c. output voltage of a forward converter shown in figure-1 is 24 V, and resistive load of 0.9Ω. The ‘ON’ state voltage drop of transistor and diode are 1.2 V and 0.7 V respectively. The duty ratio is 0.4 operating frequency is 1 kHz, supply voltage $V_s = 12$ V and transformer turns ratio is 4. Determine-
(i) average input current
(ii) efficiency
(iii) average transistor current
(iv) open circuit transistor voltage. 12

4. (a) Explain the working of a series-loaded resonant dc–dc converter, for various modes of operation. 15
(b) Describe the advantages of resonant converters over other converters. 05

5. (a) Describe briefly the application of power electronics in renewable energy systems. 15
(b) Explain the working principle of UPFC. 05

6. Write notes on the following topics:
(i) Power Quality 06
(ii) TCSC 06
(iii) ZVS resonant converter 08

Encl. figure-1.
Fig. 1
2010-2011
M.TECH. (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
POWER APPARATUS & SYSTEM MODELLING
(EE-631)

Maximum marks: 75

Duration: Three Hours

Answer any four questions including question No. 1, which is compulsory.
Symbols and abbreviations have their usual meanings.
Assume suitable data if missing.

1. (a) For an un-transposed transmission line, compute B\(^{-1}\) and B\(^{-1}\)A.
     (b) Justify the use of Park's Transformation in synchronous machine modeling. Prove
         that it is power invariant.

2. (a) Derive the expression for transfer function of speed control mechanism of speed
      governing system for turbo-generator.
     (b) Discuss the mathematical model of a 3-phase induction motor for dynamic stability
         studies.

3. (a) Derive from fundamental, the expressions for self and mutual inductances of the
      three phase stator winding of a synchronous machine in terms of rotor angle.
     (b) With suitable circuit diagram, explain the modeling of a two winding transformer
         incorporating p.u. turn ratio 1: a.

4. (a) With the help of a block diagram, explain the function of main components of an
      excitation system.
     (b) Describe the working of a brushless excitation system for an alternator.

5. (a) State different methods of modeling the loads in a power system. Comment on
      frequency and voltage dependence of active and reactive load powers.
     (b) Draw the zero sequence equivalent circuit of a three winding Delta-Star-Delta
         transformer with star neutral grounded through Z_a.
     (c) Justify the use of zig-zag connection of 3-phase grounding transformer.

6. Write short notes on any two of the following:
(a) Sub-transient state representation of a synchronous machine.
(b) Choice of voltage and power base of stator and rotor windings of an
    alternator for p.u. quantities.
(c) Grounding transformer and its application.
Answer four questions only. Question No.1 is compulsory.
Symbols have their usual meanings.
Assume missing data suitably, if any.

1. (a) Using non-singular transformations, show that
\( \hat{Z}_{\text{loop}} = \hat{C}^{-1} [ Z ] \hat{C} \)
where \( \hat{Z}_{\text{loop}} \) : loop impedance matrix of augmented network
\( [ Z ] \) : primitive impedance matrix
\( \hat{C} \) : augmented loop incidence matrix.

(b) Explain what do you understand by term ‘primitive network’? Show representation of a network component of a 3-phase system in (i) impedance form (ii) admittance form and write their performance equations.

2. For the network shown in figure-1, form Bus Impedance matrix ‘\( Z_{\text{BUS}} \)’ with bus ‘O’ as reference bus. The impedances are as given in following table:

<table>
<thead>
<tr>
<th>Element No.</th>
<th>Bus-Code</th>
<th>Impedance (p.u.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-0</td>
<td>j 1.0</td>
</tr>
<tr>
<td>2</td>
<td>1-2</td>
<td>j 0.2</td>
</tr>
<tr>
<td>3</td>
<td>2-3</td>
<td>j 0.2</td>
</tr>
<tr>
<td>4</td>
<td>3-0</td>
<td>j 1.0</td>
</tr>
<tr>
<td>5</td>
<td>3-4</td>
<td>j 0.2</td>
</tr>
<tr>
<td>6</td>
<td>2-4</td>
<td>j 0.1</td>
</tr>
</tbody>
</table>

Bus codes are encircled. Derive relations used.

3. (a) Show that a balanced three-phase element with balanced excitation can be treated as single-phase element in network problems.

(b) Show that for a 3-phase to ground fault, fault impedance matrix \( Z_{F \text{,abc}} \), elements are given by:
\[ Z_{ij} = Z_F + Z_g, \ (i = 1, 2, 3) \]
\[ Z_{ij} = Z_g, \ (i = 1, 2, 3; i \neq j, j = 1, 2, 3) \]
where \( Z_F \) : fault impedance from each phase to neutral
\( Z_g \) = impedance from neutral to ground.

4. (a) Derive expressions for the fault current and voltages for a 3-phase to ground fault at \( p^0 \) bus in a power system network using \( Z_{\text{BUS}} \) model.

...
(b) Explain Newton's method of load flow solution with necessary derivations in an n-bus power system using polar coordinates system consists of a slack bus, \( \eta_1 \) : P, Q buses and \( \eta_2 \) : P, |V| buses.

5. (a) Explain the formulation of 'Optimum Power Flow (OPF)' problem. Discuss an algorithm for the solution of OPF problem incorporating both equality and inequality constraints.

(b) (i) With the aid of a 'State Transition Diagram' explain main operating states of a power system.

(ii) Explain what do you understand by contingency analysis of power system. Draw a flow chart illustrating a simple method for carrying out contingency analysis.

6. (a) Using De-coupled Load flow method, show load flow calculations for one iteration for the system shown in figure-2. The Bus admittance matrix elements for the system shown are Diagonal elements: \( Y_{ii} = -j \ 19.98 \), \( (i = 1, 2, 3) \)

off diagonal elements: \( Y_{ij} = j \ 10 \) \( (i = 1, 2, 3) \), \( (j = 1, 2, 3) \) \( i \neq j \)

The load flow data is given in the following table:

<table>
<thead>
<tr>
<th>Bus No</th>
<th>Type</th>
<th>( P_G ) (p.u)</th>
<th>( Q_G ) (p.u)</th>
<th>( P_D ) (p.u)</th>
<th>( Q_D ) (p.u)</th>
<th>Voltage specification (p.u.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Slack</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>( \angle \Theta^* ) (( \left</td>
</tr>
<tr>
<td>2</td>
<td>Load</td>
<td>-</td>
<td>-</td>
<td>2.8653</td>
<td>1.2244</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>P.V. bus</td>
<td>0.6661(p.u)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>( \left</td>
</tr>
</tbody>
</table>

(b) Distinguish clearly between De-coupled Load flow and Fast De-coupled Load flow methods.

Encl. figures.
Figure 1

Figure 2

V_1 = 1.1 V_1

V_2 = 1 V_2 \angle \theta_2

S_2 = \phi_2 + j \phi_2

\theta_2
2009-2010
M. TECH.(1 SEMESTER) EXAMINATION
(ELECTRICAL ENGG)
Optimal Control Systems

Maximum Marks: 75

EE-641 Duration: Three Hours

Attempt all questions.

1. (a) Explain the following terms:
   (i) Admissible control
   (ii) Admissible trajectory
   (iii) Optimal trajectory
   (iv) Performance measure
   
   (b) Find the extremal for the functional.

   \[
   J(x) = \int_{t_0}^{t_f} \left[ 2 \, x(t) + \frac{1}{2} \dot{x}^2(t) \right] dt
   \]

   The boundary conditions are \( x(t_0) = 1 \), \( x(t_f) = 4 \) and \( t_f > 1 \) is free.

   OR

   1 (a) Find the extremal for the functional.

   \[
   J(x) = \int_{0}^{\pi/4} \left[ x_1^2(t) + 2 \, x_1(t) \dot{x}_2(t) + \dot{x}_2^2(t) \right] dt
   \]

   The functions \( x_1 \) and \( x_2 \) are independent and the boundary conditions are

   \[
   x_1(0) = 0; \quad x_1(\pi/4) = 1
   \]

   \[
   x_2(0) = 0; \quad x_2(\pi/4) = -1
   \]

   (b) Find the necessary condition for a function to be an extremal for the functional

   \[
   J(x) = \int_{t_0}^{t_f} \left[ g \left( x(t), \dot{x}(t), t \right) \right] dt
   \]

   \( t_0, x(t_0) \) and \( t_f \) are specified and \( x(t_f) \) is free.

2. (a) Find the equation of the curve \( x(t) \) in the \( x(t) - t \) plane which is joining two points having maximum length

Contd.................2
(b) Derive the Hamilton-Jacobi Bellman equation for the process described by the state equation

\[ \dot{x}(t) = a(x(t), u(t), t) \]

Which is to be controlled to minimize the performance measure

\[ J = h(x(t_f), t_f) + \int_{t_0}^{t_f} g(x(\tau)u(\tau)) d\tau \]

Where \( h \) and \( g \) are specified functions, \( t_0 \) and \( t_f \) are fixed and \( \tau \) is a dummy variable of integration.

3 (a) For the liquid level system find the value of \( u \) using matrix Ricatti equation

The steady state equation of the system

\[ \dot{x} = -x + u \]

where \( x \) = deviation of liquid head from steady state position and \( u \) = rate of liquid flow, performance index to be minimized is

\[ J = \int_{0}^{\infty} (x^2 + u^2) \, dt \]

(b) The state equations of a system are given as

\[ \begin{align*}
\dot{x}_1 &= x_2, \\
\dot{x}_2 &= 3u
\end{align*} \]

Obtain control \( u(t) \) by using the method of Hamiltonian which derives the system from a given initial state to desired state with performance index

\[ J = \frac{1}{2} \int_{0}^{2} u^2 \, dt \]

Boundary conditions: \( x_1(0) = 0, \ x_2(0) = 0, \ x_1(2) = 0 \) and \( x_2(2) = 0 \)

4 Derive the necessary condition for \( u \) to be an optimal control using Pontryagin’s minimum principle.

OR

4' The discrete approximation to a nonlinear continuously operating system is given by

\[ x(k+1) = x(k) - 0.4 \cdot x^2(k) + u(k) \]

The state and control values are constrained by

\[ 0.0 \leq x(k) \leq 1.0 \]

\[ -0.4 \leq u(k) \leq 0.4 \]

Quantize the state into the levels 0, 0.5, 1, and the control into the levels -0.4,

Contd............3
-0.2, 0.0, 0.2, 0.4. The performance measure to be minimized is

\[ J = 4 |x(2)| + \sum_{k=0}^{1} |u(k)| \]

Use dynamic programming with linear interpolation to complete the tables shown below:

<table>
<thead>
<tr>
<th>x(0)</th>
<th>J*_{0,2}(x(0))</th>
<th>u*(x(0),0)</th>
<th>x(1)</th>
<th>J*_{1,2}(x(1))</th>
<th>u*(x(1),0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td></td>
<td></td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td></td>
<td></td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td></td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2010-2011
M. TECH. (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
FUZZY THEORY AND APPLICATIONS
(EE-646)

Maximum Marks: 75
Duration: Three Hours.

Note:
(i) Question No. 1 is compulsory. Attempt also any three of the remaining questions. Marks of each question and its parts are indicated.
(ii) Symbols and abbreviations have their usual meanings.
(iii) Assume suitable value for missing data, if any.

1. (a) Explain graphically and mathematically any THREE terms associated with fuzzy sets:

(i) Algebraic, bounded and drastic product.
(ii) Fuzzy Complement, Union and Intersection.
(iii) Interval of confidence and $\alpha$-cut set
(iv) Convexity and normality of Fuzzy set
(v) Cylindrical extension and projection.

(b) What do you understand by fuzzy relation?

2. For given two Fuzzy Numbers A & B, whose membership functions are defined as follows:

$$
\mu_A(x) = \begin{cases} 
0 & x \leq -2 \\
\frac{x}{2} + 1 & -2 < x \leq 0 \\
\frac{-x}{6} + 1 & 0 < x \leq 6 \\
0 & 6 < x 
\end{cases}
$$

and

$$
\mu_B(x) = \begin{cases} 
0 & x \leq -4 \\
\frac{x}{7} + \frac{4}{7} & -4 < x \leq 3 \\
\frac{-x}{2} + \frac{5}{2} & 3 < x \leq 5 \\
0 & 5 < x 
\end{cases}
$$

... 2
Find $A + B$, $A \cdot B$, $A - B$, $\min(A, B)$, $\max(A, B)$ in expression form and draw the diagram for all operations.

OR

Let $A$ & $B$ are two Fuzzy numbers representing 0.4 and 0.2 respectively. Their definitions are as given below:

$$A = \begin{bmatrix}
0 & 0.2 & 1.0 & 0.1 & 0 \\
0 & 0.2 & 0.4 & 0.6 & 0.8
\end{bmatrix}$$

$$B = \begin{bmatrix}
0 & 1.0 & 0.4 & 0.5 & 0 \\
0 & 0.2 & 0.4 & 0.6 & 0.8
\end{bmatrix}$$

Calculate: (a) $A + B$  (b) $A - B$  (c) $B - A$  (d) $\min(A, B)$  
and (e) $\max(A, B)$  (f) $A \cdot B$  

3. (a) For the Implication "if $x$ is $A$ then $y$ is $B$"

where

$$A = \frac{0.1}{x_1} + \frac{0.5}{x_2} + \frac{0.8}{x_3} + \frac{1}{x_4}$$

and,

$$B = \frac{0.1}{y_1} + \frac{0.4}{y_2} + \frac{0.9}{y_3}$$

Find the Rule Matrix by:

(i) Zadeh’s Implication  
(ii) Godel Implication  
(iii) Luckaswicz Implication  
(iv) Kleene – Dienes Implication

(b) For the definition of age being young and old as given below:

$$\mu_{\text{young}}(x) = \text{gaussian}(x; 0, 20) = e^{-\frac{(x)^2}{30}}$$

$$\mu_{\text{old}}(x) = \text{gaussian}(x; 100, 30) = e^{-\frac{(x-100)^2}{30}}$$

Find the definition of: (i) not young and not old  
(ii) not very young and not very old  
(iii) very young or very old  

.... 3
4. (a) What do you understand by fuzzy composition?

(b) Fuzzy sets A, B, and C are defined as:

\[
A = \frac{0.1}{x_1} + \frac{0.4}{x_2}
\]
\[
B = \frac{0.1}{y_1} + \frac{0.8}{y_2} + \frac{0.9}{y_3}
\]
\[
C = \frac{0.2}{z_1} + \frac{0.5}{z_2} + \frac{0.9}{z_3}
\]

Relation R is defined in the domain of Cartesian product A x B, and it relates A to B. Relation S is defined in the domain of Cartesian product B x C, and it relates B to C. Find a relation T which relates A to C by using Max-min composition or Max-product composition.

(c) Give the structural diagram of a Fuzzy Inference System (FIS) and explain the operation of its components.

5. (a) Prove that the Fuzzy Knowledge Base Controller (FKBC) is a non-linear transfer element.

(b) Prove that Fuzzy Knowledge Based Controller (FKBC) function as a PI, PD, or PID controller under different consequent conditions.

(a) Explain the properties of rule set.

6. (a) Consider a Fuzzy Knowledge Base Controller (FKBC) designed to work as a PI-like Fuzzy controller. Let the inputs are error (e) and change-in-error (Δe) each having five term sets {NB, NS, ZO, PS, PB}. The consequent variable is change in control input (Δu), which is also having the term set as that of e or Δe. Write down the rule matrix for this system and discuss the groups in which the matrix can be divided. Briefly mention the properties of the groups.

(b) Write short notes on engineering applications of fuzzy theory in any two relevant fields.
Maximum marks: 75

Answer any four questions including question No.1, which is compulsory.
Symbols have their usual meanings.
Assume missing data, if any.

1. Differentiate between multi-channel data acquisition system (DAS) using digital multiplexing before transmission and that employing multiplexing of outputs of sample and hold circuit (S/H). Name the fields of applications for these two schemes of data acquisition.  

2. (a) What are the principal tasks which are to be performed in a typical data acquisition system? What are general configurations of DAS and which factors decide the configuration?  

(b) With the help of block diagram explain the working of a universal counter.  

3. (a) Discuss the method of correction of interfering and modifying inputs in instrumentation system.  

(b) Explain input-output configuration of a generalized instrumentation system.  

4. (a) Describe briefly working of modern display devices.  

(b) Describe the criteria for selection of a transducer for a particular application and differentiate between  

(i) Active and passive transducer  

(ii) Analog and digital transducer.  

5. (a) With the help of block diagram, describe the working of wave analyzer used for audio frequency range.  

(b) With the help of a block diagram, explain digital multimeter.  

6. (a) With the help of a suitable diagram, describe Kelvin-Verley transformer voltage divider.  

(b) Draw the diagram of double ratio bridge circuit incorporating voltage ratio transformer. Explain its use for the comparison of like impedances.
2010-2011
M.TECH (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
(Instrumentation and control)
PROCESS INSTRUMENTATION
(EE-652)

Maximum Marks: 75
Duration Three Hours

Answer All Questions
Assume suitable data, if missing

Q1(a) Differentiate between
1. Feed Back and Feed forward control
2. Single variable and Multivariable control
3. Cascade control and Ratio control

(b) What is an actuator? Explain the Electrical actuators commonly used in process industry.

Q2(a) With neat sketch, explain pneumatic PID controller. Mention its advantages and limitations.

(b) Define Rangeability? An equal percentage control valve has Rangeability of 32 if the maximum flow rate is 100 m³/hr, find the flow rate at 2/3 and 4/5 open settings.

OR

Q2'(a) Derive the transfer function of an electronic PID controller. Explain the effect of integral and derivative controllers on the performance of system.

(b) For the error shown in Fig (1) Find the output of a PI controller and show it graphically. If $K_p=5$, $K_D=1$, $K_I=0.5$, $P_o=20%$
Q3(a) Draw a neat sketch of Hydraulic proportional controller and explain its operation.

(b) An integral control system will have a measurement range from 0.4 to 2.0 volts and output range of 0 to 6.8 volts. Design an OPAMP integral controller to implement a gain of $K_i = 4\% / (%-\text{min})$. Specify the values of $G_i$ and $R$ if $C = 100\mu F$.

Q4(a) Explain direct digital control and computer supervisory control in a process and mention their advantages and limitations.

(b) Write technical note on display systems used in process industry.

OR

Q4'(a) What does tuning a control system mean? What are different tuning methods for feedback control system? Explain open loop transient response method.

(b) With the help of suitable diagram, explain Data Acquisition systems.

Q5(a) Explain with diagram the commonly adopted techniques of Boiler control of a power plant. In what situation are these control schemes used.

(b) What are parameters required to be controlled in paper pulp preparation? How they are controlled? Explain with neat sketch.
2010-2011
M.TECH. (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
INSULATION SYSTEMS
(EE-661)

Maximum marks: 75

Answer any four questions.
Question No.1 is compulsory and carries 15 marks.
Questions 2- 6 carry 20 marks each.
Symbols used have their usual meanings.

1. (a) Justify the use of SF₆ as insulation.
  (b) Compare the arc quenching property of vacuum w.r.t. oil and air.
  (c) Testing of insulation – write a brief note.

2. (a) Describe the working of a Puffer type SF₆ circuit breaker. Use neat diagrams to
      explain the different stages.
  (b) Discuss Audible noise due to corone and state the factors, which determine the
      audible noise.

3. (a) With a neat diagram describe the constructional detail and working of a vacuum
      contactor.
  (b) Discuss the advantages and limitations of vacuum switches.

4. Discuss insulation coordination. Write appropriate insulation coordination schemes
   for 220 kV and 400 kV systems. Explain protective margin.

5. (a) Differentiate between disruptive discharge, partial discharge, puncture and flash over
      in connection with insulation testing.
  (b) Derive equation to relate physical parameters of a sheet of solid insulation to the
      partial discharge inception voltage Vₖ. Explain inception voltage Vₖ and state the
      assumptions under which the equations have been derived.

6. Write short notes on any three of the following:
   (a) Temperature classification of solid insulating materials.
   (b) Use of SF₆ with other gases.
   (c) Causes of over voltages and protection against them.
   (d) Multiplying factors used for selection of insulation for a 400 kV overhead
       transmission line.
   (e) Metal oxide lightning arrester.
2010-2011
M.TECH. (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
NETWORK THEORY
(EE-682)

Maximum marks: 75
Duration: Three Hours

Answer four questions only. Question No.1 is compulsory.
Symbols and abbreviations used have their usual meanings.
Assume suitable value for missing data, if any.

1. (a) For the graph shown in figure-1, show that $B_f Q_f^T = 0$.  
(b) Write a short note on computer aided analysis of linear resistive networks.

2. (a) Obtain the short circuit admittance matrix of the network shown in figure-2.  
(b) Also find open circuit impedance matrix for the network of figure-2.

3. The gyrator circuit is shown in figure-3(a) and its corresponding graph is given in figure-3 (b). The gyration constant of the gyrator is denoted by ‘$\alpha$’ and conductances of resistors are represented by $G_3$ and $G_4$. Use admittance matrix method to find branch voltage vector $V_b$ (s).

4. Distinguish between “Proper tree” and “Normal tree”. For the linear time invariant network shown in figure-4, obtain the state equations in normal form.
Take $C_1 = C_2 = 1 F$, $C_7 = 2 F$, $L_3 = L_4 = \frac{1}{2} H$
$L_6 = 1 H$ and $R_5 = R_8 = 1 \Omega$.

5. (a) Compute state transition matrix using minimum polynomial approach for matrix:  
$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 2 \end{bmatrix}$$

(b) For the network shown in figure-5 obtain following matrices:
$Q_f$, $F$ and $H_{St}$, also show the various sub-matrices of $F$. Assume all elements are linear time varying and non-zero for all $t \geq 0$.

6. (a) Enumerate the necessary and sufficient conditions for testing of a rational function $z(s)$ to be positive real. Test the following function for positive realness:
$$Z(s) = \frac{s^2 + 3s + 2}{s^2 + 7s + 12}$$

(b) Find the first Foster form of the deriving point fn.
$$Z(s) = \frac{2s^2 + 14s + 20}{s^2 + 10s + 24}$$

Encl. figures.