2013-2014
M. TECH. AUTUMN (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
POWER SYSTEM & DRIVES/INSTRUMENTATION & CONTROL
MATHEMATICS
(AM-621)

Maximum Marks: 60
Duration: Three Hours

"Students governed by the old ordinances will be examined out of 75 marks and their obtained marks shall be proportionately raised"

Note: Answer any FIVE questions.

Q1. (a) In the figure given below, assume that the probability of each relay being closed is p and that each relay is open or closed independently of each other. Find the probability that current flows from L to R.

![Diagram of a circuit with relays]

(b) A certain item is manufactured by three factories say 1, 2 and 3. It is known that 1 turns out twice as many items as 2, and that 2 and 3 turn out the same number of items (during a specified production period). It is also known that 2 percent of items produced by 1 and 2
are defective while 4 percent of those manufactured by 3 are defective. All the items produced are put into one stockpile, and then one item is chosen from the stockpile and is found to be defective. What is the probability that it was produced in factory 1?

A bag contains 5 gold and 3 silver coins. A second bag contains 4 gold and 2 silver coins. A coin is chosen at random from first bag and put into second bag. Then a coin is chosen at random from second bag. What is the probability this coin is of gold?

Q2. (a) The percentage of alcohol (100 X) in a certain compound may be considered as a random variable, where \( X, 0 < X < 1 \), has the following pdf:

\[
 f(x) = 20x^3(1-x), \quad 0 < x < 1
\]

(i) Obtain an expression for the cdf \( F \)

(ii) Evaluate \( P(X \leq \frac{2}{3}) \)

(b) Suppose that the joint pdf of two dimensional random variable \((X, Y)\) is given by

\[
 f(x, y) = \begin{cases} 
 x^2 + \frac{2y}{3}, & 0 < x < 1, 0 < y < 2 \\
 0, & \text{elsewhere}
\end{cases}
\]

Compute the following:

(i) \( P(X > \frac{1}{2}), \ P(Y < X) \), (iii) \( P(Y < \frac{1}{2} | X < \frac{1}{2}) \)

Q3. (a) Let \( X \) be a binomially distributed random variable with parameter \( p \), based on \( n \) repetitions of an experiment. Prove that \( E(X) = np \).

(b) Let \( X \) be a random variable. If \( V(X) \) denotes the variance of \( X \) and \( C \) is a constant, prove that

(i) \( V(X + C) = V(X) \), (ii) \( V(CX) = C^2V(X) \).

(c) Suppose that the two-dimensional random variable \((X, Y)\) has joint pdf

\[
 f(x, y) = \begin{cases} 
 \lambda x(x - y), & 0 < x < 2, -x < y < x \\
 0, & \text{elsewhere}
\end{cases}
\]

(i) Evaluate the constant \( \lambda \)

(ii) Find the marginal pdf of \( X \)

(iii) Find the marginal pdf of \( Y \)

Q4. (a) What do you understand by stochastic process? Give two examples of stochastic process. What is meant by the terms (i) covariance
stationary, (ii) evolutionary
Consider the process \( X(t) = A \cos \omega t + B \sin \omega t \), where \( A \) and \( B \) are uncorrelated random variables each with mean 0 and variance 1 and \( \omega \) is a positive constant. Prove that the process is covariance stationary.

(c) Consider the process \( \{X(t), t \in T\} \) whose probability distribution is given by
\[
P_T\{X(t) = n\} = \begin{cases} \frac{(at)^{n-1}}{(1+at)^{n+1}}, & n = 1,2, \ldots \\ \frac{at}{1+at}, & n = 0 \end{cases}
\]
Prove that the process \( \{X(t)\} \) is not stationary.

Q5. (a)
A tightly stretched string with fixed end points \( x = 0 \) and \( x = l \) is initially displaced in a sinusoidal arch of height \( y_0 \) and then released from rest. Find the displacement \( y \) at any distance \( x \) from one end at time \( t \). Show that each point of the string has simple harmonic motion. Find the period.

(b) Find particular solution of the Laplace equation
\[
\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0
\]
by the method of separation of variables.

Q6. (a)
Express the function
\[
f(x) = \begin{cases} 1 & \text{for } |x| \leq 1 \\ 0 & \text{for } |x| > 1 \end{cases}
\]
as a Fourier integral. Hence evaluate
\[
\int_0^\infty \frac{\sin \lambda \cos \lambda x}{\lambda} d\lambda
\]

(b) Find the function \( f(x) \) satisfying the integral equation
\[
\int_0^\infty f(x) \cos \lambda x dx = \begin{cases} 1 - \lambda & \text{for } 0 \leq \lambda \leq 1 \\ 0 & \text{for } \lambda > 1 \end{cases}
\]

(c) \( F_s(s) \) and \( G_s(s) \) are Fourier sine transforms of \( f(x) \) and \( g(x) \) respectively. Show that
\[
\int_0^\infty F_s(s) G_s(s) ds = \int_0^\infty f(x) g(x) dx
\]
Q7. (a) Prove that
\[ \int_{0}^{\infty} e^{-ax} f_0(bx) \, dx = \frac{1}{\sqrt{a^2 + b^2}}. \]

(b) For the Legendre polynomial \( P_n(x) \), prove the following:
(i) \[ \int_{-1}^{1} \frac{P_n(u)}{\sqrt{1 - u^2}} \, du = \frac{2n!}{n!}. \]
(ii) \[ \frac{1}{x(1 - 2x^2 + x^2)^{1/2}} - \frac{1}{x} = \sum_{n=0}^{\infty} (P_n(x) + P_{n+1}(x)) x^{n+1}. \]

(c) (i) Express \( x^3 + 2x^2 - x - 3 \) in terms of Legendre polynomials.
(ii) Obtain the solution of the equation
\[ 4 \frac{d^2y}{dx^2} + 9xy = 0 \]
In terms of Bessel functions.

Q8. (a) Solve by the method of variation of parameters the equation
\[ \frac{d^2y}{dx^2} + ay = sec ax \]
OR

(a') Using method of Frobenius, obtain two linearly independent solutions of the differential equation
\[ x^2 \frac{d^2y}{dx^2} + x(x - 1) \frac{dy}{dx} + (1 - x)y = 0 \]
about \( x = 0 \).

(b) Find the ordinary and singular points of the differential equation
\[ (1 - x^2) \frac{d^2y}{dx^2} - 6x \frac{dy}{dx} - 4y = 0 \]
Solve this equation near the ordinary point \( x = 0 \). Give the interval in which the solution will be valid.
OR

(b') Solve
\[ \frac{d^2y}{dx^2} - 4x \frac{dy}{dx} + (4x^2 - 1)y = -3e^{x^2} \sin 2x \]
by the method of removal of first derivative.

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2013 – 2014
M. TECH. AUTUMN (I SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
POWER SYSTEM & DRIVES/INSTRUMENTATION & CONTROL
MATHEMATICS
(AM-621-N)

Max. Marks: 60

Note: Attempt 5 questions by selection two questing from section ‘A’ and three questions from section ‘B’.

SECTION - A

1. (a) Define correlation coefficient of two random variable x and y. If \( z = a \cdot x + b \cdot y \) show that
\[
\sigma_z^2 = a^2 \sigma_x^2 + b^2 \sigma_y^2 + 2ab \rho \sigma_x \sigma_y
\]
where \( \sigma_x \) and \( \sigma_y \) are the standard deviations of \( x \) and \( y \) respectively. [04]

(b) The joint probability distribution function (pdf) of the random variables \( x \) and \( y \) is given by \( f(x, y) = K (ny + y^2), 0 \leq x \leq 1, 0 \leq y \leq 2 \). Find [08]
(i) the value of \( K \).
(ii) \( P(y > 1) \)
(iii) \( P(x > \frac{1}{2}, y < 1) \),
(iv) \( P(x + y \leq 1) \)
(v) \( P(x < 1) \),
(vi) \( P(x - y \leq \frac{1}{2}) \).

2. (a) (i) Events \( A \) and \( B \) are independent. Examine whether the events \( \overline{A} \) and \( \overline{B} \) are independent? [02]
(ii) A dice is thrown twice and the sum of the numbers appearing, is noted to be 8. What is the conditional probability that the number 5 has appeared atleast once? [03]

(b) Find the Fourier Transform of the following functions: [07]
(i) \( f(t) = \begin{cases} -e^{\alpha t}, & t < 0 \\ -e^{-\alpha t}, & t > 0 \end{cases} \), \( \alpha > 0 \)
(ii) \( g(t) = f(t-3) \cdot e^{-\alpha t} \).

(a) Write a short note on the following: [06]
(i) Wigner-Ville distribution
(ii) Wigner-Ville spectral analysis of non-stationary processes.

(b) The temperature distribution \( U(x, t) \) in a thin homogeneous, infinite bar can be modeled by the initial boundary value problem [06]
\[
\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}, -\infty < x < \infty, t > 0
\]
\( u(x, 0) = f(x) \), \( u(x, t) \) is finite as \( x \rightarrow \pm \infty \). Find \( u(x, t) \) by Fourier Transform.

SECTION - B

3. Define wavelet with an example. Let \( \psi \) be a wavelet and \( \phi \) be a bounded integer function. Then show that the convolution function \( \psi \ast \phi \) is a wavelet. [06]

4. Define continuous Wavelet Transform \( W_\psi \) of a function \( f \in L^2(\mathbb{R}) \) with respect to wavelet \( \psi \). Let \( \phi \) and \( \psi \) be wavelets. Then prove the following: [06]

Contd....2,
(i) $W_{\psi}(T_c f)(a, b) = W_{\psi} f(a, b - c)$ where $T_c$ is the translation operator.

(ii) $W_{\psi}(D_c f)(a, b) = \frac{1}{\sqrt{c}} W_{\psi} f\left(\frac{a}{c}, \frac{b}{c}\right)$, $c > 0$, where $D_c$ is the dilation operator.

(iii) $(W_{\psi \times f})(a, b) = a(\psi)(a, b) + b(\psi)(a, b)$ for any scalars $\alpha, \beta$.

5. (a) Discuss the scaled and translated version of wavelet $\psi(t) = t e^{it}$. Also discuss the application of Wavelets.

(b) Consider the space $V_j$ of all functions in $L^2(\mathbb{R})$, which are constant on intervals $[2^j K, 2^j (K+1)]$, i.e.,

$V_j = \{f \in L^2(\mathbb{R}) | f \text{ is constant on } [2^j K, 2^j (K+1)] \}$ for all $K \in \mathbb{Z}, j \in \mathbb{Z}$

Show that the space $\{V_j\}_{j \in \mathbb{Z}}$ satisfies all of the conditions of a multiresolution analysis (MRA). Construct a wavelet from the above MRA generated by the scaling function $\phi = \chi_{(0,1)}$.

6. (a) Solve the equation $u_{xx} + u_{yy} = -10 (x^2 + y^2 + 10)$ in the domain of the following figure:

\[
\begin{array}{c|c|c|c}
  & u = 0 & u = 0 \\
\hline
  u = 0 & u_3 & u_4 \\
\hline
  0 & u_1 & u_2 \\
\hline
\end{array}
\]

choose $k = h = 1$

(b) Solve the boundary value problem $\frac{\partial^2 u}{\partial x^2} = 4 \frac{\partial^2 u}{\partial t^2}$

with the condition $u(x, 0) = ux - x^2$, $0 \leq x \leq u$.

$u(u, t) = u(0, t) = 0$, $u'(x, 0) = 0$.

with $h = 1$ and integrate up to three time levels.

7. (a) Let $V_j$ be the space of all finite energy signals $f$ that is continuous and piece-wise linear, with possible discontinuities occurring only at the dyadic points $K/2^j$, $K \in \mathbb{Z}$. Let $\phi(t)$ be the scaling function defined as

$\phi(t) = \begin{cases} 
  t + 1 & -1 \leq t < 0 \\
  1 - t & 0 < t \leq 1 \\
  0 & |t| > 1 
\end{cases}$

Then (i) find the scaling filter coefficients.

(ii) construct the wavelet basis that is orthogonal to the scaling function.

(b) Use the Bender Schmidt recurrence relation to solve the equation:

$\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$

with the condition $u(x, 0) = \sin \pi x$ for $0 \leq x \leq 1$ and $u = 0$ at $x = 0$ and $x = 1$ for $t > 0$. Take $h = 0.2$, $\lambda = 1$ and compute the values of $u$ at the internal mesh points up to two time steps.
Q.No. | Question                                                                                                                                                                                                                                                                                                                                                                                                   | M.M.
-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------
1(a) | A separately excited dc motor is fed from a 1-phase fully-controlled rectifier. Draw the waveforms of voltage across and the current through the armature for different modes of steady-state motoring operations. Assume that speed remains constant. Also show the interval of conduction for each thyristors.                                                                                   | [09] |
1(b) | Why dc shunt motor is not used in solar photovoltaic dc drives?                                                                                                                                                                                                                                                                                     | [03] |
2(a) | Consider a separately excited dc motor which is being fed from a single-phase fully-controlled rectifier. Derive the relation for its torque speed characteristics when it is operating in mode II of discontinuous conduction modes. Also give the circuit diagram and show the waveforms of armature voltage and armature current for this mode of operation. Mention the conditions to be satisfied for operation in this mode. | [09] |
2(b) | Describe the self-control operation of synchronous motor drive.                                                                                                                                                                                                                                                                                   | [03] |
3(a) | A 200 V, 1200 rpm, 15 A separately excited dc motor has armature resistance and inductance of 1.8 Ω and 32 mH, respectively. This motor is controlled by a single-phase fully-controlled rectifier with source voltage of 230 V, 50 Hz. Identify the mode of operation and calculate the speed for \( \alpha = 45^\circ \) and developed torque is 40 N-m. | [09] |
3(b) | Describe the sequence of steps required for identifying the modes of operation of a  

Contd......2
4(a) A separately excited dc motor is controlled by a dc-dc buck converter using TRC and operates in continuous conduction mode. Draw the equivalent circuits for duty and free-wheeling intervals. Derive the expression for steady-state armature current for these intervals. Define current ripple factor and obtain its expression. Mention the assumptions made.

4(b) Prove that the average current in current-limit control operation of chopper feeding a dc motor is constant.

5 A separately excited dc motor is fed from a fully-controlled rectifier for its closed-loop speed control operation. The current loop and the speed loop use PI controllers. With the help of relevant transfer function of different components of the system and block diagram explain the procedure to design the gains of the two controllers.

6(a) Describe different types of synchronous motors used in drives applications. Derive the equivalent circuit of any one of them.

6(b) With the help of circuit diagram and relevant waveforms describe the operation of current source inverter with load commutation feeding a synchronous motor. Describe its merits and demerits.

7 With the help of \((i - v)\) and \((p - v)\) characteristics of a solar cell explain its maximum power point operation. Discuss the different options of motors for water pumping application of PV array. What are the various possibilities for its operation with DC and AC motors? Explain them giving the relevant circuit diagram or block diagram.
Answer any FIVE questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. | Question | M.M.
--- | --- | ---
1(a) | Derive from the fundamental, the expressions for self and mutual inductances of stator phases a-b-c of a synchronous machine in terms of rotor angle. | [08]
1(b) | With a suitable circuit diagram, explain the modelling of a phase shifting transformer with \( \theta \) as the phase shift between primary and secondary. | [04]
2(a) | Justify the use of zig-zag connection of 3-phase grounding transformer. | [04]
2(b) | For a transmission line the equation \( I = YV \) can be written as:

\[
\begin{bmatrix}
I_1 \\
I_2
\end{bmatrix} =
\begin{bmatrix}
y_{11} & y_{12} \\
y_{21} & y_{22}
\end{bmatrix}
\begin{bmatrix}
V_1 \\
V_2
\end{bmatrix}
\]

Give the relation of \( y_{11}, y_{12}, y_{21}, \) and \( y_{22} \) in terms of \( A, B, C \) and \( D \) constants. | [05]
2(c) | Discuss various methods used to represent load in a power system. | [03]
3 | What are the objectives of multi-area AGC in a power system? Develop a transfer function model for Multi Area AGC studies. | [12]
4(a) | Derive the swing equation of a synchronous machine including the effect of damper windings. | [06]
4(b) | Show that in a salient pole machine:

(i) \( x_d'' < x_d' < x_d \)

(ii) \( x_q'' < (x_q' = x_q) \) | [06]
5 | Derive the transfer function of speed control mechanism of speed governing system for turbo-generator. | [12]
6(a) | Explain the construction and working of a compound controlled rectifier excitation system. | [08]
6(b) | Draw zero sequence equivalent circuit of a 3-winding delta-star-delta transformer with star neutral grounded through \( Z_n \). | [04]
7(a) | Derive the necessary equations of \( I_0, I_d, I_q \) and \( V_0, V_d, V_q \) using phasor diagram under steady state condition of a synchronous machine. Assume balanced loading on the machine. | [08]
7(b) | Write a note on the choice of voltage and power base of stator and rotor windings of an alternator for per unit quantities. | [04]
1. Form the incidence matrices $A$, $A^T$, $K$, $B$, $B^T$ and $C$ for the network shown in figure 1 with node 1 as reference node.

2. Discuss an algorithm for formulation of bus impedance matrix $Z_{bus}$ of a power system network.

3(a) Give reason why symmetrical component transformation is used for short-circuit studies.

3(b) Derive expressions for fault current and bus voltages during fault using 3 phase $Z_{bus}$ as network model. Give and justify the assumptions.

Contd......2
3'(a) Show that a balanced three-phase element with balanced excitation can be treated as single phase elements in network problems.

3'(b) Obtain $Z_f^{abc}$ and $Z_f^{a12}$ for a single line to ground fault.

4. What are the assumptions made in Decoupled Load Flow (DLF) to formulate Fast Decoupled Load Flow (FDLF) solution? Give the algorithm for FDLF method and necessary equations.

OR

4'. Explain clearly the Newton-Raphson's method of load flow study with necessary derivations in an n-bus power system using polar co-ordinates. The system has $n_1$: PQ buses, $n_2$: PV buses and a slack bus.

5 (a). What do you mean by security analysis with reference to electrical power system?

5 (b) Draw the state transition diagram. Classify and briefly explain the main operating state of a power system.
Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer any five questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question
1 Distinguish the following:
   i) Regulator and Tracking problems
   ii) Lagrangian and Hamiltonian Functions
   iii) LQR and LQG Problems
   iv) Calculus of variations and Pontryagin’s principle
2(a) Discuss the steps involved in the formulation of an optimal control problem.
2(b) Derive the expression of optimal control for LQR problem using Riccati equation
3(a) Explain the basic principle of dynamic programming using Bellman’s principle of optimality.
3(b) Using dynamic programming, minimize the performance measure
     \[ J(x) = \int_0^2 [tx^2 + u^2] \, dt \]
     Subject to the boundary conditions \( x(t) = u(t) \) and \( x(0) = 1 \). The input may be assumed to be unconstrained and the number of intermediate stages may be taken as 10.
4 Derive the Transversality condition of optimal control.
5 Find the equation of extremal for the functional
     \[ J(x) = \int_0^2 \left[ \frac{1}{2} \dot{x}^2 + x \ddot{x} + \dot{x} + \dot{x} \right] \, dt \]
     Subject to the boundary conditions \( x(0) = \frac{1}{2} \) and \( x(2) \) is free.
6 Discuss the methods used for numerical solution of two point boundary value problem.
7 Using Pontryagin’s principle minimize
     \[ J(x) = \int_{t_1}^{t_2} (x_1^2 + u^2) \, dt \]
     The system dynamics are given as
     \[ \dot{x}_1 = -x_1 + u \]
     Subjected to \( x_1(0) = 1 \), \( x_1(t_2) = 0 \) and the input \( u \) is unconstrained.
2013-14
M.TECH. (WINTER SEMESTER) EXAMINATION
Inst & Controls
ADVANCED INSTRUMENTATION
EE-651

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer any five questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. | Question | M.M.
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1(a) | What are the different types of input present in any measurement system? Explain with the help of example. | [06]
1(b) | What are the different methods of correction for interfering and modifying inputs? | [06]
2(a) | A voltmeter having a sensitivity of 1000 Ω/V reads 100 V on its 150 V scale when connected across an unknown resistor in series with a milli-ammeter. When the milli-ammeter reads 5 mA, calculate i) apparent resistance of the unknown resistor ii) actual resistance of the unknown resistor iii) error due to the loading effect of voltmeter | [06]
(b) | Define the following terms: i) Accuracy ii) Resolution iii) Threshold iv) Stability | [06]
3(a) | Differentiate between sensors and transducers? | [06]
(b) | What are the different types of inductive transducers? Explain the measurement of displacement using inductive transducer. | [06]
4(a) | What are the important properties for bonding materials? | [06]
(b) | Explain the piezoelectric phenomenon. | [06]
5(a) | What are the basic characteristics of photo detectors? Explain them in brief. | [06]
5(b) | What is the difference between a photo emissive, a photoconductive and a photovoltaic cell? Name one application for each. | [06]
6(a) | What are the commonly known ionizing radiations? With the help of schematic diagram explain the working of Geiger-Muller counter? | [06]
(b) | Differentiate between multilayer DAS using multiplexing before transmission and that employing multiplexing the outputs of sample/holds. | [06]
7(a) | Write a short note on display devices. | [06]
(b) | With the help of block diagram explain the working of wave analyzer. | [06]
2013-14
M.TECH. (AUTUMN SEMESTER) EXAMINATION
INSTRUMENTATION AND CONTROL
PROCESS INSTRUMENTATION
EE-652

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No. Question M.M.
1 (a) Define:
    (i) Proportional Band
    (ii) Process load
    (iii) Self regulation
    (iv) Potential value

1 (b) The controller output varies from 4-20 mA to control motor speed from 140-600 rpm with linear dependence. Calculate
    (i) The current corresponding to 310 rpm
    (ii) Value of calculated current as percentage of control output.

1 (c) Differentiate between
    (i) Feed back and Feed Forward control.
    (ii) Continuous and floating mode control.

2 (a) Derive the transfer function of a Hydraulic PI controller. Explain why composite controller modes are more popular in process control applications.

2 (b) A PI controller is used to control the pressure in a tank which varies from 40 psi to 140 psi. Desired pressure is 90 psi. Controller output is to be changed by 100% on 40 psi pressure deviation. Reset rate is 1/5 repeats per minute and the controller output at zero error is 50%. Calculate the controller output at the end of two minutes, when pressure in tank becomes 80 psi.

Contd……..2
2'(a) Draw a neat sketch of Electrical proportional controller and explain its operation.

2'(b) A water tank gradually loosing heat, its temperature drops by 2°K per minute. When the heater is ON the system gains temperature at 4°K per minute. A two position controller has 0.5 minute control lag and neutral zone of ± 4% about a set point of 318 °K. Plot the temperature versus time graph and find the oscillation period. Assume at t = 0, temperature is at set point and the heater is OFF.

3 (a) What is actuator, explain Pneumatic actuators commonly used in process industry.

3(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

3' (a) Classify control valves used in process industry and explain them.

3' (b) A control valve regulates the fluid flow of a tank. The water level is controlled in the tank at 25 feet by regulating the outflow. The measurement inflow varies from 0 - 120 gallons per minute. Calculate valve flow coefficient Cv.

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

4 (b) The proportional gain of a control system is increased until the system exhibits sustained oscillations. At this time the proportional gain $K_c$ is 325 and frequency of oscillation is 0.25Hz. Using Zeigler Nichol’s method, calculate the appropriate values of PID constants $K_p$, $T_i$ and $T_d$.

OR

4'(a) What does tuning a control system mean? What are different tuning methods for feedback control system? Explain Frequency response method.


5 (a) Explain with diagram the commonly adopted techniques for Boiler control OR Feed water control of a power plant.

5 (b) What parameters are required to be controlled in paper pulp preparation? How they are controlled? Explain with neat sketch.
2013-14
M.TECH. I\textsuperscript{st} SEMESTER EXAMINATION
M.Tech (Electrical)
High Voltage & Insulation Engineering
Condition Monitoring of Power System Apparatus
EE-661N
Credits: 04

Maximum Marks: 60

Duration: Three Hours

Answer any \textbf{FIVE} questions.
Notations used have their usual meaning.

1(a) What is meant by “preventive maintenance”? How is it different from predictive maintenance and proactive maintenance? [06]

1(b) Discuss the various measurable parameters employed to characterize the condition of insulating materials. [06]

2(a) How does the processing procedure in manufacturing affect the behaviour and expected life of insulation structures? [06]

2(b) Discuss the various breakdown modes for failure of high voltage current transformer. [06]

3(a) Discuss the vacuum pressure impregnation process as applicable to rotating machine insulation. [06]

3(b) What are the various insulation problems associated with power transformers and reactors? [06]

4(a) Discuss with suitable diagram, the basic components of a partial discharge measuring circuit. [06]

4(b) What are the essential features of a good acoustic emission system? Explain with a figure a four channel acoustic emission system. [06]

5(a) Compare electrical PD and acoustic PD detection methods. [06]

5(b) With help of a diagram explain the oscillating wave test for cable diagnosis. [06]

6(a) Discuss the very low frequency testing method as applied to cables. [06]

6(b) What are the recommended tests for HV rotating machines? Briefly discuss the AC hipot test and DC hipot test. [06]

7(a) Discuss the acoustic PD measurement in gas insulated substations. [06]

7(b) What are the various parameters that are used for assessing condition of outdoor insulators? [06]
Maximum Marks: 60    Credits: 04    Duration: Three Hours

Answer any five questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No.  Question                   M.M.
1(a). Sketch a block diagram for processing of biomedical signal and explain each block.   [07]
1(b). What are the problems associated with bio-signal processing? Explain briefly.     [05]

2. Distinguish the following:
   i. Continuous-time vs. Discrete-time signals.
   ii. Analog vs. Digital signals.
   iii. Deterministic vs. Random signals.
   iv. Periodic vs. Aperiodic signals.
   vi. Finite length vs. Infinite length signals.

3(a). State the Dirichlet's conditions for periodic and aperiodic signals.              [06]
3(b). Prove that $f_1(t) \ast f_2(t) \xrightarrow{\mathcal{F}} F_1(j\omega)F_2(j\omega)$

   where $f_1(t) \xrightarrow{\mathcal{F}} F_1(j\omega)$ and $f_2(t) \xrightarrow{\mathcal{F}} F_2(j\omega)$        [06]

4(a). What are FIR filters? Give its structure and explain the significance of coefficients. [06]
4(b). Mention the properties of correlation and covariance sequences.                    [06]

5(a). What are the different segments of ECG waves and its associated heart activities?   [06]
5(b). Explain Curve fitting method for removal of base line wandering from ECG.            [06]

6(a). Describe various EEG waves and associated activities.                                [06]
6(b). What are the biological and external artifacts in EEG recording?                    [06]

7(a). Explain differentiator based QRS detection algorithm.                               [08]
7(b). In the following tracing of EEG what changes do you observe after point “A” in Figure 1? What may be it’s possible cause? [04]

![Figure 1](image)

8(a). Prove that impulse function signal is white noise.                                   [04]
8(b). What are the artifacts associated with ECG recording? Explain.                      [04]
8(c). Mention the usages of EEG.                                                        [04]
M.TECH. (AUTUMN SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
NETWORK THEORY
EE682
Credits: 04

Maximum Marks: 60

Answer any FIVE questions.
Assume suitable data if missing.
Notations and abbreviations used have their usual meanings.

1(a) Prove that the network shown in figure 1 is equivalent to a ohm resistor. Assume, inductor is flux controlled, capacitor is charge controlled and all initial conditions are zero.

![Figure 1](image)

1(b) The graph of a network is shown in figure 2. For this network, prove that $AB_t^T = 0$.

![Figure 2](image)

Q2 Define indefinite admittance matrix (IAM). For network $N_2$ shown in figure 3, find IAM:

(i) When all nodes are accessible.
(ii) Node “d” is suppressed.
(iii) If network $N_2$ is connected with another network $N_b$ as shown in

Contd.......2
figure 4, find IAM for the resultant network.

Q3 The gyrator circuit and its corresponding graph are shown in figure 5 (a) and 5(b) respectively. Use admittance matrix method to find branch voltage vector \( V_b(s) \). \( \alpha \) is gyrator constant and conductances of resistors are represented by \( G \).

Q4 Distinguish between "Proper tree" and "Normal tree". For the linear time invariant network shown in figure 6, obtain the state equations in normal form. Take \( C_1 = C_2 = 1F, C_3 = 2F, L_2 = L_4 = 1/2H, L_6 = 1H \) and \( R_5 = R_6 = 1 \) ohm.
Q5(a) Use Laplace-transform method to compute $e^{At}$ where $A$ is:

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

Q5(b) Realise the given function in Foster First Form:

$$Z(s) = \frac{(s(s^2+4))/((s^2+1)(s^2+9))}{(s^2+9)}$$

Q6(a) For the two port network shown in figure 7, the open circuit impedance and source resistance matrices are given by:

$$Z_{oc} = \begin{bmatrix} 1+s & 1 \\ 1 & 1+s \end{bmatrix}, \quad R = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

Determine the voltage scattering matrix.

Q6(b) Write a short note on computer aided analysis of linear resistive network.

Q7(a) Enumerate the basic steps involved in writing the state equation of a simple network. Also comment on the choice of state variables.

Q7(b) Test for positive reality the function:

$$H(s) = \frac{(s^4+2s^3+3s^2+s+1)}{(s^4+s^3+3s^2+2s+1)}$$