Max. Marks: 60

<table>
<thead>
<tr>
<th>Question</th>
<th>Instructions</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q.1 (a)</td>
<td>Draw the ‘Alternator Load characteristics’.</td>
<td>4</td>
</tr>
<tr>
<td>(b)</td>
<td>Derive the expression for power developed by a three phase salient pole alternator neglecting armature resistance. Draw the power/load angle characteristics.</td>
<td>8</td>
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<tr>
<td>OR</td>
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<tr>
<td>(b')</td>
<td>Explain how the values of Xd and Xq of a synchronous machine are measured experimentally by ‘Slip test’. Discuss the precautions used.</td>
<td>8</td>
</tr>
<tr>
<td>Q.2 (a)</td>
<td>Derive an expression of power shared between two alternators in terms of their no load and full load frequencies of governor characteristics.</td>
<td>4</td>
</tr>
<tr>
<td>(b)</td>
<td>A three phase alternator has rated voltage of 6.6 kV and a synchronous reactance of 5 ohm/phase and supplies 300 Amp at 0.8 p.f. lagging to infinite bus bar. Calculate the current and its power factor supplied by the alternator, if the excitation is increased by 25% keeping steam input unchanged.</td>
<td>8</td>
</tr>
<tr>
<td>OR</td>
<td></td>
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<tr>
<td>Q.2' a)</td>
<td>What are the conditions which should be satisfied in order that an incoming alternator may be connected in parallel with infinite bus bar. Describe “One Dark-Two Bright Lamp” method of synchronizing a three phase alternator with bus bar.</td>
<td>8</td>
</tr>
<tr>
<td>(b)</td>
<td>Explain and draw the Potier triangle curve of a synchronous machine.</td>
<td>4</td>
</tr>
<tr>
<td>Q.3</td>
<td>Define and explain the ‘transient and ‘sub-transient’ reactances and time constants of a synchronous machine and draw the relevant equivalent circuits.</td>
<td>12</td>
</tr>
<tr>
<td>Q.4(a)</td>
<td>Draw and explain the characteristics of a d. c. shunt generator.</td>
<td>6</td>
</tr>
<tr>
<td>(b)</td>
<td>Explain ‘commutation’ in d. c. machines.</td>
<td>6</td>
</tr>
</tbody>
</table>

**Note:**
- (i) Answer all questions.
- (ii) Assume suitable data, if missing.
- (iii) Symbols used have their usual meanings.
<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q.4 (a)</td>
<td>A shunt generator delivers 50kW at 250V and 400 rpm. The armature and field resistance are 0.02 ohms and 50 ohms respectively. Calculate the speed of the same machine running as a shunt motor and taking 50kW input at 250 V. Allow 1 volt per brush for contact drop.</td>
<td>8</td>
</tr>
<tr>
<td>(b)</td>
<td>Define and explain 'armature reaction' in d.c. machine.</td>
<td>4</td>
</tr>
<tr>
<td>Q.5 (a)</td>
<td>Explain the function of a d.c. shunt motor starter with 'No-volt' and 'over-load' coils with the help of a neat diagram of the starter.</td>
<td>6</td>
</tr>
<tr>
<td>(b)</td>
<td>Explain the construction and principle of operation of 'Stepper motor'.</td>
<td>6</td>
</tr>
</tbody>
</table>
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. | Questions                                                                 | M.M. |
-----|---------------------------------------------------------------------------|------|
1(a) | Define the following terms: (i) Accuracy (ii) precision (iii) resolution (iv) dead zone | [06] |
1(b) | Explain Gross, systematic and random errors using suitable examples.      | [06] |

OR

1(b') | Discuss the frequency errors in resistors and hence derive the expression for effective inductance, $L_{eff}$. | [06] |
2(a) | For a PMMC type instrument, derive the expression for final steady state deflection. Explain the main sources of errors present in these instruments. | [06] |
2(b) | A wattmeter has a current coil of 0.03 Ω resistance and a pressure coil of 6000 Ω resistance. Calculate the percentage error if the wattmeter is so connected that: i. the current coil is on the load side, ii. the pressure coil is on the load side if the load takes 20 A at a voltage of 220 V and 0.6 power factor in each case. What load current would give equal errors with the two connections? | [06] |

OR

2'(a) | Explain the two wattmeter method for the measurement of power in three phase circuits and hence derive the expression, $\tan \phi = \sqrt{3} \frac{P_1 - P_2}{P_1 + P_2}$ | [08] |
2'(b) | Discuss the creeping error in single phase induction type energy meter. How is it minimised? | [04] |
3(a) Draw the circuit of Kelvin’s double bridge used for measurement of low resistance. Derive the conditions for balance.  
3(b) What is phantom loading? How a wattmeter can be calibrated using this method?  

OR  
3'(a) Derive the equations of balance for Anderson’s bridge. Draw the phasor diagram for conditions under balance.  
3'(b) Explain the working of Megger with the help of neat diagram.  
4(a) Describe the method of Sphere gaps for measurement of peak voltages.  
4(b) A current transformer of nominal ratio 1000/5 A is operating with total secondary impedance (0.4+j0.3). At rated current the components of the primary current associated with the core magnetising and core loss effects are respectively 6 A and 1.5 A, the primary winding has 4 turns. Calculate the ratio error and phase angle at rated primary current if the secondary winding has 800 turns.  
5(a) Draw the circuit of an instrumentation amplifier and obtain the expression for output voltage.  
5(b) Draw the block diagram of a CRO and briefly explain its components. How voltage and frequency is measured using CRO?
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question

1(a) Define Superconductivity and Silsbee’s rule. Classify the superconducting materials according to the behaviour of applied magnetic field giving two examples.

1(b) Define thermal conductivity of metals and briefly explain the significance of Debye temperature in defining thermal conductivity of metals.

OR

1’ Derive a relationship between relaxation time and collision time of an electron and show that for isotropic material relaxation time is equal to collision time.

2(a) Classify the solid dielectrics in connection with their dielectric behaviour. Can electronic polarization and orientational polarization be separately measured?

2(b) There are \(10^{27}\) Hydrochloric (HCL) acid molecules per cubic meter in a vapour. Determine the Orientational polarization at room temperature if the vapour of HCL acid is subjected to an electric field of \(10^6\)V/m. The permanent dipole moment of molecule is equal to 1.04 Debye unit.

OR

2’ Define dipolar relaxation? Show that dipolar relaxation leads to a complex dielectric constant.

3(a) Define Townsend’s first and second ionization coefficients. What is Townsend’s criterion for spark breakdown in case of gaseous dielectrics?

3(b) Define the term volume resistance and surface resistance associated with insulating materials.

4(a) Giving examples, differentiate between soft and hard magnetic materials.

4(b) Classify different types of magnetic materials. Briefly explain each type with two examples each.

5(a) What is ferrite? Explain different applications of Ferrites?

5(b) Giving reasons explain what types of insulating materials are used in the construction of transformers and rotating electrical machines?
B.TECH. (AUTUMN SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
MATLAB FOR ENGINEERS
EE-278

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all the questions.
Assume suitable data if missing. Notations used have their usual meaning.
Grading will be done on correct and complete answers only.
Write detailed comments for each MATLAB code
Try to attempt questions in sequence preferably starting each question from a new page.

Q.No. Question M.M.

1 Given x = [3 1 5 7 9 2 6], explain briefly what the following commands "mean" by summarizing the net result of the command.
   i. x(1:7)
   ii. x(1:end)
   iii. x(6:2:1)
   iv. x([1 6 2 1 1])

OR

1'(a) Given the array A = [2 7 9 7 ; 3 1 5 6 ; 8 1 2 5], briefly explain the results of the following commands:
   i. A(:,[1 4])
   ii. A([2 3],[3 1])
   iii. sum(A,2)
   iv. [[ A ; sum(A) ] [ sum(A,2) ; sum(A(:)) ]]

2 Given that x = [1 5 2 8 9 0 1] and y = [5 2 2 6 0 0 2], execute and explain the results of the following commands:
   i. x | y
   ii. x & (~y)
   iii. (x > y) | (y < x)
   iv. (x > y) & (y < x)
Write a MATLAB code to enter the following matrix:

\[
A = \begin{bmatrix}
1 & 2 & a \\
b & -3 & 2 \\
3 & 1 & c
\end{bmatrix}
\]

i) Determine the matrix T which is transpose of the matrix A
ii) Determine the matrix P which is product of matrix A and transpose of matrix A.
iii) Check whether P is symmetric.
iv) Determine matrix M = 3A + 5T^3

Consider the initial value problem:

\[
x' = \frac{tx}{(1+x^2)}, \quad x(0) = 3
\]

Compute x(t) on the interval [0, 4]. How many steps are used to obtain this result?

Determine how many terms are required for the sum of the series \(9m^2-3m+1,\)
\(m=1,2,3,...\) to exceed 10,000. What is the sum for this many terms? Write a MATLAB code using While command to calculate and display the output.

Write a script that asks for a temperature (in degrees Fahrenheit) and computes the equivalent temperature in degrees Celsius. The script should keep running until no number is provided to convert.

A model of an electrically excitable cell that processes and transmits information through electrical and chemical signals, given by the following differential equation:

\[
\begin{pmatrix}
x' \\
y' \\
\cdot \\
\cdot \\
z'
\end{pmatrix} =
\begin{pmatrix}
-ax^2 + bx^2 + \varphi_1 x + \varphi_2 + g_s y - g_z z + \alpha \\
-c - dx^2 - \varphi_2 x - \beta y \\
r(s(x+x_0)-z)
\end{pmatrix}
\]

In this model, the state \(x(t)\) represents the electric potential the neuron produces. Parameters \(a, b, c, d, r, s, x_0, g_s, g_z, \ldots\) are constants. Inp is the input of the model.

Draw a Simulink model that can simulate this system for 2000ms with initial conditions \(x_0 = 0, y = 0\) and \(z = 0\).
Maximum Marks: 60  Credits: 04  Duration: Two Hours

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

Q.No Questions

1(a) A continuous time signal \( x(t) \) is as shown below. Sketch and label carefully each of the following signals (i) \( x(4 - \frac{t}{2}) \) (ii) \( [x(t) + x(-t)]u(t) \)

\( x(t) \)

\[ -2 \quad -1 \quad 0 \quad 1 \quad 2 \]

1(b) Consider a continuous time system with input \( x(t) \) and output \( y(t) \) related by \( y(t) = x(sin(t)) \). Determine whether the system is causal and time invariant.

2: Consider an LTI system with input \( x[n] = 2^n u[-n] \), \( h[n] = u[n] \). Let \( y[n] \) denotes the convolution of \( x[n] \) and \( h[n] \). Determine and plot \( y[n] = x[n] \ast h[n] \)

OR

2': Consider an LTI system with \( x(t) = \begin{cases} 1, & 0 < t < T \\ 0, & Otherwise \end{cases} \)

\( h(t) = \begin{cases} t, & 0 < t < 2T \\ 0, & Otherwise \end{cases} \)

Let \( y(t) \) denote the convolution of \( x(t) \) and \( h(t) \). Determine and plot \( y(t) = x(t) \ast h(t) \)

contd...
3. A periodic time signal \( x(t) \) is as shown below. Using the differentiation and shifting properties of Fourier series find the exponential Fourier series of the waveform.

\[
\begin{array}{cccccccc}
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\
-T & -T/2 & -T_1 & 0 & T_1 & T/2 & T & t \to
\end{array}
\]

OR

3' Using the Fourier Transform properties determine and sketch the magnitude and phase spectrum of the signal shown below.

\[
\begin{array}{cccccccc}
\cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\
-T & -T_1 & 0 & T & t \to
\end{array}
\]

4(a) The transfer function of the system is given by \( H(s) = \frac{2}{s+3} + \frac{1}{s-2} \).

Determine the impulse response if the system is (i) Stable (ii) Causal.

4(b) Determine the unilateral Laplace Transform of \( x(t) = \delta(t+1) + \delta(t-6) + e^{2(t+3)}u(t+1) \).

5(a) Determine the inverse z-transform of the following function

\[
X(z) = \frac{3 - 5z^{-1}}{(1 - \frac{1}{4}z^{-1})(1 - \frac{1}{3}z^{-1})}, \quad \text{ROC: } 1/4 < |z| < 1/3
\]

5(b) Find The z – transform and the corresponding ROC of the function

\[
x(n) = \sum_{k=0}^{\infty} \delta(n - k)
\]
Q. No. | QUESTIONS | M. M.
--- | --- | ---
1(a) | Express vector $\vec{A} = y\vec{a}_x + x\vec{a}_y$ in spherical coordinate system. | [06]
1(b) | In free space $V = 6xy^2z + 8$. At point $P(1, 2, -5)$, calculate $\vec{E}$ and $\rho_v$. | [06]
1'(a) | Given that $\rho_v = \begin{cases} 12 \rho \ nC/m^3, & 1 < \rho < 2 \\ 0, & \text{otherwise} \end{cases}$
Determine $\vec{D}$ everywhere. | [06]
1'(b) | Given that $\vec{E}_1 = 10 \vec{a}_x - 6 \vec{a}_y + 12 \vec{a}_z \ V/m$ in figure 1, find $\vec{E}_2$. | [06]

![Figure 1](image)

2 (a) | In a certain region,
$\vec{H} = yz(x^2 + y^2)\vec{a}_x - y^2xz\vec{a}_y + 4xz^2y^2\vec{a}_z \ A/m$
Show that the divergence of magnetic field density is zero. | [06]
2 (b) | Using Ampere's circuit law find the expression of magnetic field intensity due to infinite line current. | [06]
2'(a) | Given that $\vec{H}_1 = -2 \vec{a}_x + 6 \vec{a}_y + 4 \vec{a}_z \ A/m$ in region $y - x - 2 \leq 0$, $\mu_1 = 5\mu_0$, calculate $\vec{H}_2$ and $\vec{B}_2$ in region $y - x - 2 \geq 0$, where $\mu_2 = 2\mu_0$. | [06]
2'(b) | Show that $\vec{V} \times \vec{H} = \vec{J}$. | [06]
3(a) | Explain Transformer emf and Motional emf and find the expressions for these two. | [06]
3(b) | Show that the displacement current density is given by $\vec{J}_d = \frac{\partial \vec{D}}{\partial t}$. | [06]

contd... 2.
4(a) At 50 MHz, a lossy dielectric material is characterized by $\varepsilon = 3.6 \varepsilon_0$, $\mu = 2.1\mu_0$, and $\sigma = 0.08 \text{ S/m}$ if $\vec{E} = 6e^{-\gamma x} \vec{a}_z \text{ V/m}$, compute $\lambda, \mu, \eta$ and $\vec{H}$.

4(b) In a nonmagnetic medium, $\vec{H} = 0.2 e^{-y} \cos(2\pi \times 10^8 t - 5y) \vec{a}_x \text{ A/m}$. Find $\vec{E}$.

5 Determine the global coefficient matrix for the two-element region shown in figure 2.

![Figure 2](image)

**OR**

5' List the most commonly used numerical techniques in electromagnetism. Determine the potential at the free nodes in the potential system of figure 3 using finite difference method up to third iteration by iteration technique.

![Figure 3](image)
B. Tech. (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
Logic & Digital Circuits
EL-203

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions. Assume suitable data if missing.
Notations and symbols used have their usual meaning. Use of Calculator is NOT Allowed.

Q.No. Question M.M.  
1(a) Convert the decimal number 109.6875 into binary number. [03] CO-1  
1(b) Express the decimal number -39 as an 8-bit number in the sign-magnitude, 1's complement, and 2's complement forms. [03] CO-1  
1(c) Draw the logic diagram to implement the given Boolean function ‘F’ without simplifying it. \( F = A + B.C + (A + C)(\overline{B} + C) \) [06] CO-2  

OR

1(c') Implement XOR function using only NAND gates. [06] CO-2  
2(a) What do you understand by the Noise Margin, Power Dissipation and Fan-Out of a logic gate? [03] CO-2  
2(b) Implement the given logic function ‘F’ using NMOS logic. \( F = A \overline{B} + C.D \) [03] CO-2  
2(c) Draw a circuit diagram of 2-input TTL NAND gate with totem-pole output and describe its operation. [06] CO-2  

OR

2(c') Draw a circuit diagram of 2-input ECL OR/NOR gate and describe its operation. [06] CO-2  
3(a) Express the complement of the function ‘F’ in SOP form. \( F(x, y, z) = \overline{\prod (3, 5, 7)} \) [03] CO-3

Contd.... 2
3(b) Construct 3-to-8 line decoder using two 2-to-4 line decoders having active low Enable Input.

3(e) A combinational circuit is defined by function \( F = \sum (0, 2, 5, 6, 7) \). Hardware implement the Boolean function ‘\( F \)’ using a 4-to-1 MUX.

OR

3(e') Implement a 1-bit Full Adder circuit using 3-to-8 line decoder and external OR/NOR gates.

4(a) What do you understand by Synchronous and Asynchronous inputs of a Flip-Flop. Name various synchronous and asynchronous inputs in JK Flip-Flop.

4(b) What do you understand by Set-up Time, Hold Time and Propagation Delay of a Flip-Flop?

4(e) Design a MOD-10 ripple counter that will count as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, ....

OR

4(e') Design a 3-bit synchronous counter using D Flip-Flop that counts as 0, 1, 2, 3, 4, 5, 0, 1, ....

5(a) What do you understand by Step Size, Percentage Resolution and Offset Error of a DAC?

5(b) What do you understand by Astable, Monostable and Bistable Multivibrators?

5(e) Describe the method of Digital to Analog conversion with the help of 4-bit R/2R Ladder type DAC.

OR

5(e') Describe the method of Analog to Digital conversion with the help of 3-bit Flash ADC.