1. (a) Find the Laplace transform of the following
   
   (i) \((te^{s} \sin bt + e^{-t} u (t - 2))\)  
   (ii) \(\left(\frac{e^{-at} - e^{-bt}}{t}\right)\)
   
   (b) Evaluate the following:
   
   (i) \(L^{-1}\left[\frac{S}{(S^2 + a^2)^2}\right]\) by convolution theorem  
   (ii) \(L^{-1}\left[\frac{8S + 29}{S^2 - 12S + 32}\right]\)
   
   (c) Solve, by Laplace transform method,
   
   \((D^3 - D^2 + 4D - 4)x = 68e^{t} \sin^2 t, x_0 = 1, x_1 = -19, x_2 = -37.\)
   
   OR
   
   (c') Express \(f(t)\) in terms of unit step function and hence obtain Laplace transform, \([5+5+5]\)
   
   where
   
   \(f(t) = \cos (\omega t + \phi),\) for \(0 < t < T\) and
   
   \(= 0,\) for \(t > T.\)

2. (a) Solve the following system of linear equations by Gauss elimination method
   
   \[
   \begin{align*}
   2x + 2y + z + 2u &= 7 \\
   x - 2y - u &= 2 \\
   3x - y - 2z - u &= 3 \\
   x - 2u &= 0
   \end{align*}
   \]
   
   (b) The characteristic equation of the matrix
   
   \[
   \begin{bmatrix}
   10 & -1 & 0 \\
   -1 & 2 & 2 \\
   0 & 2 & 3
   \end{bmatrix}
   \]
   
   is \(\lambda^3 - 15\lambda^2 + 15\lambda - 17 = 0.\)
   
   Using the Newton-Raphson method, determine the eigen value \(\lambda\) that lies in
   
   interval \((9, 11),\) correct to three decimal places.
   
   OR

   Contd......2
(b') Determine p, q and r so that the order of iterative method:

\[ x_{n+1} = px_n + \frac{q_n}{x_n} + \frac{r_n}{x_n^2} \]

for a^3 become us high as possible.

(c) Prove the following identities:

(i) \( \Lambda V = \Lambda - V = \delta^2 \)
(ii) \( \mu = \sqrt{1 + \frac{\delta^2}{4}} \)
(iii) \( \frac{\mu}{c} \)
(iv) \( \mu \delta = \frac{1}{2} (\Lambda + V) \)

where the operators have their usual notations.

3. (a) Calculate \( f(15) \) and \( f(45) \) using suitable Newton's interpolating polynomials from the following data:

<table>
<thead>
<tr>
<th>x</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>f(x)</td>
<td>0.1736</td>
<td>0.3420</td>
<td>0.50</td>
<td>0.6428</td>
<td>0.7660</td>
</tr>
</tbody>
</table>

(b) Using the following table find \( f(x) \) as a polynomials in \( x \) by Newton's divided difference method:

<table>
<thead>
<tr>
<th>x</th>
<th>-1</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>f(x)</td>
<td>3</td>
<td>-6</td>
<td>39</td>
<td>822</td>
<td>1611</td>
</tr>
</tbody>
</table>

Also find the value of \( x \) for \( f(x) \) is maximum / minimum.

OR

(b') Given the following data table, use the Lagrange's interpolation polynomial, \( f(x) \), to fit the data and find \( f(1998) \).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>f(x)</td>
<td>440</td>
<td>510</td>
<td>525</td>
<td>571</td>
<td>500</td>
<td>600</td>
</tr>
</tbody>
</table>

(c) Derive Simpson \( \frac{3}{8} \) rule and use it to evaluate the integral \( I = \int_1^2 \frac{dx}{1+x} \) with \( h = \frac{1}{6} \). [5+5+5]

4. (a) Use Runge-Kutta fourth order to find \( y(0.2) \) with \( h = 0.1 \) for initial value problem

\[ \frac{dy}{dx} = \sqrt{x + y} \ , \ y(0) = 1 \]

Contd......3
(b) Use the Taylor Series method including terms up to \( x^4 \) to solve \( \frac{dy}{dx} = x^2 + y^2 \) with initial condition \( y(1) = 1 \) and approximate \( y(1.2) \).

OR

(b') Solve, by modified Euler's method, the initial value problem \( \frac{dy}{dx} = x + y \), \( y(0) = 0 \), choose \( h = 0.2 \), compute \( y(0.4) \) and \( y(0.6) \).

(c) Solve B.V.P. \( y'' - 64y + 10 = 0 \), \( y(0) = y(1) = 0 \), using Finite difference method with \( h = \frac{1}{4} \).
Q.1 (a) Derive the expression for power developed by a three phase salient pole alternator neglecting armature resistance. Draw the power/load angle characteristics and explain the terms ‘excitation power’ and ‘reluctance power’.

(b) Explain what do you understand by the term ‘Armature Reaction’ of a synchronous machine. Discuss its effects at unity, lagging and leading power factors.

OR

Q.1’ (a) Explain and draw the ‘Alternator load characteristics’.

(b) The ‘open circuit’ and ‘Zero power factor’ test results of a 6 pole, 440V, 50Hz, the three phase, star connected turbo-alternator are given in the following table. The effective ohmic resistance between any two stator terminals is 0.3 ohm.

<table>
<thead>
<tr>
<th>Field current (Amp)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>O.C. terminal Voltage (Volt)</td>
<td>156</td>
<td>288</td>
<td>396</td>
<td>440</td>
<td>474</td>
<td>530</td>
<td>568</td>
<td>592</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Zero P.F. terminal Voltage (Volt)</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>80</td>
<td>206</td>
<td>314</td>
<td>398</td>
<td>460</td>
<td>504</td>
<td>-</td>
</tr>
</tbody>
</table>

Calculate the value of voltage regulation for a full load output of 40A at rated voltage and 0.8 power factor lagging.

Q.2 (a) What are the conditions which should be satisfied in order that an incoming alternator may be connected in parallel with infinite bus bar. Describe any one method of synchronizing a three phase alternator with bus bar.

(b) What do you understand by ‘Hunting’ of a synchronous motor? Derive expressions for load angle in under damped, over damped and critically damped conditions.

OR

[End of Page]
Q.2' (a) Explain the effect of governor characteristics on load sharing between alternators operating in parallel. Also derive an expression of power shared between two alternators in terms of their no load and full load frequencies of governor characteristics.

(b) A three phase star connected alternator is supplying 300 Amp. At 0.8 power factor lagging to 11 KV infinite bus bar. It has a synchronous reactance of 6 ohms per phase and the armature resistance is negligible. If the steam input of the alternator is increased by 30% and the excitation is also decreased by 25% find the current and power factor at which the alternator supplies power to the bus bar.

Q.3 (a) Write short notes on: (i) Stepper motor (ii) Hysteresis motor

(b) Draw and explain the equivalent circuits of a synchronous machine in d-axis and q-axis. Hence, explain the transient and sub-transient reactances of the machine.

Q.4(a) Explain 'Commutation' in d.c. machines. Also discuss the function of interpole windings.

(b) A d.c. shunt generator gave the following open circuit characteristics:

<table>
<thead>
<tr>
<th>Field current (A)</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Circuit emf (V)</td>
<td>54</td>
<td>107</td>
<td>152</td>
<td>185</td>
<td>210</td>
<td>230</td>
</tr>
</tbody>
</table>

The armature and field resistance are 0.1 and 80 ohms respectively, calculate.

(i) The voltage to which the machine will excite when run as a shunt generator at the same speed.
(ii) The voltage drop due to armature reaction when 100 amp current is passing in the armature at a terminal voltage of 175 volt.
(iii) The percentage reduction in speed at which the machine would fail to excite on open circuit.

OR

Q.4' (a) Define and explain armature reaction in a d.c. machine. Derive expressions for damagnetising and cross magnetizing ampere turns.

(b) Explain the characteristics of a d.c. shunt generator and discuss the causes of failure of voltage build up.

Q.5 (a) Draw and explain different types of characteristics of a d.c. compound motor. Also discuss the merits and demerits of compound motors compared to shunt and series motors.
(b) A 4 pole, 240 volt, wave connected shunt motor gives a power output of 11 kW when running at 1000 rpm and drawing armature current of 50A and field current of 1A. The armature has 600 conductors and the value of armature resistance is 0.1 ohm. The brush volt drop is negligible. Calculate:

(i) flux per pole
(ii) torque developed
(iii) field copper loss and rotational loss
(iv) efficiency
Max Marks: 60

Note: (i) Answer all questions. (ii) Assume suitable data of missing. (iii) Notations and abbreviations have their usual meaning.

1. (a) Discuss the constitutional features of ACSR conductor. What are its advantages? Also name other conductors used on over-head power transmission lines. [06]
(b) Determine the inductance of a single phase transmission line consisting of three conductors of 2cm. radii in 'go' conductor and two conductors of 4cm. radii in 'return' conductor as shown in Fig. 1.

Fig 1.

1. (a) What is method of images? Use this method to derive an expression for calculating the capacitance of a single phase line. [06]
(b) A ph. 132kv, 50Hz overhead transmission line is shown in Fig. 2. The radius of each phase conductor is 1.12cm and inter-distances between the phase conductors are 4.56m. If the length of line is 100km, calculate charging current per phase. Also mention the assumptions made.

Fig 2

2. (a) What do you understand by term "CORONA"? Discuss various factors on which it depends. [06]
(b) Determine the voltage, current and power factor at the sending end of a 3ph, 50Hz, overhead transmission line 160km long delivering a load of 100MVA at 0.8 pf lagging and 132 KV to a balanced load, Resistance, inductance and capacitance per km length of line are 0.160ohm, 1.2mH & 0.0082μF respectively. Use nominal π method.

OR

2. (a) What is Ferranti effect? With the help of a mathematical model explain this phenomenon. [06]

Contd.....2
(b) Two 3ph lines have following constants:
\[ A_1 = D_1 = 0.98/2^0, \quad B_1 = 28/69^0 \Omega, \quad C_1 = 0.0002/80^0S \]
\[ A_2 = D_2 = 0.95/3^0, \quad B_2 = 40/85^0 \Omega, \quad C_2 = 0.0004/50^0S \]
The lines are connected in cascade find:
(i) ABCD parameters of composite line.
(ii) Sending end current if composite system delivers 200A at 110 kv and 0.95 p.f. lagging.

3. (a) Name the various types of insulators used on over head power transmission lines. Discuss the advantages of disc type insulator over pin type. Also mention the material used for them.

(b) An over head transmission line has a span of 150m. The diameter of conductor used is 2.8 cm and weight is 1520 kg/km and an ultimate strength of 12900 kg. It is subjected to a wind pressure of 20kg/m². The thickness of ice coating is 1.25 cm. Determine the vertical and deflected sag. Use a factor of safety 2.

OR

3'. (a) What is sug template? What is its use and how they are prepared?

(b) A 3 unit insulator string is fitted with guard ring. The capacitances of link pins to metal work and guard ring can be assumed to be 15% and 5% of the capacitance of each unit. Determine the voltage distribution and string efficiency.

4. (a) With the help of a neat diagram explain the constructional details of a 3ph belted cable. What is the major draw-back of such type of cable?

(b) A single core cable has a conductor diameter of 3cm. and inside diameter of lead sheath is 6cm. If cable is designated for operating voltage of 33KV (line to neutral) find,
   (i) Minimum and maximum values of stress
   (ii) Optimal value of conductor radius for the smallest value of maximum stress.

5. (a) What is a sub-station? How are they classified on the basis of location? Illustrate the procedure to select the most suitable site for it.

(b) Discuss the role of earthing in power system. Describe the procedure to prepare an earth for earthing of a sub-station.
### Question & Answer

**Q. No.** | **Question** | **M.M.**
---|---|---
1(a) | Mention the Static and Dynamic characteristic of instruments and measurement system and categorise them as desirable and undesirable. | [05]
1(b) | What is “Loading Effect”? Explain the “Loading Effect” due to shunt and series connected instruments. | [07]

**OR**

1’(a) | Mention the considerations which should be taken into account while designing and constructing an “Inductance Standard”. | [07]
1’(b) | Current was measured during a test as 30.4 Amp, flowing in a resister of 0.105 Ω. It was discovered later that the ammeter reading was low by 1.2% and the marked resistance was high by 0.3%. Find the true power as a percentage of power that was originally calculated. | [05]

2 | Derive torque equation for “Electrodynamometer” types of instruments and explain its operation with D.C. and A.C. | [12]

**OR**

2’(a) | Describe the Error in “Moving Iron” types of instruments operating with alternating current due to following reasons:
(i) Frequency Error  
(ii) Eddy Current Error | [07]
2’(b) | The operating coil of a 250 V moving iron voltmeter has a resistance of 500 Ω and inductance of 0.1 H. The series resistance is 2000 Ω. The instrument reads correctly.
when a direct voltage of 250 V is applied. What will it read when 250V at 50Hz is applied? With what value of capacitance must the series resistance be shunted to make the meter read correctly at 50Hz?

3(a) Obtain the “Bridge Sensitivity” equation for Wheatstone Bridge.  
3(b) With the help of circuit diagram describe the “Phantom Loading” method for testing of Wattmeters and Energymeters.

OR

3'(a) Describe the Schering Bridge. Draw phasor diagram and obtain balance equations. Mention its advantages and disadvantages.  
3'(b) A highly sensitive galvanometer with negligible resistance can detect a current as low as 0.1nA. This galvanometer is used in a Wheatstone’s bridge as detector. Each arm of the bridge has a resistance of 1kΩ. The input voltage applied to the bridge is 20V. Calculate the smallest change in resistance which can be detected.

4(a) Describe the “Iron Losses” and its components. Illustrate the procedures for separation of Iron Loss components.  
4(b) Explain the “Rectifier Capacitor Charging” method for measurement of peak high voltage.

5(a) Explain and Derive the expression for the “Electrostatic Deflection” in CRO.  
5(b) Obtain the Gain equation of an Instrument Amplifier.
2014-15
B.TECH. (WINTER SEMESTER) EXAMINATION
MATLAB FOR ENGINEERS
EE-278

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

1(a) If vectors X and Y are given as

\[ X = [2 \ 3 \ 4], \ Y = [2 \ 5 \ 1] \]

Find
i) \( \text{xor}(\sim X, X \& \sim Y) \)
ii) \( X = \sim Y \mid X > Y \)

(b) Write a program to reverse the digits of a four digit number. The program should ask the user to input a four digit number.

(c) A positive integer is entered through the keyboard, write a function to find the binary equivalent of this integer.

OR

(c') What are the various data types in MATLAB. Explain with examples.

2(a) What is the value of \( D \) after the following MATLAB commands are executed:

\[ A = [1 \ 2 ; 3 \ 4]; B = [0 \ 1 ; 2 \ 1]; C = A \times B; D = B \times C; \]

(b) Show the contents of variables \( aa, bb, cc, dd \) and \( ee \) after the following instructions.

i. \( aa = [8 \ -3 \ 0; 1 \ 4 \ 12]; \)
ii. \( bb = [10 \ 20 \ 30 \ 40 \ 50 \ 60]; \ \text{bb} = \text{bb}(2) + \text{bb}(5); \)
iii. \( cc = [1, 2, 3, 4, 5, 6, 7, 8]; \ \text{cc}(1, 2) = 3 + \text{cc}(1, 1); \)
iv. \( dd = [1, 2, 3, 4, 5, 6, 7, 8, 9]; \ \text{dd}(1, 2) = \text{dd}(2, 1), 3; \)
v. \( ee = [2 \ 2 \ 18]; \ \text{ee} = \text{ee}(2:3:8); \)

(c) Write in brief about the following commands in MATLAB

\( \text{(e) scatter()} \quad \quad \text{(b) plot3()} \quad \quad \text{(c) subplot()} \quad \quad \text{(d) pie()}. \)

3(a) What are the contents of a M-file function? Explain each of them in detail.

(b) Write a program to implement the Bubble Sort algorithm on a set of 10 numbers.

Cont'd... 2.
(c) The surface area $A$ of a sphere of radius $r$ is given by the formula: $A = 4\pi r^2$. Write a MATLAB function named `sphereSurface` that takes the radius of the sphere as a parameter and returns the surface area of the sphere using the formula given above. Make sure the function is executable even if a vector of radius values is given.

OR

(c') A 5-digit positive integer is entered through the keyboard, write a function to calculate sum of the digits of the 5-digit number.

4(a). The equivalent circuit of a PV cell is shown in the figure. Obtain the block diagram of the simulation model for implementing a PV cell in SIMULINK. Assume $I_L$, $a$, $R_{Sh}$, $R_s$, $I_0$ to be constant under STC and provided by manufacturer.

4(b). Obtain the block diagram of steady state simulation model for a dc series motor in SIMULINK. The model should plot the torque vs armature current, speed vs armature current, torque vs speed characteristic.

OR

4'. Obtain the block diagram of dynamic simulation model for a dc shunt motor in SIMULINK. The model should plot the torque vs time, speed vs time curve.

5. Answer ANY THREE of the following:
   (a) Write a program to evaluate the following integral.

   \[ \int_{-1}^{1} \int_{0}^{2} (1 - 6x^2y) \, dx \, dy \]

   (b) Write a program to solve the first order ordinary differential equation as given below: $dx/dt = x + t$. With the initial conditions $x(0) = 0$. Show a plot for $x$ vs $t$.

   (c) A paper cup shaped as a cone is designed to have a volume of $V$ cm$^3$ (to be entered by the user). Write a program to determine the radius $R$ and height $h$ such that the least amount of paper will be used for making the cup.

contd. . . 
(d). Write a program in MATLAB to plot the step and impulse time response of a second order system. The program should ask the user to input the values of natural frequency, damping ratio and then calculate rise time, peak time, max. overshoot and settling time.

(e). Write a program to fit the polynomial of degree 3 for the data given below. The program should plot the curve also.

<table>
<thead>
<tr>
<th>x</th>
<th>2</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>24</td>
<td>156</td>
<td>284</td>
<td>560</td>
</tr>
</tbody>
</table>
2014-2015
B. Tech. IV SEMESTER EXAMINATION
(ELECTRICAL)
Signals & Systems
EE-282N

Maximum Marks: 60 Credit: 04 Duration: Three Hours

Q.No. Question M.M.
1 (a) Sketch the waveforms of the following signals:
   (a) \( x(t) = u(t) + r(t) - 2r(t-1) + r(t-2) - u(t-2) \)
   (b) \( y(t) = -u(t+1) + r(t+1) - r(t-1) - u(t-1) \)
   (b) Determine whether the following CT signals are periodic or not? If periodic, determine fundamental period.
   (i) \( \cos(100\pi t) + \sin(50\pi t) \)
   (ii) \( e^{-t/2} \)
   (iii) \( \cos^2(2\pi t) \)

OR

1' (a) Let \( x[n] \) be the input and \( y[n] = x[n^2] \) be the output of a system, determine whether the system is:
   (i) memoryless (ii) stable (iii) causal (iv) linear (v) time-invariant.
   (b) Figure below shows a pulse \( x(t) \) that is the superposition of three rectangular pulses. Using the rectangular pulse \( g(t) \), express \( x(t) \) in terms of \( g(t) \).

\[ \text{Figure:}
\begin{array}{c}
\text{g(t)}
\end{array}
\]

2 (a) Let \( x(t) = u(t-3) - u(t-5) \) and \( h(t) = e^{-2t} u(t) \).
Compute (i) \( x(t) \ast h(t) \) and (ii) \( \left( \frac{dx(t)}{dt} \right) \ast h(t) \)

(b) Find the unit impulse response of an LTI system specified by the equation:
\( (D^2 + 4D + 3)y(t) = (D + 5)f(t) \)

OR

(b') Describe the relationship between the impulse response and LTI system properties: memory and causality.

(06)

(06)

(06)

(06)
3. State and prove the time differentiation and time shifting property. Use these properties to find the Fourier transform of the triangular pulse \( f(t) = \Delta \left( \frac{t}{\tau} \right) \) illustrated in the figure below.

\[
\text{OR}
\]

\[
\frac{d^3}{dt^3} y(t) + 6 \frac{d^2}{dt^2} y(t) + 11 \frac{d}{dt} y(t) + 6 y(t) = x(t)
\]

(b) State and prove the time-scaling and frequency-shifting property of the Fourier Transform.

The trigonometric Fourier spectra of a certain periodic signal \( f(t) \) are shown in the figure below. By inspecting these spectra, sketch the corresponding exponential Fourier spectra and verify the results analytically.

4. (a) State and prove the initial and final value theorems.

(b) Consider the system characterized by the differential equation

\[
\frac{d^3}{dt^3} y(t) + 6 \frac{d^2}{dt^2} y(t) + 11 \frac{d}{dt} y(t) + 6 y(t) = x(t)
\]

Determine the zero-state response, zero-input response and the total response of this system when the input is \( x(t) = e^{-4t} u(t) \). The initial conditions are given as:

\[
y(0^+) = 1, \quad \left. \frac{d}{dt} y(t) \right|_{t=0^+} = -1, \quad \left. \frac{d^2}{dt^2} y(t) \right|_{t=0^+} = 1
\]

5. (a) Discuss how the Region of Convergence (ROC) is related to the characteristics of a discrete time signal, \( x[n] \). Support your answer with relevant figures.

(b) Determine the z-transform of the signal: \( x[n] = n \left( \frac{1}{2} \right)^n u[n] * \left( \frac{1}{4} \right)^n u[-n] \).

Specify the properties used in the intermediate steps.
2014 – 2015

B.TECH. (IV SEMESTER) EXAMINATION
(ELECTRICAL ENGINEERING)
CIRCUIT THEORY – II
HE – 284(N)
Credits : 03

Maximum Marks: 60

Duration: Three Hours

Note: Answer all questions.
Assume data suitably, wherever necessary.
Notations and symbols used have their usual meanings.

1. (a) Determine the parameters for the circuit shown in Fig. 1.

(b) Find image parameters of the network shown in Fig. 2.

OR

(b') Obtain the Lattice equivalent of a symmetrical π network shown in Fig. 3.
2. (a) (i) Test the polynomial $s^3 + 6s^2 + 12s + 8$, is Hurwitz or not.

(ii) Test the fn. $\frac{s^3 + 4}{s^2 + 2s + 5}$ for positive realness.

(b) Realize the fn. $\gamma(s) = \frac{(s^2 + 2)(s^2 + 4)}{(s^2 + 1)(s^2 + 3)}$ in Foster First Form.

OR

(b') Realize the fn. $\gamma(s) = \frac{s^3 + 4s + 3}{s^2 + 2}$ in Cauer First Form.

3. (a) Write fundamental cut set and fundamental loop matrix for the graph shown in Fig. 4

Choose 1, 2, 3 as tree branches.

OR

(a') Draw the graph of network shown in Fig. 5 and find the number of possible trees, also draw them.

(b) A network is shown in Fig. 6. Obtain loops currents using branch impedance matrix and tie-set matrix.
4(a) What are filters? How ideal filters could be obtained? Explain the term 'attenuation' referred to filters and establish relationship between 'Decibel' and 'Neper'.

(b) Calculate the cutoff frequency for the high pass filter shown in following circuit and determine the effect of load resistance $R_L = 100 \, \text{k}\Omega$ on the cutoff frequency. Also, determine the filter insertion loss if the signal source resistance $R_s = 100 \, \Omega$.

4(b) Determine the cutoff frequency for the following low pass filter. If the value of load resistor $R_L$ is $100 \, \text{k}\Omega$, determine power insertion loss. Also determine the effect of $R_L$ on cutoff frequency.

5. Write systematic procedure of writing the state equations for simple networks by inspection. How do you choose state variables for a circuit? Write state equations in matrix form for the following circuit.
B.TECH (WINTER SEMESTER) EXAMINATION
ELECTRICAL ENGINEERING
ELECTROMAGNETIC FIELD THEORY
EE285N

Maximum Marks: 60
Credits 04
Duration: Three Hours

Questions

1(a) Express the vector field
\[ H = xy^2z \hat{a}_x + x^2yz \hat{a}_y + xyz^2 \hat{a}_z \]
in cylindrical and spherical coordinates and also find it at (3, -4, 5).

1(b) Let
\[ \rho_v = \begin{cases} \frac{10}{1} \mu C/m^2, & 1 < r < 4 \\ \frac{5}{1}, & r > 4 \end{cases} \]

i. Find the net flux crossing surface \( r = 2 \text{ m} \) and \( r = 5 \text{ m} \).
ii. Determine \( D \) at \( r = 1 \text{ m} \) and \( r = 5 \text{ m} \).

1'(a) A spherical capacitor has inner radius \( a \) and outer radius \( b \) and filled with an inhomogeneous dielectric with \( \varepsilon = \varepsilon_0 \frac{k}{r^2} \). Show that the capacitance of the capacitor is
\[ C = \frac{4\pi \varepsilon_0 k}{b - a} \]

1'(b) Given that \( j = \frac{5e^{-3x^2}}{r} \hat{a}_r \ A/m^2 \), at \( t = 0.1 \text{ ms} \), find
i. Current passing through surface \( r = 2 \text{ m} \),
ii. The charge density on that surface.

2(a) Find the expression of the magnetic field intensity \( B \) for infinitely long coaxial transmission line.

2(b) The \( xy \)-plane serves as the interface between two different media. Medium 1 \((Z < 0)\) is filled with a material whose \( \mu_r = 6 \), and medium 2 \((Z > 0)\) is filled with a material whose \( \mu_r = 4 \). If the interface carries current \( \frac{1}{\mu_r} \hat{a}_x \ A/m \), and \( \vec{B}_2 = 5 \hat{a}_x + 3 \hat{a}_z \ \mu Wb/m^2 \), find \( \vec{B}_1 \) and \( \vec{H}_1 \).

2'(a) In a certain region,
\[ \vec{H} = yz(x^2 + y^2) \hat{a}_x - y^2x \hat{a}_y + 4x^2 y^2 \hat{a}_z \ A/m \]
i. Determine \( \vec{f} \) at \((5, 2, -3)\)
ii. Find the current passing through \( x = 1, 0 \leq y, z < 2 \)
iii. Show that \( \nabla \cdot \vec{E} = 0 \)

Contd.... 2.
2(b) A rectangular loop carrying current $I_2$ is placed parallel to an infinitely long filamentary wire carrying current $I_1$ as shown in figure 1. Show that the force experienced by the loop is given by $F = -\frac{\mu_0 I_1 I_2}{2\pi} \frac{1}{\rho_0} - \frac{1}{\rho_0} \frac{\partial}{\partial \rho} \rho \partial N$

![Figure 1](image)

3(a) Explain Transformer emf and Motional emf and find the expressions for these two.

3(b) The loop shown in figure 2 is inside a uniform magnetic field $\vec{B} = 50 \, \text{mT} \, \text{m}^{-2}$. If side DC of the loop cuts the flux lines at the frequency of 50 Hz and the loop lies in the yz-plane at time $t = 0$, find:

i. The induced emf at $t = 1 \, \text{ms}$

ii. The induced current at $t = 3 \, \text{ms}$

![Figure 2](image)

4(a) In a certain region with $\sigma = 0$, $\mu = \mu_0$ and $e = 6.25 \epsilon_0$, the magnetic field of an EM wave is $\vec{B} = 0.6 \cos \beta x \cos 10^3 \pi t \, \text{A/m}$. Find $\beta$ and corresponding $E$ using Maxwell's equations.

4(b) In a nonmagnetic medium $\vec{E} = 4 \sin(2\pi \times 10^7 t - 0.6x) \, \text{V/m}$. Find

i. $\sigma$, $\eta$

ii. The time-average power carried by the wave

iii. The total power crossing 100 cm$^2$ of plane $2x + y = 5$

Contd...
4(a) Express Maxwell's equations in phasor form. State and prove Poynting's theorem.

4(b) A transmission line operating at 500 MHz has $Z_0 = 80 \Omega$, $\alpha = 0.04 \, \text{Np/m}$, $\beta = 1.5 \, \text{rad/m}$. Find the line parameters $R, L, C$ and $G$.

5(a) For the potential system shown in figure 3 (divided into a square grid), write down the finite differential equations of nodes 1 to 3. Solve for potential for nodes 1, 2, and 3 by hand matrix technique.

5(b) Determine the global coefficient matrix for the two-element region shown in figure 4.
UNIT – I

1. Write a persuasive letter to the prospective buyers of luxurious flats being developed in Greater Noida with all modern facilities. Try to convince the buyer with interesting and attractive offers.

OR

Write a job application and create your CV in response to an advertisement that you recently saw in a national newspaper.

UNIT – II

2. Define and draft any two of the following business messages assuming appropriate business situations:
   (a) Tender and Bid
   (b) e-mail
   (c) Press Notice
   (d) Memo

UNIT – III

3. Make notes or write an abstract of the following passage:

The real estate sector continues to confront liquidity issues owing to subdued demand and restricted debt funding. However, private equity (PE) funds have continued to gain strength as an alternate source of funding. PE fund inflows into the real estate sector in the first quarter of calendar 2015 grew 85 per cent to Rs 5,108 crore, of which the residential sector attracted 53 per cent.

A study by real estate consultancy Cushman & Wakefield attributed the increase to improved market sentiments and higher investments in residential and commercial office assets.

The report said Chennai was the only city to see investment in commercial office in first quarter of 2015. However, it said leased office assets such as IT parks and IT-SEZs are likely to gain significant interest from foreign investors due to low risk, owing to high occupancy levels along with stable rental yields, and significant potential for capital value appreciation. In addition, the introduction of REITs (real estate investment trusts) in India is likely to boost investments as investors now have an exit route.

During the period, residential assets recorded the second highest PE investment since 2008 with total value of investments in residential sector 2.5 times more than the year ago figure at Rs 2,752 crore. The total investment in commercial office assets was at Rs 2,416 crore, up 68 per cent. It was the third highest investment in the commercial office sector since 2008.

“With improving macro-economic conditions, enabling policy environment, recovering demand, attractive valuations and increasing capital requirements of the Indian real estate sector, PE funds are likely to increase their investments in the next few years,” Sanjay Dutt, Executive Managing Director, South Asia, Cushman & Wakefield said in a statement.

“However, the PE funds are likely to take only calculated risks and collaborate strictly with renowned developers to protect their investments.”

The report said that although the number of deals during the quarter fell to 15 from 18, average deal size more than doubled to Rs 320 crore from Rs 150 crore.
UNIT-IV

4. How will you maximize your performance in a job frequently asked questions in job interviews? Attempt to answer two of such questions.

OR

Write the transcript of a telephonic conversation you had with the student advisor of a foreign university discussing your prospect of admission for M.S. and also the different options available for financial support there.

UNIT-V

5. Generate a group discussion choosing ONE of the following topics with at least FOUR participants:

(a) Reservation in jobs is doing more harm than good for the country.
(b) Privatization of health care will improve the quality of health care facility.
(c) Government should give more incentives to the farmers to ensure food security.