MAXIMUM MARKS: 60

DURATION: THREE HOURS

There are five questions
Each question has three parts (a, b and c)
Answer any two parts from each question.
Each part carries 6 Marks.
Symbols and notations have their usual meanings.
Any missing data may be suitably assumed.

1 (a) Draw the phasor diagram of a loaded alternator for the following conditions:
   (i) Lagging power factor
   (ii) Leading power factor
   (iii) Unity Power Factor
   (b) Explain and draw the alternator load characteristics.
   (c) A three-phase, 8-pole, 60 Hz, star-connected, salient-pole synchronous generator has 96 slots, with 4 conductors per slot connected in series in each phase. The coil pitch is 10 slots. If the maximum value of the air-gap flux is 60 mWb and the flux-density distribution in the air-gap is sinusoidal, determine:
      (i) The effective phase and line voltage
      (ii) If the phase is capable of carrying 650 A current, what is the kVA rating of the machine?

2 (a) What is the necessity of parallel operation of alternators? State the conditions necessary for parallelizing alternators.
   (b) Explain Potter-triangle method of determining the voltage regulation of an alternator
   (c) What is the effect of governor characteristics on load sharing of alternators?

3 (a) Explain heating of a synchronous machine. What is the purpose of damper windings in the synchronous motors?
   (b) What are V-curves and inverted V-curves of a 3-phase synchronous motor?
   (c) A 3000 V, 3-phase synchronous motor running at 1500 r.p.m. has its excitation kept constant corresponding to no-load terminal voltage of 3000 V. Determine the power input, power factor and torque developed for an armature current of 250 A if the synchronous reactance is 5 Ω per phase and armature resistance is neglected.

contd... 2
4  (a) Using relevant diagrams and waveforms, explain how armature flux distorts and reduces the main field flux in DC machines. Also discuss the effects of compensating and interpolar windings on the main field flux.

(b) Discuss the process of voltage build up in a DC shunt generator. Also discuss in brief the conditions for which DC shunt generator fails to generate the emf?

(c) Show that in a DC shunt generator for a given no load emf, the voltage drop at loading conditions is more for higher speeds.

A 250V compound generator has armature, series field and shunt field resistances of 0.4Ω, 0.2Ω and 125Ω respectively. If this generator supplies 10kW at rated voltage, find the e.m.f generated in the armature when machine is connected as long shunt. Assume a 1 volt per brush contact drop.

5  (a) Draw the speed-current, torque-current and speed-torque characteristics of DC shunt and DC series motors with and without considering the effect of armature reaction and saturation. Also derive the relevant expressions.

(b) Briefly discuss the operation of a three point DC motor starter. Discuss in brief its major limitation and how it is resolved using a four point starter.

(c) Explain the operation of a multi-stack variable reluctance type stepper motor.
2014-15
B.E. IV SEMESTER EXAMINATION
(ELECTRICAL)
ELECTRICAL MEASUREMENT
(EEE-251N)

Maximum Marks: 60
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) Describe the primary and laboratory standards for emf. Discuss their advantages. [07]
1(b) Current was measured during a test as 36.4 Amp, flowing in a resistor of 0.105 Ohm. 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(a) Drive the expression for capacitance to be connected across the multiplier of moving iron voltmeter so as to make its circuit for frequency upto 125 Hz. [05]
2(b) Describe the construction and working of PMMC instrument. Discuss their advantages and disadvantages. [07]

OR

2' (a) The coil of a 150 V moving iron voltmeter has a resistance of 400 Ohm and an inductance of 0.75 H. The coil is made of copper which has a resistance temperature coefficient of 0.004/°C. The current consumed by the instrument when placed on a 150 V d.c. supply is 0.05 A. The series resistance of the voltmeter is of manganin with a resistance temperature coefficient 0.00015/°C. Estimate,

(a) The temperature coefficient of the instrument,
(b) The alteration of the reading between direct current and alternating current at 100 Hz.
(c) Capacitance of the capacitor necessary to eliminate the frequency error.

contd... 2
2 (b) Prove that the true power = \[ P = \frac{\cos \phi}{\cos \phi \cos (\phi - \beta)} \times \text{actual wattmeter reading} \] for an electrolydynamometer type of wattmeter where \( \cos \phi \) is power factor of the circuit and \( \beta = \tan^{-1}(\omega L/R) \) where \( L \) and \( R \) are inductance and resistance of the pressure coil of the circuit.

3 (a) Drive the expression for bridge sensitivity for a Wheatstone bridge with equal arms resistance.

3 (b) Describe the requirements of an AC potentiometer. Mention its application.

OR

3' Describe the construction and working of a co-ordinate type AC potentiometer. How is it standardized?

4 (a) Describe a method of experimental determination of flux density in a specimen of magnetic material using ballistic galvanometer. Explain how the correction for flux in the air space between the specimen and the coil is applied.

4 (b) Why should not secondary winding be open when C.T. is in operation?

OR

4' (a) Describe the Lloyd fisher square method for measurement of iron loss in a specimen.

4' (b) Discuss the advantages of instrument transformers.

5 (a) Explain the electrostatic focusing of CRO.

5 (b) Write a short notes on instrumentation amplifier.
MAXIMUM MARKS: 40

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

\[ X = [5, 2, 1], \ Y = [0, 1, 5] \]

Find
i) \( x o r(x, x, x o r y) \)
ii) \( a n d(x, y | x > y, x > 2) \)

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

1(c) A positive integer is entered through the keyboard, write a program to obtain the sum of all integers up to the entered integer.

OR

1(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:

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

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

i. \( aa = [8:3:9, 1:4:12] \);
ii. \( bb = [10, 20, 30, 40, 50, 60]; \) \( bb(l e n g t h(b b)) = bb(2) + bb(5) \);
iii. \( cc = [1, 2, 3, 4, 5, 6, 7, 8]; \) \( cc(:, 2) = 3 + cc(:, 1) \);
iv. \( dd = [1, 2, 3, 4, 5, 6, 2, 8, 9]; \) \( dd([1, 2]) = dd([1, 2], 3) \);
v. \( ee = [2:2:18]; \) \( ee = ee([2:3:8]) \);

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

(a) \( plot() \) (b) \( bar() \) (c) \( fprintf() \) (d) \( input() \)

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

3(b) Write a program to implement the selection Sort algorithms on a set of 10 numbers.

3(c) Ten numbers are entered from the keyboard into an array. The number to be searched is entered through the keyboard by the user. Write a program to find if the number to be searched is present in the array and if it is present, display the number of times it appears in the array and its position.

OR

3(c') A positive integer is entered through the keyboard, write a function to find the binary equivalent of this number.
4(a). Obtain the block diagram simulation model for implementing a pv cell in SIMULINK. Assume the equivalent circuit shown in the figure. Assume $I_{k, a}$, $R_{k}$, $R_{s}$, $I_{c}$ to be constant under STC and provided by manufacturer.

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

4(c). Obtain the block diagram dynamic simulation model of 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 integral and derivatives of the following polynomials:

   \[ P(s) = s^4 + 4s^3 + 10s^2 + 20s + 15; \quad k = 1 \]
   \[ Q(s) = s^3 + 5s + 10; \quad k = 2 \]

   (b). Write a program to solve the first order ordinary differential equation

   \[ \frac{dy}{dt} = ye^{t} - 1 \]

   with the initial conditions $y(0) = 1$. Plot $x$ versus $t$ for the interval $0 < t < 2$.

   (c). Explain the following functions identifying parameters in brackets with the help of examples:

   \[ \text{a) int}(x, a, b) \quad \text{b) diff}(x, a, v) \quad \text{c) solve}(x, a) \quad \text{d) collect}(y, a) \]

   (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 2 for the data given below. The program should plot the curve also.

   \[
   \begin{array}{c|c|c|c}
   \hline
   x & 2 & 5 & 7 \\
   \hline
   y & 12 & 39 & 67 \\
   \end{array}
   \]
Q.No. 1 (a) Define Energy and Power signals. Identify the following signals as Energy or Power signals and find their value.

(i) \( x(t) = 5\cos(\pi t) + \sin(5\pi t) \), \(-\infty < t < \infty\)  
(ii) \( x(t) = \begin{cases} 
5\cos(\pi t) & -1 \leq t \leq 1 \\
0 & \text{otherwise} 
\end{cases} \)

\( x(t) \) is a continuous time signal.

(b) For a system with \( x(t) \) as input and \( y(t) \) as output, determine whether it is (i) memoryless (ii) stable (iii) causal (iv) linear (v) time-invariant.

\( y(t) = \begin{cases} 
0 & t < 0 \\
 x(t) + x(t-2) & t \geq 0 
\end{cases} \)

OR

1' (a) Express the staircase signal \( x(t) \) given below as a superposition of four rectangular pulses in terms of the basic rectangular function \( g(t) \).

(b) Sketch the waveforms of the following signals:

(a) \( x(t) = u(t + 1) - u(t) + r(t) - r(t - 1) - u(t - 2) \)

(b) \( y(t) = -u(t + 1) + r(t + 1) - r(t - 1) - u(t - 1) \)
2 (a) List the steps for carrying out the graphical approach to convolution.

(b) Use these steps to find the convolution of $x(t)$ and $h(t)$, if $x(t)$ and $h(t)$ are defined as follows:

\[ x(t) = 2u(t-1) - 2u(t-3) \]

\[ h(t) = u(t+1) - 2u(t-1) + u(t-3) \]

Sketch the intermediate plots and the convolution output, $x(t)*h(t)$. 

OR

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

3 (a) State and prove the Convolution property of the Fourier Transform.

(b) Find the Fourier Transform of a unit step function. Use the result and the time convolution property to show that:

\[ \mathcal{F}\{f(t) \ast d(t)\} = \frac{F(\omega)}{j\omega} + \pi F(0)\delta(\omega) \]

OR

(b') Find the exponential Fourier Series for the Half-wave rectified sinc wave shown in Figure and sketch the line spectrum.

![Half-wave rectified sinc wave](image)

4 (a) Find the unilateral Laplace Transform of $x(t) = e^{-t}(t-2)u(t-2)$. Specify clearly the intermediate steps and explain the properties used.

(b) Determine the forced $y^{(f)}(t)$ and natural responses $y^{(n)}(t)$, for the system described by the following differential equations with the specified inputs and initial conditions:

\[ \frac{d^2}{dt^2} y(t) + 5 \frac{dy}{dt} + 4 y(t) = 2 \frac{dx}{dt} \] $x(t) + x(t)$,

$y(0^+) = 1, \quad \left. \frac{dy}{dt} \right|_{t=0} = 2, x(t) = u(t)$

5 (a) Define Region of Convergence (ROC) in a Z-transform. Find the ROC for the following signal: $y[n] = 2\delta[n+2] + 3\delta[n] - 5\delta[n-1] + 3\delta[n-2]$

(b) Determine the z-transform of the signal: $x[n] = a^n \sin(\omega_0 n)u[n]$. Specify the property used.
B.E. (IV SEMESTER) EXAMINATION
(ELECTRICAL)
ELECTROMAGNETIC FIELD THEORY
(EEE - 285 N)

Maximum Marks: 60
Duration: Three Hours

Note: All the symbols have their usual meaning in the context of this course. Make suitable assumption if any data is missing.

(a) The three vertices of a triangle are located at A(6, 1, 2), B(-2, 3, 4), and C(-3, 1, 5). Find (a) $\bar{R}_{AB}$, (b) $\bar{R}_{AC}$, (c) the angle $\theta_{BAC}$ at vertex A and (d) the projection of $\bar{R}_{AB}$ on $\bar{R}_{AC}$.

(b) Infinite uniform line charges of $5\mu C/m$ lie along (positive and negative) x and y axes in free space. Find

(a) $\bar{E}$ at $P_A (0, 0, 4)$ and
(b) $\bar{E}$ at $P_B (0, 3, 4)$.

OR

(b') An electric dipole is located at the origin in free space has a moment $\bar{p} = 3\hat{a}_x - 2\hat{a}_y + \hat{a}_z$. Find

(a) $V$ at $P_A (2, 3, 4)$ and
(b) $V$ at $r = 2.5, \theta = 30^\circ, \phi = 40^\circ$.

2.

(a) Calculate the value of vector current density ($\vec{j}$) in rectangular coordinates at $P_A (2, 3, 4)$ if $\vec{H} = x^2\hat{a}_y - y^2\hat{a}_x$.

(b) A conducting filamentary triangle joins points A(3, 1, 1), B(5, 4, 2), and C(1, 2, 4). The segment AB carries a current of 0.2 A in the $\hat{a}_x$ direction. There is present a magnetic field $\vec{B} = 0.2\hat{a}_x - 0.1\hat{a}_y + 0.3\hat{a}_z$ T. Find the force on segment BC.

OR

(b') The permittivity of region A ($x < 0$) is $5\mu F/m$ and of region B ($x > 0$) is $20 \mu F/M$ respectively. If there is a surface current density $\vec{K} = 150\hat{a}_x - 200\hat{a}_y$ A/m at $x = 0$ and $\vec{H}_A = 300\hat{a}_x - 400\hat{a}_y + 500\hat{a}_z$ A/m. Find $|\vec{H}_{BA}|$, $|\vec{H}_{AB}|$, $|\vec{H}_{BC}|$ and $|\vec{H}_{NA}|$.

Contd....2
3. (a) Write the expression and statement for the point form of Maxwell's equations.
(b) Let $\mu = 10^{-5}$ H/m, $\epsilon = 4 \times 10^{-9}$ F/m, $\sigma = 0$ and $\rho = 0$. Find $E$, so that the following pair of fields satisfies Maxwell's equations:

$$\vec{D} = (20y - Kt) \hat{a}_x \text{ V/m} \quad \text{and} \quad \vec{H} = (y - 2 \times 10^6 t) \hat{a}_x \text{ A/m}.$$ 

OR

(b') The displacement current density is $5 \cos (2 \times 10^3 t - KZ) \hat{a}_x \text{ J/m}^2$ in a material for which $\sigma = 0$, $\epsilon = \epsilon_0$ and $\mu = 4\mu_0$. Find $\vec{D}$, $\vec{E}$, $\vec{B}$ and $\vec{H}$.

4. (a) What is 'surface impedance' of a conductor? Derive its expression.
(b) A wave with amplitude $E_0 = 600 \text{ V/m}$ at $(0, 0, 0, t = 0)$ is propagating in the $\hat{a}_x$ direction in a material where $\sigma = 0.1 \text{ S/m}$, $\epsilon = 2 \times 10^{-11} \text{ F/m}$, $\mu = 2 \times 10^{-6} \text{ H/m}$. If $s = 10^{16} \text{ rad/s}$, find

(a) $E_x$ at $(0, 0, 2 \text{ cm}, 0.1 \text{ ns})$, and
(b) $H_y$ at $(0, 0, 2 \text{ cm}, 0.1 \text{ ns})$.

OR

(b') In free space $E = 4 \sin (2\pi \times 10^7 t - 0.8x) \hat{a}_x \text{ V/m}$. Find (a) the time average power carried by the wave, and (b) the total power crossing $100 \text{ cm}^2$ of plane $2x + y = 5$.

5. (a) What do you understand by 'ionizing' and 'non-ionizing' radiation? Describe how they affect human health.
(b) Describe the Finite Difference Method (FDM) for solving Laplace's equation in 2D.
Maximum Marks: 60

Note: Answer all questions. Abbreviations have their usual meaning. Assume suitable data, if missing.

(a) Draw circuits for following expressions using minimum number of gates:

(i) \( z = \overline{A}BC + ABC + BCD \)

(ii) \( y = \overline{PQRS} + \overline{FRS} + \overline{FQR} \overline{R} \)

Use Boolean theorems for minimization.

(b) Prove that NOR gate is universal gate.

(c) Represent each of the following signed decimal numbers in the 2's-complement system. Use a total of eight bits, including sign bit.

(i) +32  (ii) +127  (iii) -191  (iv) -55

(v) -127  (vi) -104  (vii) -89  (viii) -1

OR

(c') Perform the following operations in 2's-complement system by using 8-bits for each number inclusive of sign bit.

(i) Add -48 to -80  

(ii) Subtract 36 from -15  

(iii) Subtract +21 from -13  

(iv) Add +14 to -17

(a) With the help of clear circuit diagrams explain the operation of ECL OR/NOR gate.

(b) Draw the voltage transfer characteristics of CMOS inverter. Drive all regions of operation and clearly label them in the characteristics.

OR

2'. (a) Implement the following functions using CMOS logic using minimum number of transistors:

(i) \( o = AB + CD + \overline{E} \)  

(ii) \( x = ABC + ADE \)

(iii) \( y = A + B + \overline{CD} \)  

(iv) \( z = \overline{PQ} + RS \)

(b) Which technology among ECL, TTL and CMOS will you prefer for low power consumption, high speed and best noise immunity, respectively? Give reasons also.

Contd....2
3. (a) What do you understand by decoders, encoders, multiplexers and demultiplexers? What are their applications?  
(b) Minimize the following functions using K-map:
   (i) \( y = C(\bar{A}B\bar{D} + D) + \bar{A}BC + \bar{D} \)
   (ii) \( x = \bar{A}BC + \bar{A}BC + ABC + A\bar{B}C + A\bar{B}C \)
   Draw the circuit also.
(c) What do you mean by programmed and not-programmed RAMs? Explain with clear diagrams.

4. (a) What is the difference between asynchronous and synchronous counters? Design a MOD-12 synchronous counter and draw the designed circuitry.
    OR
(a') With all the suitable circuits, explain the write and read operations of Static RAM.
(b) Give the classification of memory.

5. (a) Explain the working of digital ramp ADC, with clear diagrams.
(b) Write note on:
   (i) Sample and hold circuits
   (ii) Astable multi-vibrators
(c) An 8-bit DAC produces an output of 2.0 V for an input code of 01100100. What will be the value of output voltage for an input code of 10110011? Also find out the percentage resolution of this DAC.