[This question paper contains 7 printed pages]

Roll No.	

ASME-24BC-EENG-I

ELECTRICAL ENGINEERING (PAPER-I)

Time Allowed: 3 Hours [Maximum Marks: 100

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read the following instructions carefully before attempting questions.

1. There are EIGHT questions printed in English.
2. Candidate has to attempt FIVE questions in all.
3. Question No.1 is compulsory. Out of the remaining SEVEN questions, FOUR are to be attempted.
4. All questions carry equal marks. The number of marks carried by a question / part are indicated against it.
5. Write answers in legible handwriting.
6. Wherever any assumptions are made for answering a question, they must be clearly indicated.
7. Diagrams / Figures, wherever required, shall be drawn neatly. Unless otherwise mentioned, symbols and notations carry their usual standard meanings.
8. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in answer book must be clearly struck off.
9. Re-evaluation / Re-checking of answer book of the candidate is not allowed.
10. Graph and Semi-log paper may be required to answer some questions.

1. (a) The h −parameter matrix of network block shown in Figure 1(a) is given as 05

$$h = \begin{bmatrix} 1 & 3 \\ -3 & 1 \end{bmatrix}$$

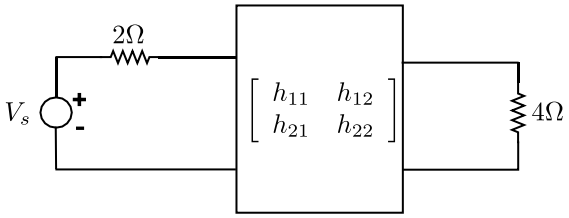

Figure 1(a)

The power dissipated in the 4Ω load is 25W. Calculate the value of the source V_s. Also find the power supplied by the source.

(b) Two single phase transformers rated as 500kVA and 400kVA respectively are connected in parallel to supply a load of 800kVA at 0.8pf lagging. The first transformer has resistance and reactance of 3pu and 6.5pu respectively. The second transformer has resistance and reactance of 1.5pu and 8pu respectively. Calculate the kVA loading and power factor at which each transformer operates. 05

(c) Construct the state diagram of a mod-7 UP/DOWN counter and design its circuit using $J-K$ flip flops. 05

(d) The bilateral Laplace transform of a signal $x(t)$ is given as $X(s) = \frac{2s^2+3s+18}{(s+2)(s^2+2s+10)}$. 05

Using partial fractions, evaluate the signal $x(t)$ for the following different Region of Convergences (ROCs)

(i) with ROC $\Re\{s\} < -2$

(ii) with ROC $-2 < \Re\{s\} < -1$

(iii) with ROC $\Re\{s\} > -1$

2 (a) If $x(t) = 10 \text{ rect}\left(\frac{t-2}{5}\right)$, find its Fourier Transform $X(j\omega)$. Evaluate the energy of the signal $x(t)$ using Parseval's theorem. Further, evaluate the Fourier transforms for the signals (i) $x(t-2)$ and (ii) $x(4t-8)$ via use of obtained $X(j\omega)$. 07

(b) For the circuit shown in Figure 2(b), the BJT has $\beta = 100$ and $r_0 = \infty\Omega$ 07

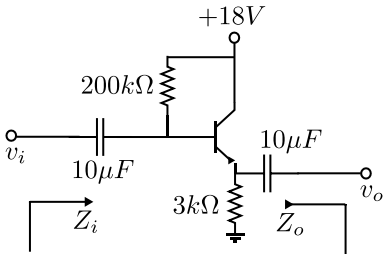

Figure: 2(b)

(i) Compute I_B, I_E, r_e, Z_i, Z_o and A_v

If practically BJT has $r_o = 20k\Omega$, then calculate A_v and compare its value with the A_v obtained for $r_o = \infty\Omega$.

(c) An AM wave is given as $s(t) = Acos(\pi 200t) + Bcos(\pi 170t) + Bcos(\pi 230t)$. The ratio of sideband power to the total power is 50%. The power of the carrier wave is $50W$. Compute the amplitude of the carrier and sideband signals, and the modulation factor μ. Also compute the expression for the envelope $v(t)$for the modulated signal and its real Fourier series representation. 06

3. (a) The function table of a converter is as shown in Table 3(a) below. Starting with the Boolean expressions for the three outputs (P, Q, R,), minimize them using Karnaugh maps and then hardware-implement this converter with a suitable PLD with PAL architecture. 07

Input Signal			**Output Signals**		
A	**B**	**C**	**Y1**	**Y2**	**Y3**
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	0	1
0	1	1	0	0	1
1	0	0	0	1	1
1	0	1	1	1	1
1	1	0	1	0	1
1	1	1	1	0	1

Table 3(a)

(b) In a three-dimensional space bounded by $|x|, |y|, and\ |z| < 1$, with $\epsilon_r = 4$ and $\mu_r = 3.5$ and $\sigma = 0$, the current density is given by 07

$$J_d = 18\cos(1.5 \times 10^8 t - bx)\boldsymbol{a_y}\,\mu A/m^2.$$

(i) Find **D** and **E**

(ii) Find **B** and **H** using point form of Faraday's Law and integration with respect to time

(iii) Use $\nabla \times \boldsymbol{H}$ to find J_d

(iv) Using above part solutions, evaluate the value of b

(c) A fully controlled single-phase full wave bridge rectifier has a source voltage of 220, 50Hz. The rectifier is supplying an RL load with $R = 20\Omega$ and $L = 48mH$ with a firing angle $\alpha = 45°$. Assuming that there is no source inductance and no freewheeling diode, derive 06

(i) expression for the load current and comment whether the load current is continuous or discontinuous.

(ii) Calculate the average load current and power absorbed by the load.

4. (a) For the circuit shown in Figure 4(a), if the source voltage is $V_s = 20\angle 0°$, calculate the voltage V_2 across 6Ω resistor and the average power delivered to the 6Ω resistor for the cases when (i) $\alpha = 0$mS and (ii) $\alpha = 1$mS. 07

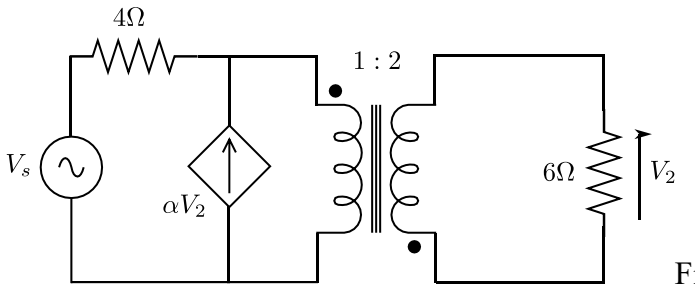

Figure 4(a)

(b) Given a modulating signal $m(t) = e^{-2t^2}$ modulating a carrier wave of frequency $f_c = 10^4$Hz. The frequency sensitivity and phase deviation are given as $k_f =$ 07

4000π and $k_p = 6000\pi$ respectively. Find the frequency deviation for the FM and PM signals. Also estimate the bandwidth of FM and PM signals.

(c) A 400V, 50Hz, 4-pole, 3-phase Y-connected induction motor has the following circuit model parameters $R_s = 0.3\Omega$, $R_r' = 0.25\Omega$, $X_s = X_r' = 0.6\Omega$ and $X_m = 35\Omega$. The nominal full load slip is 0.04. Determine the initial braking torque, when the motor is to be braked by plugging from its initial full load condition without any braking resistor. Also calculate the value of braking resistance to be inserted R_B and corresponding braking toque so as to limit the braking current to 1.6 times its full load value. 06

5. (a) For a lossless transmission line operating at $50Hz$ has $Z_0 = 60\Omega$ and $\gamma = 0 + j0.2\pi\ m^{-1}$, find the inductance and capacitance of the transmission line. If a load of $Z_L = 70 + j80\Omega$ is located at $z = 0$, then what is the shortest distance from the load to a point at which $Z_{in} = R_{in} + j0$? 07

(b) The single-phase converter as shown in Figure 5(b) operating on V_s =220V, 50Hz AC supply is feeding an RL load with $R = 33\Omega$, $L = 72\text{m}H$ and delay angle of $\alpha = 60°$. 07

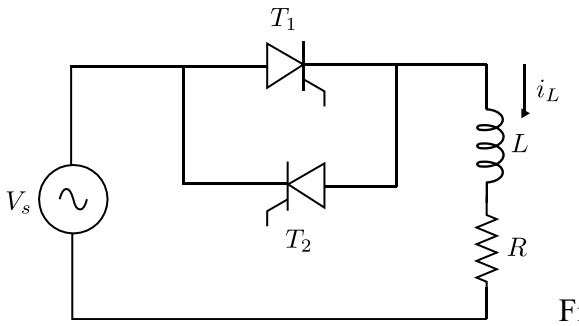

Figure 5(b)

For this converter configuration, determine

(i) expression for the load current $i_L(t)$
(ii) RMS load current
(iii) RMS current in each SCR
(iv) Power dissipated in the load

Also sketch the output voltage waveform.

(c) Sketch the schematic circuit diagram and discuss the principle and working of a Dual Slope A/D converter. Also derive the expression for the count recorded in the counter of converter. 06

6. (a) A band pass filter consists of a symmetrical T-section as shown in Figure 6(a) below. 07

Find the cutoff frequencies, pass band and characteristic impedance of the section

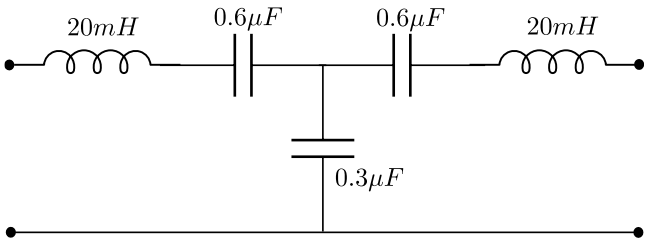

Figure 6(a)

(b) A 500kVA, 3300V, 50Hz, 4-pole three phase Y-connected round rotor synchronous generator has $X_s = 0.9\Omega$ per phase. The generator is operating at full load and 0.8pf lagging while connected to an infinite bus. If due to disturbance, the power angle swings by 2°electrical, calculate the synchronizing torque and power per phase. Assume armature resistance to be negligible. 07

(c) For the JFET source follower circuit shown in Figure 6(c) 06

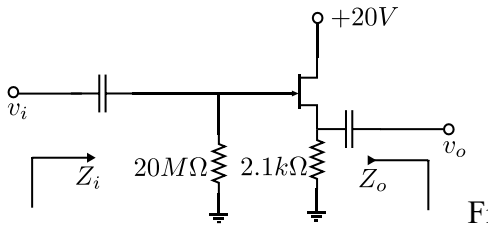

Figure 6(c)

If JFET has $I_{DSS} = 6mA$, $V_p = -6V$ and $r_d = 50k\Omega$, find Z_i, Z_o *and* A_v.

7. (a) Evaluate the Z transform of the following signals and then convert back the signals to x[n] taking inverse-Z transform in a form with convolution term expanded. 07

(i) $x[n] = \left(\frac{1}{3}\right)^n u[n] * 3^n u[-2n-1]$

(ii) $x[n] = n\left(\left(\frac{1}{4}\right)^n u[n] * \left(\frac{1}{3}\right)^n u[n-3]\right)$

(b) A square wave 50Hz single phase inverter is fed from a 240V DC source. The inverter is feeding an RL load with $R = 30\Omega$, $L = 40mH$. Determine 07

(i) expression for the load current and sketch the output voltage and current waveforms.

(ii) RMS load current

(iii) Average source current

(c) A 220V, 20kW DC shunt motor has a field resistance of 110Ω while driving certain load. The motor achieves maximum efficiency of 90% at 840rpm with the shaft load of 16kW. Calculate 06

(i) armature resistance and rotational loss

(ii) Efficiency, line current and speed of the motor if the shaft load is increased to 18kW

8. (a) A microstrip line is constructed using a lossless dielectric with $\epsilon_r' = 0.6$. The line has a characteristic impedance of 100Ω. Calculate (i) $\epsilon_{r,eff}$ (ii) w/d 07

(b) A combinational circuit is defined as $F = \Sigma\, 1,3,4,7$. The circuit hardware is to be implemented using suitable decoder(s) and external OR/NOR gates with minimum number of inputs. Also give the implementation using universal gate(s) without using decoders. 07

(c) Discuss the properties of the positive real functions. Synthesize the following impedance function using Foster I and Foster II realizations. 06

$$Z(s) = \frac{(s^2+4)(s^2+16)}{s(s^2+9)}$$

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