Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Electrical & Electronic Engineering

Final Examination, 2023 — **3rd year 1st Semester**
Course No: EEE 501 — **Course Title: Communication I**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. : (i) Answer any three question from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)-------N/A-------

PART-A
(Answer any **three** questions)
"All the symbols have their usual meanings. Assume reasonable values for missing data."

1. (a) What is the significance of Shanon's capacity theorem? 02

   (b) Describe the envelope detection method and coherent detection method of AM signal. 08

2. (a) Why QAM is an attractive alternative to SSB? 01

   (b) Determine the power efficiency and the percentage of the total power carried by the carrier signal for single tone modulation when modulation index is 0.5. Determine the USB and LSB power when the amplitude of the message signal is 2 and the carrier signal is defined by 4 $Cos(\omega_c t)$. 02

   (c) Explain the working principle of ring modulator. 02

   (d) With diagram describe DSB-SC implementation showing both upper side band and power sideband. 05

3. (a) What is the significance of modulation? 03

   (b) Sketch $\varphi_{AM}(t)$ for modulation indices $\mu = 0.5, \mu = 1, and\ \mu = 1.5$ when $m(t) = BCos(\omega_m t)$. 03

   (c) Describe the Quadrature Amplitude Modulation (QAM) technique and its application. 04

4. (a) Find $\varphi_{SSB}(t)$ for a tone modulation, that is, when the modulating signal is $m(t) = Cos(\omega_m t)$. 04

   (b) What is Multiple Access (MA) techniques? Compare among FDMA, TDMA, CDMA. 02

   (c) In a 2 user CDMA system, the code sequence for user 1 and 2 are [-1, 1, 1,-1, 1, -1, 1] and [-1, -1, 1, 1, -1, -1, 1] respectively. In a certain bit period, user 1 and user 2 are transmitting bit '1' and '0', respectively. Draw the transmitted/received CDMA signal and decoded CDMA signal for each user at their receivers. Also determine the bit decision for each user at their receivers. 04

PART-B

(Answer any **three** questions)

"All the symbols have their usual meanings. Assume reasonable values for missing data."

5. Discuss all types of DSB-SC modulators with proper block diagram and equations. 10

6. (a) How can you demodulate a SSB-SC signal? 03

   (b) The carrier frequency of a certain VSB signal is ω_c = 20 kHz, and the baseband signal bandwidth is 6 kHz. The VSB shaping filter $H_i(\omega)$ at the input, which cuts off the lower sideband gradually over 2 kHz, is shown in Fig. 6(b). Find the output filter $H_o(\omega)$ required for distortionless reception. 02

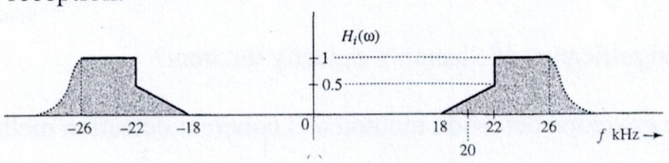

Fig. 6(b)

   (c) An angle-modulated signal with carrier frequency $\omega_c = 2\pi \times 10^5$ is described by the equation $\varphi_{EM}(t) = 10Cos(\omega_c t + 5Sin3000t + 10Sin2000\pi t)$ 05

   (i) Find the power of the modulated signal.
   (ii) Find the frequency deviation Δf.
   (iii) Find the deviation ratio β.
   (iv) Find the phase deviation $\nabla\varphi$.
   (v) Estimate the bandwidth of $\varphi_{EM}(t)$.

7. (a) What is aliasing? How can you avoid aliasing in signal sampling? 02

   (b) For the following sequence {1.2, -0.2, -0.5, 0.4, 0.89, 1.3} quantize it using a uniform quantizer of rounding type and write the quantized sequence. Quantizer range is (-1.5, 1.5) with 4 levels. 02

   (c) In a uniform quantization, the m(t) of continuous amplitude is in the range [-5, 5] with average power 3 Watt. If we use 4 bits to present each level, calculate the signal-to-noise ratio in dB. 02

   (d) Describe $\mu - law$ and A- law. 04

8. (a) What is line coding? 01

   (b) For the binary sequence {1,1,0,1,0,0,1}, show the Differential Manchester, Unipolar NRZ, NRZ-L, Bipolar RZ, Split-phase or Manchester line coding. 05

   (c) Following figure shows synchronous TDM with a data stream for each input and one data stream for the output. The unit of data is 1 bit. Find (a) the input bit duration, (b) the output bit duration, (c) the output bit rate, and (d) the output frame rate 04

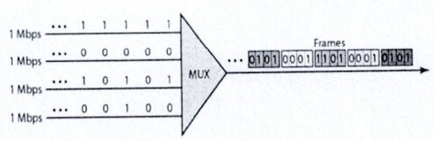

Fig. 8(c)

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Final Examination, 2023 — **3rd Year 1st Semester**
Course No: EEE 503 — **Course Title: Digital Electronics**
Time: 03 (Three) hours — **Full Marks: 60**

N.B.: (i) Answer any three question from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----------

PART-A
(Answer any **THREE** questions)

1. (a) What do you mean by sequential logic and combinational logic? Implement a Full Adder circuit showing Boolean function for inputs x, y, z. Hence prove that sum $s = x \oplus y \oplus z$ — 5

   (b) The product of all maxterms of a Boolean function of n variables in equal to 0. Prove that for n=3. — 5

2. (a) Implement the following function using don't care conditions with no more than two NOR gates. Assume that both normal and complement inputs are available — 5

$$F = A'B'C' + AB'D + A'B'CD$$
$$d = ABC + AB'D'$$

   (b) Implement $F(A, B, C, D) = \sum(0,1,3,4,8,9,15)$ using 8×1 MUX. You cannot use A in the selection line. — 5

3. (a) What do you mean by synchronous and asynchronous circuit? Draw and explain a simple 4-bit full adder. — 5

   (b) Find the complement of F=x+yz. Hence prove that F.F' = 0 and F+F' = 1. — 5

4. (a) Design a 3 bit binary counter with T flip flop. — 5

   (b) Construct a 5×32 decoder with four 3×8 decoder and a 2×4 decoder. Design a combinational circuit that converts a decimal digit from the 2,4,2,1 code to the 8,4 -2 -1 — 5

PART-B
(Answer any **THREE** questions)

5. (a) Simplify to minimum number of literals — 3
   a. $F_1 = ABC + A\bar{B}C + \bar{A}$
   b. $F_2 = (B + C')(B' + C) + (A' + B + C')'$
   c. $F_3 = AB(C'D)' + A'BD + (BCD)'$

   (b) What do you mean by register? Draw logical diagram of a 4 bit register with parallel load. — 7

6. (a) Design and Explain mod-6 counter for — 4
   a) Binary states 0,1,2,3,4,5
   b) Binary states 3,4,5,6,7,8

   (b) Draw the state and timing diagram of for a decimal counter. — 6

7. (a) Implement a 2bit magnitude comparator using K map. The logical diagram must be shown. 4

(b) Reduce the number of states from the given state diagram (Fig.01) for input sequence 01010110100. 6

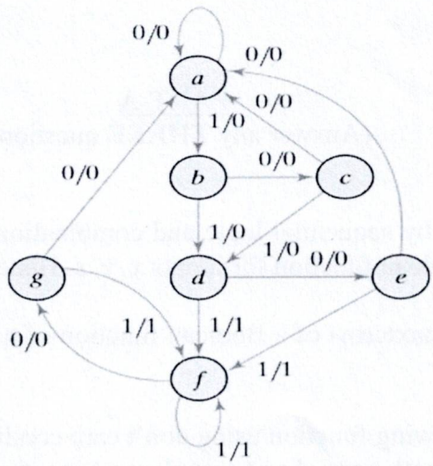

Fig. 01

8. (a) Reduce the number of states in the following state table and tabulate the reduced state table. 4

	Next State		Output	
Present State	**$x = 0$**	**$x = 1$**	**$x = 0$**	**$x = 1$**
a	f	b	0	0
b	d	c	0	0
c	f	e	0	0
d	g	a	1	0
e	d	c	0	0
f	f	b	1	1
g	g	h	0	1
h	g	a	1	0

(b) Design a counter having following sequence: 0,1,2 and repeat. Use T flip flop 6

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Final Examination, 2023 — **3rd year 1st Semester**
Course No: EEE 505 — **Course Title: Power System I**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. : (i) Answer any three questions from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)---------N/A-----

PART-A
(Answer any **three** questions)

1. (a) Classify transmission line. Draw the vector diagram for medium transmission line **T** method for a load of lagging power factor. **1+3**

   (b) A single phase overhead transmission line delivers 1100 kW at 33 kV at 0·8 p.f. lagging. The total resistance and inductive reactance of the line are 10 Ω and 15 Ω respectively. Determine (i) sending end voltage (ii) sending end power factor and (iii) transmission efficiency. **04**

   (c) A 100 MW power station delivers 100 MW for 2 hours, 50 MW for 6 hours and is shut down for the rest of each day. It is also shut down for maintenance for 45 days each year. Calculate its annual load factor. **02**

2. (a) Define symmetrical Fault. Establish the equation for short-circuit KVA. **02**

   (b) For unsymmetrical fault prove that $E_0 = 1/3(E_R + E_Y + E_B)$, $E_1 = 1/3(E_R + E_Y + a^2 E_B)$, $E_2 = 1/3(E_R + a^2 E_Y + a E_B)$ **04**

   (c) 50 MVA, 11 kV three-phase alternator was subjected to different types of faults. The fault currents are as under: 3-phase fault = 2000 A ; Line-to-Line fault = 2600 A ; Line-to-ground fault = 4200 A. The generator neutral is solidly grounded. Find the values of the three sequence reactance of the alternator. Ignore resistances. **04**

3. (a) What is unsymmetrical fault? Classify unsymmetrical fault. **1+1**

   (b) A 3-phase transmission line operating at 33 kV and having a resistance of 5 Ω and reactance of 20 Ω is connected to the generating station through 15,000 kVA 11KV/33KV step-up transformer. Connected to the bus-bar are two alternators, one of 10,000 kVA with 10% reactance and another of 5000 kVA with 7·5% reactance. Calculate the short-circuit kVA fed to the symmetrical fault between phases if it occurs ***(i)*** at the load end of transmission line ***(ii)*** at the high voltage terminals of the transformer **04**

   (c) Define busbar & reactor. Classify busbar. **2+2**

4. (a) Find per phase voltage & current for double line fault. **04**

   (b) A star connected load consists of three equal resistors of 1 Ω resistance. The load is assumed to be connected to an unsymmetrical 3-phase supply, the line voltages are $V_{RY} = 200V\angle 180^\circ$, $V_{YB} = 346V\angle 90^\circ$ and $V_{BR} = 400V\angle -60^\circ$. Find the magnitude of current in any phase by the method of symmetrical components. **06**

PART-B
(Answer any **three** questions)

5. (a) Establish the equation of voltage regulation for short transmission line. **02**

   (b) Two generators rated at 10 MVA, 13.2 kV and 15 MVA, 13.2 kV are connected in parallel to a busbar. They feed supply to two motors of inputs 8 MVA and 12 MVA respectively. The operating voltage of motors is 12.5 kV. Assuming base quantities as 50 MVA and 13.8 kV draw the reactance diagram. The per cent reactance for generators is 15% and that for motors is 20%. **04**

   (c) For medium transmission line-π find generalised constant **A, B, C, D**. **04**

6. **(a)** For long transmission line find the sending end voltage & current using rigorous method. **06**

(b) A balanced 3-phase load of 30 MW is supplied at 132 kV, 50 Hz and 0·85 p.f. lagging by means of a transmission line. The series impedance of a single conductor is (20 + j52) ohms and the total phase-neutral admittance is 315×10^{-6} siemen. Using nominal T method, determine: (i) the A, B, C and D constants of the line (ii) sending end voltage (iii) regulation of the line. **04**

7. **(a)** What is pickup current, load factor, Diversity factor, Plant capacity factor. **02**

(b) A 3-phase line delivers **3600 kW** at a p.f. **0·8** lagging to a load. If the sending end voltage is **33 kV**, determine **(i)** the receiving end voltage **(ii)** line current **(iii)** transmission efficiency. The resistance and reactance of each conductor are **5·31 Ω** and **5·54 Ω** respectively. **04**

(c) Explain the working principle of current differential relay. **04**

8. **(a)** Define pickup current, current setting, plug setting multiplier, current setting multiplier. **04**

(b) Determine the time of operation of a 5-ampere, 3-second overcurrent relay having a current setting of 125% and a time setting multiplier of 0·6 connected to supply circuit through a 400/5 current transformer when the circuit carries a fault current of 4000 A. Use the curve shown in Fig. 8(b). **04**

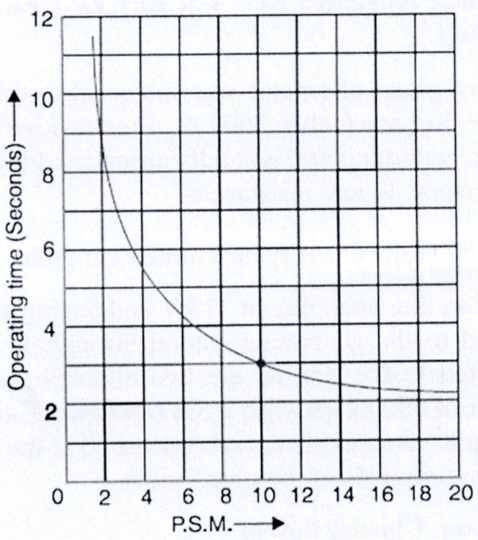

Fig. 8(b)

(c) What types of functionals relays are available? **02**

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Final Examination, 2023 — **3rd year1st Semester**
Course No: EEE 507 — **Course Title: Electrical Properties of Materials**
Time: 03 (Three) hours — **Full Marks: 60**

N.B. : (i) Answer any two questions from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----------

PART-A
(Answer any **two** questions)

1. (a) Draw some crystal structures: a) Orthorhombic, b) Rhombohedral c) Monoclinic. Explain FCC, BCC, HCP and Atomic Packing Factor. 07

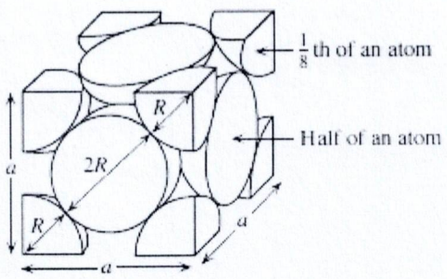
   (b) What is superconductor? Explain the types of superconductor. Lists some applications of superconductor. Explain SQUIDS and Cryotron. 08

2. (a) What is Quantum tunneling and lasing? Define Leaser? Explain what happens during absorption, spontaneous emission, and stimulated emission? 07

   (b) What is pseudo gap? Show that current density, $J = \rho v$. 08

3. (a) Explain FCC, BCC, HCP and Atomic Packing Factor. 07

   (b) Consider the FCC unit cell of the copper crystal shown in Figure: 08



   i. How many atoms are there per unit cell?

   ii. If R is the radius of the Cu atom, show that the lattice parameter a is given by $a = R2\sqrt{2}$.

   iii. Calculate the atomic packing factor (APF) defined by

$$\text{APF} = \frac{\text{Volume of atoms in unit cell}}{\text{Volume of unit cell}}$$

   iv. Calculate the atomic concentration (number of atoms per unit volume) in Cu and the density of the crystal given that the atomic mass of Cu is 63.55g mol^{-1} and the radius of the Cu atom is 0.128nm.

PART-B

(Answer any **two** questions)

4. (a) How to arrive at the highest temperature superconductivity? Write short notes on Meissner Effect, BCS theory and Josephson Effect. 07

   (b) Explain Cooper pair? Draw the crystal structure and show the direction for: 08

   a) 111 b) $1\bar{1}1$ c) $11\bar{1}$

5. (a) What is work function and contact potential? "The reality does not exist until we observed it" Justify this statement? 07

   (b) The energy of vacancy formation in the Ge crystal is about $2.2eV$. Calculate the fractional concentration of vacancies in Ge at $938^{\circ}C$, just below its melting temperature. What is the vacancy concentration given that the atomic mass M_{at} and density ρ of Ge are 72.64g $mol^{-1}$and 5.32 g cm^{-3} respectively? Neglect the change in the density with temperature which is small compared with other approximations. 08

6. (a) Explain Matthiessen's rule & debye temperature? Interpret Ohm's law in term of atomic theory? 07

   (c) Obtain the equation relating the relaxation time τ to the mean time τ_c as 08

$$\tau = \frac{\tau_c}{1 - < cos\theta >}$$

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Final Examination, 2023 — **3rd year 1st semester**
Course No: EEE 509 — **Course Title: Continuous Signals & Linear Systems**
Time: 03 (Three) hours — **Full Marks:60**

N.B. : (i) Answer any three questions from each PART (ii) Use separate answer scripts for each PART
(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)----------N/A----------

PART A

(Answer any **THREE** questions)

1. (a) Define energy signal and power signal. Find out the nature of the signals shown in the Fig. 1(a) 05

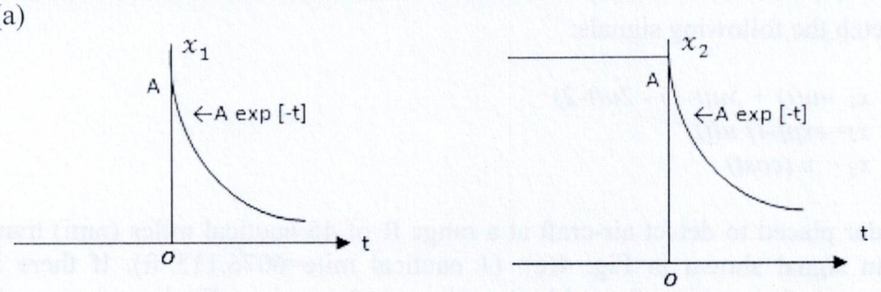

Fig. 1(a)

(b) For the following systems find if it is (i) causal or non-causal (ii) with or without memory and (iii) stable or unstable: 05

$(i)\ h_1(t) = 10\frac{\sin 5\pi t}{\pi t}$

$(ii)\ h_2(t) = -3exp[2t]u(t)$

$(iii)\ h_3(t) = 5\delta(t+1)$

2. (a) Describe convolution theorem. Compute the convolution for the two signals shown in Fig. 2(a). 05

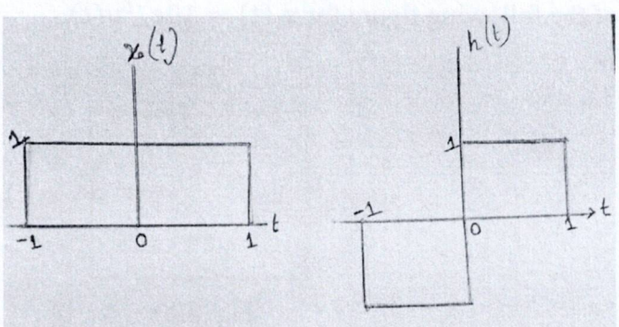

Fig. 2(a)

(b) Find $x(t-2)$ and draw the output waveform. 05

$$x(t) = \begin{cases} t+1 & ; -1 \le t \le 0 \\ 1 & ; 0 \le t \le 2 \\ -t+3 & ; 2 \le t \le 3 \end{cases}$$

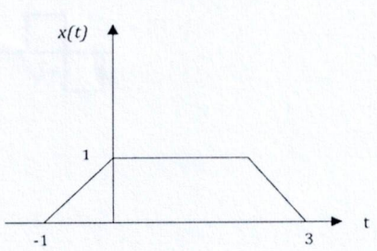

Fig. 2(b)

3. (a) Determine whether the following signals are periodic or aperiodic. If periodic find the period: 03

$(i) x(t) = \sin\left(\frac{\pi}{3}t\right) + 2\cos\left(\frac{8\pi}{3}t\right)$
$(ii) x(t) = e^{j(\pi t - 1)}$
$(iii) x(t) = \sin(2\pi/3)t$

(b) Define Energy Signal and Power Signal. Consider the sinusoidal signal $\boldsymbol{x(t) = Asin(w_o t + \varphi)}$ where, $\boldsymbol{T = \frac{2\pi}{w_0}}$ and $\boldsymbol{y(t) = 0,\ when\ T < 0}$. Determine the Total Energy and Average Power of the given signal. 07

4. (a) Give the steps for checking time invariance with a suitable example. 01

(b) Sketch the following signals: 05

a) $x_1 = u(t) + 5u(t-1) - 2u(t-2)$
b) $x_2 = exp[-t]\ u(t)$
c) $x_3 = u\ (cost)$

(b) Radar placed to detect air-craft at a range R of 45 nautical miles (nmi) transmits the pulse train signal shown in Fig. 4(c). (1 nautical mile=6076.115 ft). If there is a target, the transmitted signal is reflected back to the radar's receiver. Find out the round trip delay. 04

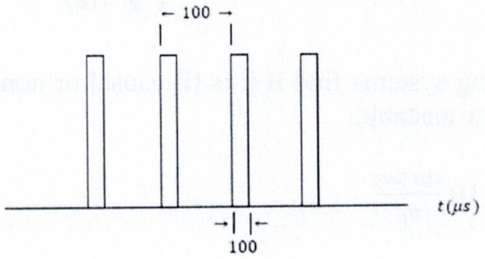

Fig. 4(c)

PART B

(Answer any **THREE** questions)

5. (a) Find $v_o(t)$ of the following figure for $v_i(t) = 10e^{-t}u(t)$ 05

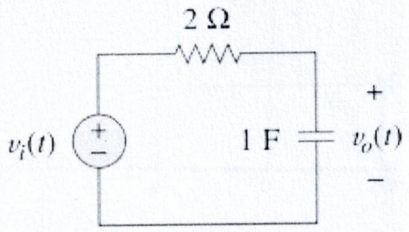

Fig. 5(a)

(b) Find the Fourier Series Expansion of the following function. Assume T = 4. 05

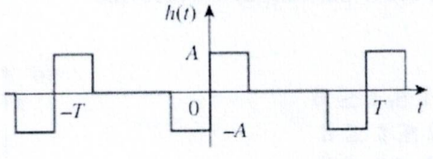

Fig. 5(b)

6. (a) What is the application of Fourier series in electrical? Find the Laplace transform of $f(t) = t^2 \cos 3t\, u(t)$ 02

(b) Calculate Laplace transform of the periodic function. 04

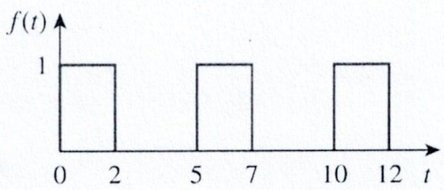

Fig. 6 (b)

(c) Using Inverse Laplace Transform, calculate $v_o(t)$. Given that, 04

$$V(s) = \frac{10s^2 + 4}{s(s+1)(s+2)^2}$$

7. (a) Obtain the inverse Fourier transformation for the following functions. 06

$$(i) F(w) = {}^{10jw+4}/_{(jw)^2 + 6jw + 8} \qquad (ii) G(w) = {}^{w^2+21}/_{w^2+9}$$

(b) Find the output voltage $y(t)$ of the system shown in Fig. 7(b), if the input voltage is the periodic signal, where $x(t) = 4cost - 2cos2t$ 04

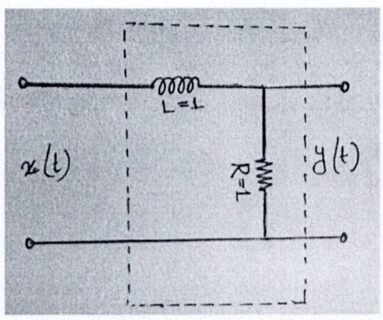

Fig. 7(b)

8. Determine the amplitude of the significant harmonics in v_i & v_0 and also comments on the quality of circuit shown in Fig. 8(a), where, $R = 1K\Omega, C = 15.9\mu F, \omega_0 = 100\pi$ and $f_0 = 50Hz$ 10

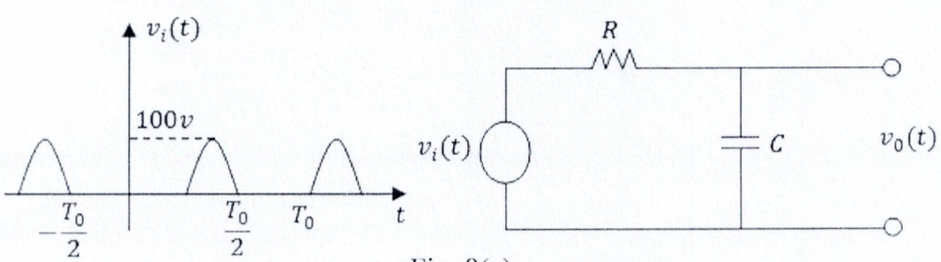

Fig. 8(a)