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Beyond A Graduate

PAST PAPERS

Faculty	Department / Section/Division
Not Applicable	Learning Resource Centre

Past Papers

Faculty of Engineering & Technology
Department of Electrical and Electronic Engineering

BSc Hons (Eng) Electronic and Telecommunication Engineering

2022

Document Control & Approving Authority	Senior Director – Quality Management & Administration

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Faculty of Engineering & Technology
Department of Electrical & Electronic Engineering
BSc Hons (Eng) Electronics & Telecommunication Engineering
Year 3 Semester 5 First Sit Final Examination 2022

Module Code	:	**EE3312**
Module Title	:	**Communication II**
Date/Time	:	**17th August 2022 / 09.00 am – 12.00 pm**
Examiners	:	**Gresha S. Samarakkody**
Time Allowed	:	**3 hours**

INSTRUCTIONS TO CANDIDATES

- This closed book examination.
- Show all stages of your work.
- You should write legibly in black or blue ink present your answers.
- Present your answers to three decimal places.
- This paper consists of **5 essay type questions.**
- Paper containing **3 pages.**
- **Attempt all 5 questions.**
- **3 hours will be allocated to answer all 5 questions.**

MATERIALS REQURIED

- Answer Booklet.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.
-

Student Number ....

1. A classic example of FSK is the old 300 baud modem that used Manchester signaling. Manchester pulse consists of two "half" pulses. The duration of one bit in these modems was 1.6667 ms. The frequency used to represent one of the half pulses was 1.5 kHz and the frequency used to represent the other half pulse was 1.8 kHz.
   i) Write a short summary on "FSK" modulation technique.
   ii) Explain the time domain and frequency domain representations of FSK with the use of appropriate diagrams.
   iii) Determine the frequency deviation of the above mentioned 300 baud modems using the given information.
   iv) Calculate the minimum bandwidth of the 300 baud modem.

(20 marks)

2. QAM is an advanced modulation scheme widely used in Wi-Fi communication systems.
   i) What is QAM?
   ii) What is Constellation Diagram? Provide an explanation for constellation diagram with using a diagram.
   iii) Draw a Constellation Diagram to represent 16-QAM.

(15 marks)

3. An experiment is conducted that measures sensitivity to a weak signal. On each trial the signal is either present (signal trails) or absent (noise trails), and the subject must respond "present" or "absent". The probability of a signal being presented on any given trial is 0.25. The data obtained from a signal detection experiment is depicted in the table below.

Table 1: Experiment Data

Transmitter	Responses (Receiver)	
Stimulus	Present	Absent
Signal	75	25
Noise (No signal)	25	75

i) Define the possible hypothesis for the above scenario.
ii) What is the prior probability of signal?
iii) Explain the detection theory concept using above scenario.
iv) Define the conditional probabilities for the possible responses.

(20 marks)

4. "AWGN is a basic noise model used in information theory to mimic the effect of many random processes that occur in nature".
   i) What is AWGN stands for? Write a summary to explain AWGN.
   ii) Explain the operation and the requirement of Optimal Receiver for a AWGN channel.
   iii) Explain the operation of "Matched Filter" when matched filter is applied into a noisy signal
   iv) How can we utilize Matched Filter while developing Optimal Receiver?

(20 marks)

5. i. Draw a model for spread spectrum system and explain the operation.
   ii. Explain the Frequency Hopping Spread Spectrum (FHSS) operation.
   iii. Provide an example for FHSS and explain it using a figure or a diagram.
   iv. Draw a diagram for FHSS transceiver model and explain the operation.
   v. Draw a diagram for Direct Sequence Spread Spectrum (DSSS) transceiver model and explain the operation.

(25 marks)

End of Questions

Supportive Equations

$$V_{fsk}(t) = V_c \cos\{2\pi[f_c + v_m(t)\Delta f]t\}$$

$$\Delta f = \frac{|f_m - f_s|}{2}$$

$$Baud = R_{bit}$$

$$B = \Delta f + 2R_{bit}$$

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FACULTY OF ENGINEERING & TECHNOLOGY

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FINAL EXAMINATION PAPER

Module Code	:	**ME1323**
Module Title	:	**Thermodynamics**
Academic Year	:	**Semester 2/2019**
Date	:	**24th January 2020**
Examiners	:	**G. Wijesundara**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- You should answer all **Five questions**. Each question carries equal marks.
- A datasheet is provided.

MATERIALS REQUIRED

- (Steam table) Thermodynamics & Transport Properties of Fluids by Rogers & Mayhew will be provided.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

1.	(a)	(i) Briefly explain the difference between intensive and extensive properties.	(03 marks)
		(ii) What are point and path functions. Give two examples for each function.	(03 marks)
	(b)	The internal energy, and equation of state of a closed gas system are given by, $u = 188.4 + 1.256\ (T - 273)$ kJ/kg and $pV = CT$, where T is the temperature in K, p is the pressure in N/m^2, v is the specific volume in m^3/kg and $C = 6$ J/kg K. If the temperature of 2 kg of gas is raised from 100° C to 200° C at constant pressure, determine the work done, change in internal energy and the heat transfer.	(08 marks)
	(c)	A steam turbine receives a steam flow of 1.5 kg/s and the power output is 600 kW. The heat loss from the casing is negligible. Determine the change of specific enthalpy across the turbine; (i) when the velocities at entrance and exit, and the difference in elevations are negligible.	(03 marks)
		(ii) when the velocity at the entrance is 50 m/s, the velocity at exit is 350 m/s, and the inlet pipe is 3 m above the exhaust (outlet) pipe.	(03 marks)

2.	(a)	Heat is transferred to a heat engine from a furnace at a rate of 60 MW. If the rate of waste heat rejection is 40 MW, determine the power output and the thermal efficiency of the heat engine.	(04 marks)
	(b)	1.5 kg of dry saturated steam at 110 bar expands isothermally and reversibly to a pressure of 10 bar. (i) Determine the heat supplied and the work done during the process.	(12 marks)
		(ii) Sketch the process on a T-s diagram indicating the area which represents the heat flow.	(04 marks)

3.	(a)	A unit mass of a perfect gas expands polytropically from state 1 to state 2 and the index of the expansion process is n. Show that the heat transfer (Q) during the expansion process can be expressed, in usual notations, as $$Q = \left(\frac{n-\gamma}{\gamma-1}\right)\frac{R(T_2 - T_1)}{n-1}$$	(08 marks)
	(b)	A volume of 0.15 m^3 of air at 1 bar and 80° C is compressed to 0.015 m^3 according to law, $pV^{1.3}$ = constant. Heat is then added at a constant volume until the pressure rises to 40 bar.	
		(i) Sketch the processes on a p-V diagram	(02 marks)
		(ii) Determine the pressure and temperature of the gas after the polytropic process	(03 marks)
		(iii) Determine the heat transfer during the polytropic process	(03 marks)
		(iv) Calculate the change of entropy during the constant volume process.	(04 marks)

4.	(a)	What is meant by, (i) a rich mixture, and (ii) a weak mixture	(04 marks)
	(b)	The gravimetric analysis of a sample coal is given as: C – 85%, H – 5%, O – 3%, N – 2.9%, S – 0.1%, Ash – 4%	
		(i) Calculate the stoichiometric air fuel ratio	(06 marks)
		(ii) If 30% excess air is available, what would be the actual air fuel ratio.	(02 marks)
		(iii) If the sample coal is burned with 30% excess air, determine, • gravimetric analysis of the wet products of combustion	(04 marks)
		• volumetric analysis of the dry products of combustion	(04 marks)

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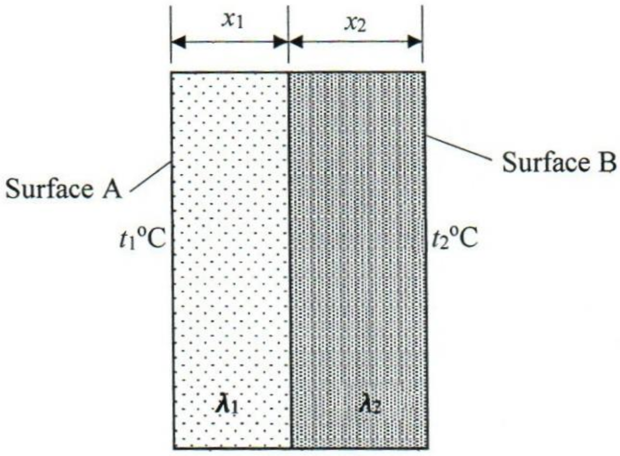
<table>
<tr><td>5.</td><td>(a)</td><td>Fig. Q5(a) shows a composite wall consisting of two different layers of materials of thermal conductivities λ_1 and λ_2. Heat is being transferred from surface A to surface B through conduction. Surface A is at a temperature t_1° C and B is at a temperature t_2° C.
Show that the rate of heat conduction ($\dot{q}$) per unit area is given by
$$\dot{q} = \frac{t_1 - t_2}{\left(\frac{x_1}{\lambda_1} + \frac{x_2}{\lambda_2}\right)}$$


Fig. Q5(a)</td><td>(08 marks)</td></tr>
<tr><td></td><td>(b)</td><td>A steel pipe of 120 mm internal diameter and 10 mm wall thickness, carrying hot water at 80° C, is insulated with a layer of lagging material of thickness 15 mm. The atmospheric temperature is 20° C. The heat transfer coefficients for the inside and outside surfaces are 800 and 16 W/m^2 K respectively. The thermal conductivities of steel and lagging material are 48 and 0.04 W/m K respectively.

Determine;
(i) the rate of heat lost by hot water per unit length of the pipe.

(ii) The temperature of the outer surface of the lagging material.</td><td>

(08 marks)

(04 marks)</td></tr>
</table>

End of Questions

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Faculty of Engineering & Technology
Department of Electrical and Electronic Engineering
BSc Hons (Eng) Electronic and Telecommunication Engineering
Year 2 Semester 4 Resit Examination 2020

Module Code	:	**EE2324**
Module Title	:	**Communications 1**
Date	:	**4th March 2020**
Examiners	:	**Ms. Piyumi Hansika**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a Closed book examination.
- Attempt **All questions.**
- Each answer to be written in an answer booklet (provided).
- Each answer to start on a new page.
- This paper contains 7 pages

MATERIALS REQURIED

- Answer booklets.
- You may use a scientific calculator. This must not be programmable and may be inspected during the examination.

Student Number ....

1 (a) Thermal Noise is an example of a Random Signal. Explain Random Signals and Thermal Noise. — 4 Marks

(b) Figure Q.1.1 shows the Thévenin equivalent circuit model that could be used to represent the thermal noise generated by the resistor. — 15 Marks

By means of calculations show how this model can be used to describe RMS Noise voltage of a resistor.

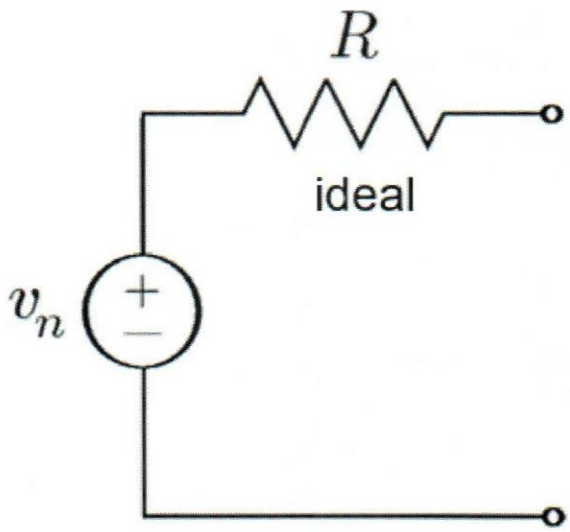

Figure Q.1.1

(c) I. Determine the RMS noise voltage spectral density of a 60 kilo-ohm resistor at a physical temperature of 25°C. — 3 marks

II. Calculate the RMS noise voltage in a bandwidth of 300 kHz. — 3 marks

2 (a) A 75kW carrier is to be amplitude modulated. Determine the total sideband power and transmitted power — 6 marks

i. when modulated to a depth of 100%
ii. when modulated to a depth of 50%
iii. with reference to your answers obtained above, explain why most of the AM transmission attempt to maintain high percentage modulation as possible while ensuring that over modulation does not occur.

(b) Sketch the Amplitude Modulated Signal for the following Modulation Indexes — 3 marks

(i) 50% Modulation
(ii) 100% Modulation
(iii) 150% Modulation

(c) An FM wave is represented by the voltage equation — 10 marks

$$e = 10 \sin (6 \times 10^6 t + 8 \sin 4 \times 10^4 t)$$

Determine

I. The modulating frequency
II. The carrier frequency
III. The modulating index
IV. The frequency deviation
V. Bandwidth of the modulated signal Using Carson's rule

(d) Give two advantages and one disadvantage of Frequency Modulation compared to Amplitude modulation — 6 marks

3 (a) Amplifier "A" has gain 30dB and noise figure 3.7 dB at the frequency of interest. Amplifier "B" has gain 20 dB and noise figure 8.4 dB at the same frequency. Input and output impedances are 50 Ω throughout.

I. When used in cascade, what is the combined noise figure? 5 marks

II. From the answer obtained for question 3(a)i, what can you say about the combined noise figure when compared to the large noise figure given in second stage? 3 marks

III. Now a long coaxial cable is inserted between the amplifiers A and B. The loss of the cable is 3dB. *(Assume the physical temperature of the cable is equal to the reference temperature)* Now what is the cascade noise figure? 5 marks

(b) Define "Free space path loss" 2 marks

(c) A satellite at an altitude of 37654 km transmits a signal of 17 GHz to a ground station directly below it. The following data is given.

- Total atmospheric losses = 40dB
- Transmit antenna gain = 55dBi
- Receiver antenna gain = 60dBi
- Signal to noise ratio of received signal = 6dB
- Receiver signal noise power = 25pW
- Receiver sensitivity = -90dBW

I. Calculate the power transmitted. 6 marks

II. Find the Fade Margin for the link and comment on your result. 4 marks

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4 (a) Following figures give illustration of three continuous waves sampling.

- Figure Q.4.1 continuous wave has a frequency of 9Hz and a sampling rate of 0.09.
- Figure Q.4.2 continuous wave has a frequency of 31Hz and a sampling rate of 0.31.
- Figure Q.4.3 continuous wave has a frequency of 95Hz and a sampling rate of 0.95.

State and give comments for each waveform, whether they are properly sampled or not with respect to the sampling theorem. 9 marks

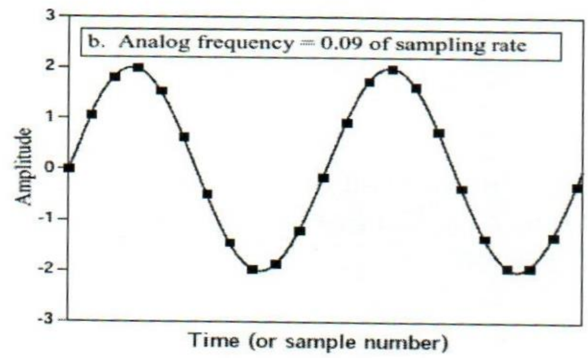

Figure Q.4.1

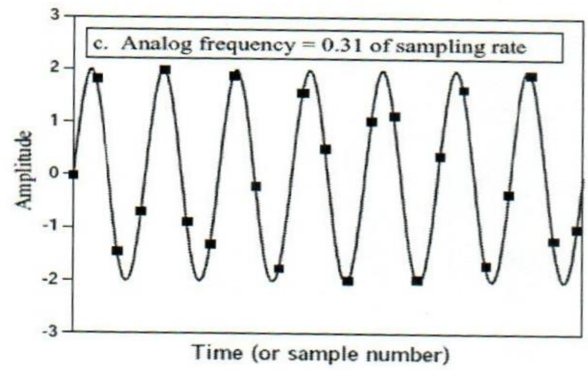

Figure Q.4.2

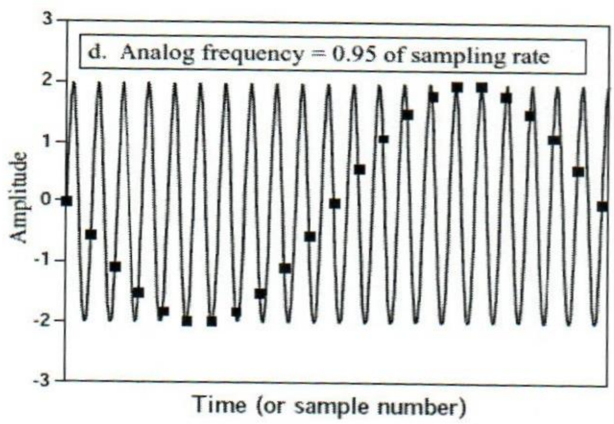

Figure Q.4.3

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(b)

I. Figure Q.4.4 shows a block diagrams of a DSP. There are two Analog filters used before ADC and after DAC. Explain the purpose of using an Analog filter before the ADC. — 3 marks

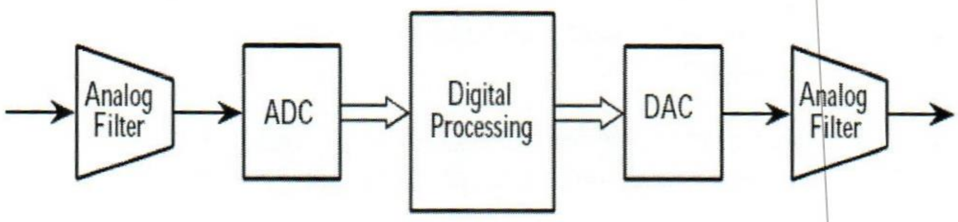

Figure Q.4.4

II. Explain in detail with aid of a sketched analogue waveform what is **Sampling, Quantizing and Encoding**, which are performed in the ADC section. — 8 marks

(c) With an aid of a diagram briefly describe — 5 marks

I. Pulse Amplitude Modulation (PAM)

II. Pulse Width Modulation (PWM)

III. Pulse Code Modulation (PCM)

Communication -1 Formula Sheet

Boltzmann's Constant (K)	1.38×10^{-23} J/K
0 degree Celsius (°C)	273.15 K

Noise

$$F = 1 + \frac{Teq}{Tin} \qquad F = \frac{1}{G}\frac{Tphys}{Tin} \qquad F^{(cascade)} = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 G_2} + \cdots$$

$$\sigma_n = \sqrt{4kTBR} \qquad T_{eq}^{(cascade)} = T_{eq}^{(1)} + \frac{T_{eq}^{(2)}}{G_1} + \frac{T_{eq}^{(3)}}{G_1 G_2} \ldots$$

Propagation

$$Pr = \frac{Pt\ Gt\ Gr\ \lambda^2}{(4\pi R)^2} \qquad S/N\ (dB) = 10 log_{10} \frac{Signal\ Power}{Noise\ Power}$$

$$Fade\ Margin = P_{RX} - Rx\ Sensitivity \qquad Gain\ (dB) = 10 log_{10} \frac{P2}{P1}$$

Modulation

$$m_A = \frac{Vm}{Vc} \qquad PT = Pc + \frac{m^2 Pc}{4} + \frac{m^2 Pc}{4}$$

$$m_f = \frac{\delta}{fm} \qquad Bw \approx 2(\delta_{max} + fm_{max})$$

FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BSC (ENG) (ELECTRONICS & TELECOMMUNICATION ENGINEERING/CIVIL ENGINEERING/MECHANICAL ENGINEERING/AUTOMOTIVE ENGINEERING)

BATCH 2A AND 2B SEMESTER 1 RESIT EXAMINATION PAPER

Module Code	:	**EE1315**
Module Title	:	**Electricity**
Date	:	**14th February 2020**
Examiners	:	**W. Satanika Lowe**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- You Should Answer any four questions. Each question carries equal marks.
- Each answer should start on a separate page.
- A datasheet is provided.
- This question paper contains 5 pages.

MATERIALS REQUIRED

- Answer booklet.
- You may use a Scientific calculator. This must not be programmable and may be inspected during the examination.

1) a) State the maximum power transfer theorem for DC electrical circuits.

(5 marks)

b) Apply Thevenin's theorem for the circuit in Figure 1.1 and find the equivalent circuit.

(10 marks)

c) Determine the resistance of the load (R_L) to transfer maximum power to the load. Calculate the maximum power.

(5 marks)

d) Calculate the current flow through the load if $R_L = 10\ \Omega$.

(5 marks)

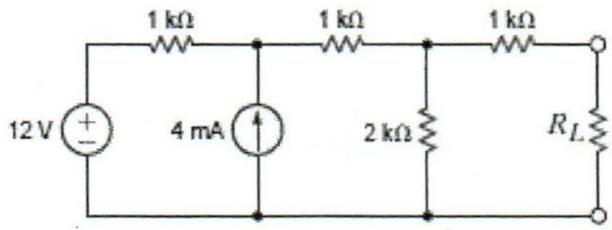

Figure 1. 1

2)

a) Convert following time domain functions into phasor domain.

i) $5\cos(\omega t - 30)$

ii) $12\sin(\omega t + 25)$

iii) $20\cos(5t + 60)$

(6 marks)

b) Calculate the input admittance Z_{in} for the circuit in figure 2.1

(6 marks)

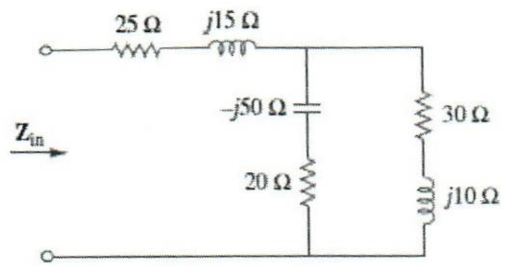

Figure 2. 1

c) Consider the circuit in figure 2.2

i) Determine the current 'i' in the circuit.

(5 marks)

ii) Determine the power factor at the input.

(3 marks)

iii) Calculate the complex power delivered to the 1H inductor.

(5 marks)

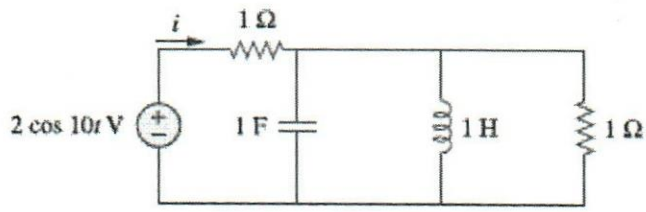

Figure 2. 2

3)

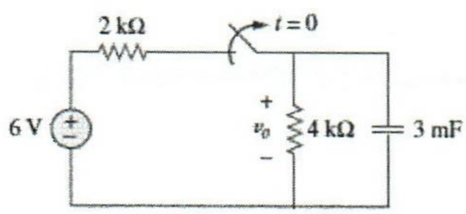

Figure 3. 1

a) Initially the switch in the Figure 3.1 has been closed for a long time. The switch opens when t=0. Find V_0 when t>0.

(10 marks)

b) A resistor, capacitor and an inductor is connected in series to a voltage source. If R=25Ω and L= 0.5H calculate the value or range of values of C (capacitance) that make the RLC circuit. If the circuit is,

(i) Critically damped
(ii) Under damped
(iii) Over damped

(15 marks)

4) a) State the definition of electric potential.

(5 marks)

b) Two point charges $Q_1 = 1mC$ and $Q_2 = -2mC$ are respectively located at (0,5,1) and (3,-2,2).

i) Find the potential V_p at P (-1,1,2).

ii) Calculate the potential difference V_{PQ} if Q is (1,2,3)

(10 marks)

c) In the free space, the electric flux density $D = 2y^2 a_x + 4\,x a_y + x y^2 z a_z\ C/m^2$.

i) Find the total charge stored in the region $1 < x < 2$, $0 < y < 2$ and $-1 < z < 2$.

(10 marks)

5)

a) State Ampere's circuit law.

(5 marks)

b) A finite wire $0 \leq y \leq 10$ carries a 10A current along a_y direction. Find the magnetic field at the point (0,0,5).

(5 marks)

c) A charged particle of mass 2g and charge 5mC starts at (0,0,1) with a velocity of $2a_y\ m/s$, in an electric field $a_x - 2a_z\ V/m$.

Determine the,

(i) Acceleration and

(ii) Velocity

(iii) Kinetic energy

of the charged particle at time t=3s.

(15 marks)

Datasheet

For source free RC circuit

$v_{(t)} = Ae^{\frac{-t}{\tau}}$

General solution of a RC circuit (with source)

$v_{(t)} = A + Be^{\frac{-t}{\tau}}$

The second order differential equation (RLC circuit) is in the form of,

$s^2 + 2\xi\omega_0 s + \omega_0^2 = 0$

Complex power in a ac circuit

$S = V_{rms}I_{rms}^*$

Vector equation of the electric force

$$F = \frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{R^2}\,\boldsymbol{a_r}$$

Electric field intensity

$$\vec{E} = \frac{\vec{F}}{Q}$$

Electric flux density

$D = \varepsilon_0 E$

Gauss's Law

$Q = \int D.ds = \int \rho_v \, dv$

$\rho_v = \nabla.D$

Electric potential

$$V = \frac{Q}{4\pi\varepsilon_0 R}$$

Magnetic field strength of a finite straight current carrying conductor

$$H = \frac{I}{4\pi R}(\cos(\alpha_2) - \cos(\alpha_1))\,\boldsymbol{a_\emptyset}$$

Lorentz force

$F = QE + Q\,u \times B$

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EXAMINATION PAPER

Module Code	**: EE1325**
Module Title	**: Programming Fundamentals**
Batch	**: 02B_ Semester 2**
Date	**: 29th January 2020**
Examiners	**: Sachini Gunasekara**
Time Allowed	**: 3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- You should answer for all four (04) questions.
- Each answer should start on a new page.

Total Marks: 100

Question 01

a) Programming languages fall into three broad categories (Levels of language). What are those categories? Explain them. (06 Marks)

b) Briefly explain three control structures used in Algorithms. (04 Marks)

c) Draw a flow chart to find the sum of the first 50 natural numbers. (15 Marks)

Question 02

a) Find the value of result and result2. (10 Marks)

```
int result, result2, a=10, b=4, c=12, d=5;

result = ++a + b--;
result2 = c++ - --d;
```

b) Write the code for following pseudocode. (15 Marks)
Hint: No need to use keyboard input

1. Start
2. Get mark
3. IF mark => 50 Then
4.   Display "Pass"
5. Else
6.   Display "Fail"
7. Endif
8. End

Question 03

a) Write a program in C to read n number of values in an array and display it in reverse order. (25 Marks)

Question 04

Find the errors in following codes and **re-write the corrected codes**. Circle the places where you have corrected. (25 Marks)

```
int PrimeOrNot(int);

int PrimeOrNot(int n1)
{
    i=2;
    while(i<=n1/2) ;
    {
        if(n1%i==0)
            return 0;
        else
            i++;
    }
            return 1;

}

int main()
{
    int n1,prime;
    printf("\n\n Function : check whether a number is prime number or not :\n");
    printf("--------------------------------------------------------------\n")

    printf(" Input a positive number : ");
    scanf("%f",n1);
    prime = PrimeOrNot(prime);
   if(prime==1)
       printf(" The number %d is a prime number.\n", &n1);
   else
     printf(" The number %d is not a prime number.\n", &n1);

}
```

--END--

CINEC CAMPUS
FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BSC (ENG) (ELECTRONICS & TELECOMMUNICATION ENGINEERING/CIVIL ENGINEERING/MECHANICAL ENGINEERING/AUTOMOTIVE ENGINEERING)

BATCH 2B SEMESTER 2 FIRST SIT EXAMINATION PAPER

Module Code	:	**EE1326**
Module Title	:	**Electronics**
Date	:	**31st January 2020**
Examiners	:	**W. Satanika Lowe**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- You Should Answer ~~any~~ four questions. Each question carries equal marks. It is compulsory to select any two questions from Part A and B.
- Each answer should start on a separate page.
- This examination paper contains eight pages.

MATERIALS REQUIRED

- One answer booklet.
- You may use a Scientific calculator. This must not be programmable and may be inspected during the examination.

Part A

1.

a) Explain the term diffusion capacitance.

(10 marks)

b) Explain the two types of semiconductor doping.

(10 marks)

c) State the definition of intrinsic and extrinsic semiconductors.

(10 marks)

d) LED is an application of semiconductor diode. Explain the internal process of LED when it is forward biased.

(20 marks)

e) Figure 1.1 shows a clipping circuit. Draw the output voltage waveform and calculate the forward peak current through each diode. (Consider D1 as a silicon diode and D2 as a germanium diode.)

(20 marks)

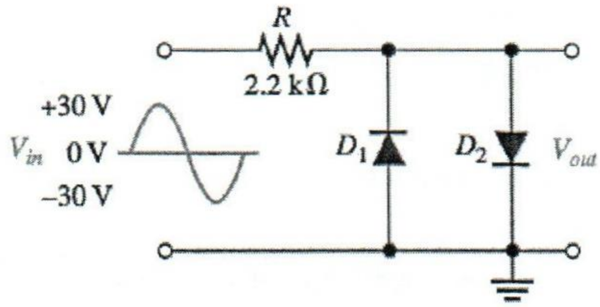

Figure 1. 1

f) Calculate the current through Zener diode in figure 1.2 if the load resistance is

i. 1kΩ

ii. 470Ω

(30 marks)

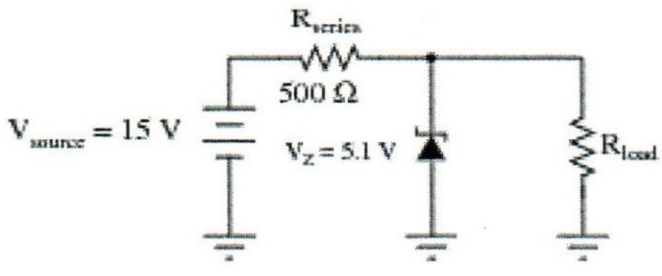

Figure 1. 2

2.

a) Why is the base current in a transistor so much less than the collector current?

(10 marks)

b) Plot the I-V output characteristic curve of a transistor and mark the saturation, active and breakdown regions.

(10 marks)

c) What is the value of I_C for I_E=21.42mA, and I_B=420μA in a PNP transistor.

(10 marks)

d) Calculate the currents I_B, I_E, I_C and voltages V_{CE}, V_{CB} for the BJT circuit given in figure 2.1.

(25 marks)

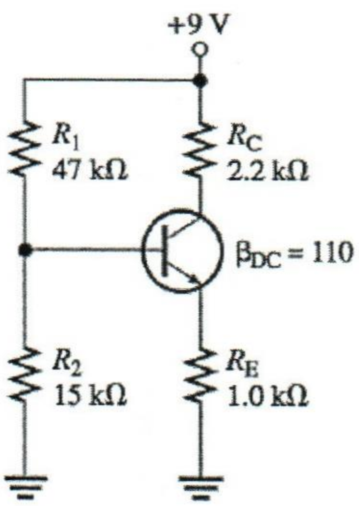

Figure 2. 1

e) State the definition of pinch-off voltage and cut-off voltage for a JFET.

(20 marks)

f) Why must the Gate to source voltage of a n-channel JFET always be either zero or negative?

(10 marks)

g) A certain n-channel JFET has a VGS(off)= -6V and IDSS=12A. Calculate ID when VGS= - 4V.

(15 marks)

3.

a) Draw the schematic diagram of an Op-Amp and mark the input and output terminals.

(10 marks)

b) State the practical Op-Amp characteristics.

(10 marks)

c) Derive the close loop gain equation of an inverting Op-Amp amplifier with the aid of a diagram.

(15 marks)

d) The figure 3.1 depicts an amplifier circuit.

(i) Calculate the value of R_f that will produce the indicated closed loop gain in each amplifier.

(20 marks)

(ii) If the peak input voltage in each amplifier is 5V. Calculate the peak current through R_f resistor.

(15 marks)

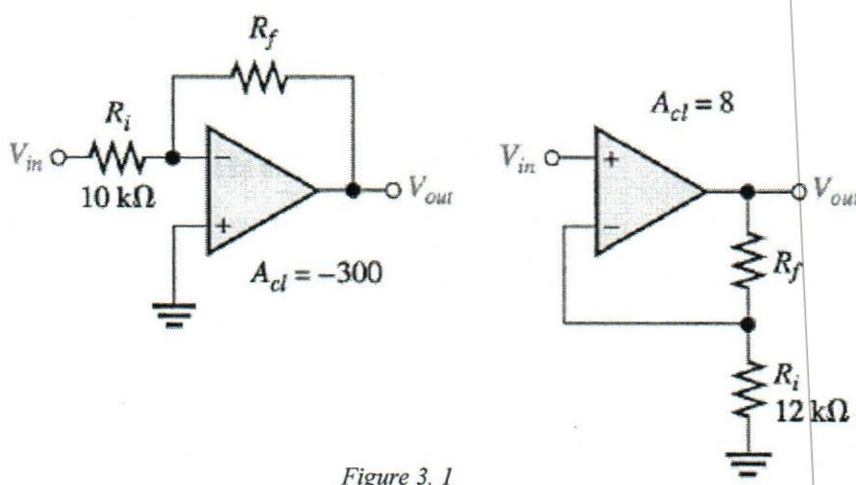

Figure 3. 1

e) The figure 3.2 depicts an op-amp circuit. Calculate the closed loop gain of the circuit. (Consider both op-amps as ideal.)

(30 marks)

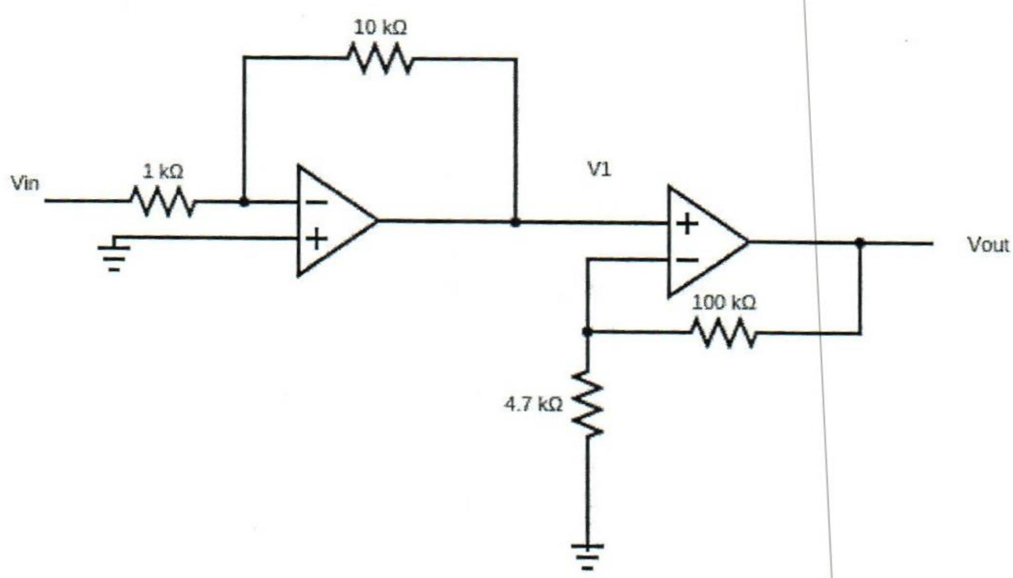

Figure 3. 2

Part B

4.

a) Convert following Binary numbers in to hexadecimal
   i. 111001010_2
   ii. 1100001101_2
   iii. 101111111_2
   iv. 1110000001_2

(20 marks)

b) Convert the binary number 11011001.1101_2 in to decimal.

(5 marks)

c) Convert the decimal number 245.75_{10} into binary.

(5 marks)

d) Convert the hexadecimal number $F749_{16}$ into binary and into octal.

(10 marks)

e) Subtract 17 from 15 and perform the calculation in 8 bit 2's compliment arithmetic.

(20 marks)

f) Using binary division divide 11110_2 by 110_2.

(10 marks)

g) Using De Morgan's theorem prove following identities.
   i. $(A+B).(A+\bar{C}).[\bar{A}+B(\bar{B}+\bar{C})] = B\bar{C}$
   ii. $\overline{(\bar{A}+B).(\bar{A}+\bar{C}).(\bar{B}+C)} = A\bar{B}+AC+B\bar{C}$

(20 marks)

h) Using the truth table prove the Boolean identity, $\overline{ABC}+A\overline{BC} = \bar{A}+\bar{B}+\bar{C}$

(10 marks)

5.

a) Write down the logic expression for the output Q shown in figure 5.1.
(15 marks)

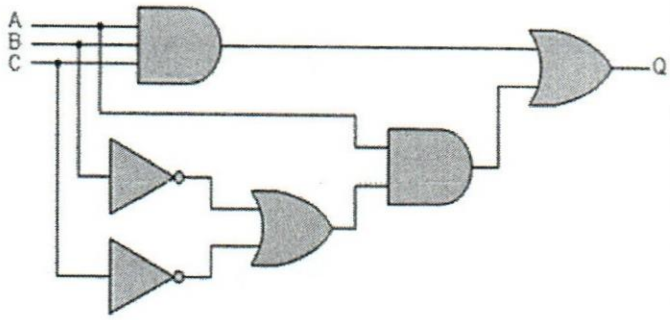

Figure 5. 1

b) NAND and NOR gates are universal logic gates.

(i) Define the term universal logic gate.
(10 marks)

(ii) Implement NOT gate using only two input NAND gates.
(10 marks)

(iii) Implement two input OR gate using only two input NAND gates.
(10 marks)

(iv) Implement two input AND gate using only two input NOR gates.
(10 marks)

c) A three-variable logic function is given by $K_{(A,B,C)} = \sum(0,1,3,4,5)$. using Karnaugh maps find,

(i) Minimum POS expression

(ii) Minimum SOP expression
(30 marks)

d) Simplify the Boolean function $F = \bar{A}\bar{B}\bar{C} + AB\bar{C} + \bar{A}B\bar{C} + A\bar{C}\bar{B}$ using Boolean theorems and verify it using Karnaugh map.
(15 marks)

6.

a) In a system, there are three inputs A, B, C and output F. The input 3 bits
A, B, C contribute the Binary number N.
Output F = 1 if N ≥ 011 and F = 0 if N < 011.

(i) Construct a truth table for above system

(15 marks)

(ii) Derive a SOP expression from the truth table obtained

(15 marks)

(iii) Use Karnaugh map to simplify the expression obtained in question 6(ii)

(15 marks)

(iv) Draw the logic circuit for the expression obtained in question 6(iii)

(15 marks)

b) Draw a truth table and show what input conditions are necessary to set, reset, no change and toggle the J-K flip-flop.

(15 marks)

c) Figure 6.1 shows the clock and input signal applied to a positive-edge triggered D-type flip-flop. Complete the waveform to record the output signal from the flip-flop.

Note the waveform commences with Q = 0. You should include a clear diagram of the CK, D and Q signals in your answer book.

(25 marks)

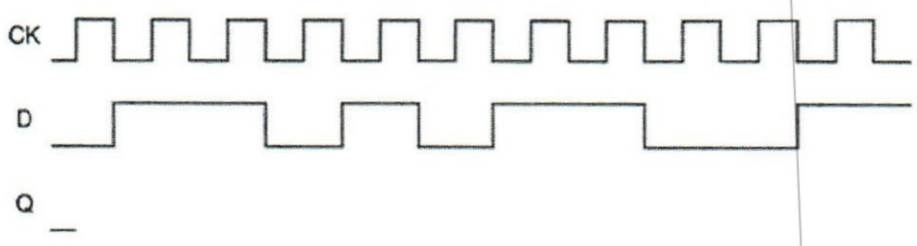

Figure 6. 1

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CINEC CAMPUS
FACULTY OF ENGINEERING & TECHNOLOGY

EXAMINATION PAPER

Module Code	:	**EE2325**
Module Title	:	**Computer Organization**
Academic Year	:	**Semester 4/2019**
Date	:	**3rd January 2019**
Examiners	:	**C. D. Makavita**
Time Allowed	:	**3 Hours**

INSTRUCTIONS TO CANDIDATES

- This is a closed book examination.
- You Should Answer all four questions. Each question carries equal marks.
- Each answer should start on a separate page.
- A datasheet is provided.

MATERIALS REQUIRED

- six-page answer booklets will be provided
- You may use a Scientific calculator. This must not be programmable and may be inspected during the examination.

1) a) Assume you have been given the basic NAND gate; how would you build the following gates using the NAND gates only.

   i. NOT gate
   ii. AND gate
   iii. OR gate

30%

b) Using the above three gates

   i. draw the gate diagram for the XOR gate if the HDL interface is given below (including the names of internal connections)

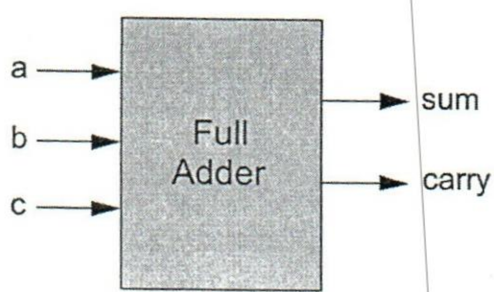
```
CHIP Xor {
    IN  a,  b;
    OUT out;

    PARTS:
    //implementation missing

    }
```

   ii. complete the above implementation and write the complete HDL code for XOR gate.

70%

2) One of the most important parts of the computer is the ALU. T
   a) The truth table of the Full Adder which is an important part of the ALU is given below.

a	b	c	carry	sum
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

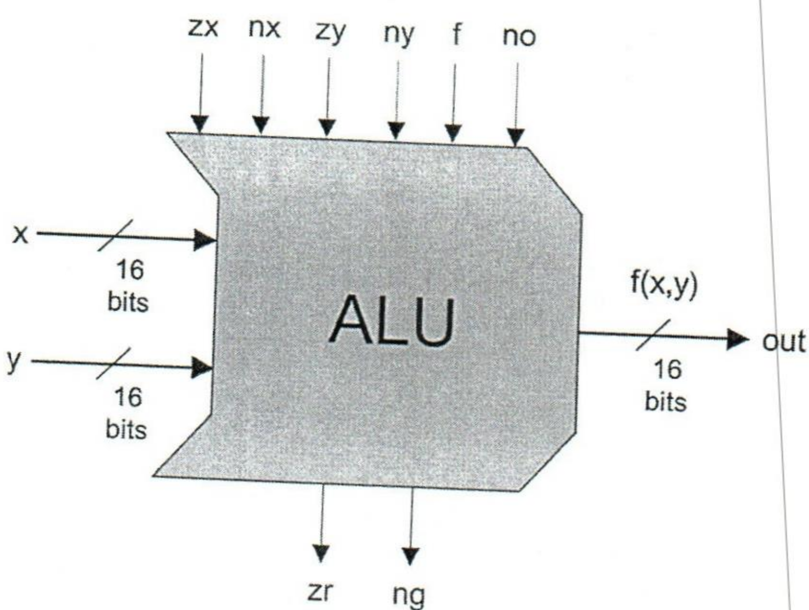


Complete the following Chip interface, you can use any basic gate and half adder chip i.e HalfAdder(a=, b=, sum=, carry=)

```
CHIP FullAdder {
    IN a, b, c;
    OUT sum, carry;

    PARTS:
    //implementation missing

    }
```

40%

b) The diagram of the ALU of the HACK computer is given below



i. Describe the function of each input and output
ii. The following is one of the 18 possible input configurations of the ALU control bits. What is the output?

zx	nx	zy	ny	f	no
1	0	1	0	1	0

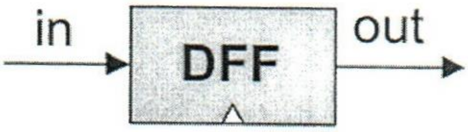
60%

3)

a) Memory is an important component of the stored computer architecture.
   i. Explain the different types of memory available in a computer
   ii. Explain how these are arranged in the memory hierarchy
   iii. What is the purpose of the memory hierarchy?

40%

b) The most elementary sequential element in the computer is a device called a flip-flop, of which there are several variants. In this module we use a variant called a data flip-flop, or DFF. DFFs form the basis of the main memory of computers called RAM.



$$out(t) = in(t-1)$$

A RAM is a storage device that can "store," or "remember," a value over time, implementing the classical storage behaviour out(t)=out(t-1). Definition of RAM8 chip is given below.

Chip name: RAM8 // 8 and 3 are listed below
Inputs: in[8], address[3], load
Outputs: out[8]
Function: out(t)=RAM[address(t)](t)
If load(t-1) then
RAM[address(t-1)](t)=in(t-1)

Let us implement RAM8 defined above by following the steps given below. show all the connections.

i. Implement a 1-bit register using a DFF and draw the corresponding block diagram.
ii. Implement a 8-bit register using a 1-bit registers and draw the corresponding block diagram.
iii. Implement a RAM8 chip using a 8-bit registers and draw the corresponding block diagram.

60%

4)

a) Explain what the outcome is after running the following code snippets from the HACK machine language.

i.
```
@10
D=A
D=D+1
```

ii.
```
@3
D=M
@5
M=D
```

iii.
```
@R1
```

```
M=0
@10
0;JMP
```

50%

b) Complete the following programme to flip the values in RAM[0] and RAM[1] by filling the code in place of question marks.

```
    @R1
    D=M
    ?
    ?

    @R0
    D=M
    @R1
    M=D

    ?
    D=M
    ?
    M=D

(END)
    @END
    ?
```

50%

DATA SHEET

A-instruction: *@value* // Where *value* is either a non-negative decimal number
// or a symbol referring to such number.

value (v = 0 or 1)

Binary: `0 v v v` `v v v v` `v v v v` `v v v v`

C-instruction: *dest=comp;jump* // Either the *dest* or *jump* fields may be empty.
// If *dest* is empty, the "=" is omitted;
// If *jump* is empty, the ";" is omitted.

comp (a, c1–c6) *dest* (d1–d3) *jump* (j1–j3)

Binary: `1 1 1 a` `c1 c2 c3 c4` `c5 c6 d1 d2` `d3 j1 j2 j3`

j1 ($out < 0$)	j2 ($out = 0$)	j3 ($out > 0$)	Mnemonic	Effect
0	0	0	null	No jump
0	0	1	JGT	If *out* > 0 jump
0	1	0	JEQ	If *out* $= 0$ jump
0	1	1	JGE	If *out* ≥ 0 jump
1	0	0	JLT	If *out* < 0 jump
1	0	1	JNE	If *out* $\neq 0$ jump
1	1	0	JLE	If *out* ≤ 0 jump
1	1	1	JMP	Jump

(when a=0) ***comp** mnemonic*	c1	c2	c3	c4	c5	c6	(when a=1) ***comp** mnemonic*
0	1	0	1	0	1	0	
1	1	1	1	1	1	1	
-1	1	1	1	0	1	0	
D	0	0	1	1	0	0	
A	1	1	0	0	0	0	M
!D	0	0	1	1	0	1	
!A	1	1	0	0	0	1	!M
-D	0	0	1	1	1	1	
-A	1	1	0	0	1	1	-M
D+1	0	1	1	1	1	1	
A+1	1	1	0	1	1	1	M+1
D-1	0	0	1	1	1	0	
A-1	1	1	0	0	1	0	M-1
D+A	0	0	0	0	1	0	D+M
D-A	0	1	0	0	1	1	D-M
A-D	0	0	0	1	1	1	M-D
D&A	0	0	0	0	0	0	D&M
D|A	0	1	0	1	0	1	D|M

d1	**d2**	**d3**	*Mnemonic*	***Destination (where to store the computed value)***
0	0	0	null	The value is not stored anywhere
0	0	1	M	Memory[A] (memory register addressed by A)
0	1	0	D	D register
0	1	1	MD	Memory[A] and D register
1	0	0	A	A register
1	0	1	AM	A register and Memory[A]
1	1	0	AD	A register and D register
1	1	1	AMD	A register, Memory[A], and D register

Library

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FACULTY OF ENGINEERING & TECHNOLOGY

RESIT EXAMINATION PAPER

Module Code	**:**	**EE2316**
Module Title	**:**	**Signals and Systems**
Academic Year	**:**	**Semester 3/2019**
Date	**:**	**14th February 2020**
Examiners	**:**	**Srimal Punchihewa**
Time Allowed	**:**	**3 Hours**

INSTRUCTIONS TO CANDIDATES

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- You Should Answer all four questions. Each question carries equal marks.
- Each answer should start on a separate page.
- A datasheet is provided.

MATERIALS REQUIRED

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1) The input, $x[n]$ to a discrete linear time-invariant (LTI) system and the impulse response, $h[n]$ of the system are shown in Figure 1. Find the system output, $y[n]$.

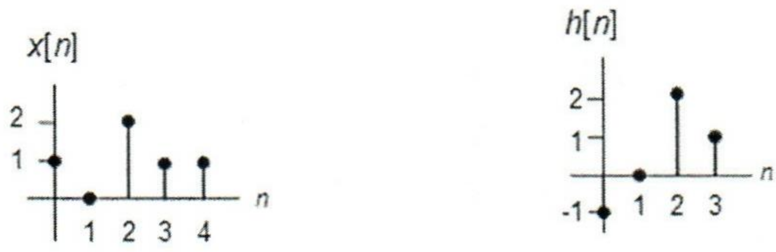

Figure 1

(100%)

2) Find the complex exponential Fourier series coefficients, c_k for the periodic signal $x(t)$ shown in Figure 2 and write the series $x(t)$ using c_k for $-4 \le k \le 4$. *[Trigonometric series coefficients will also be accepted instead of complex exponential coefficients].*

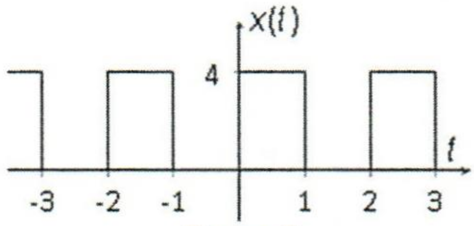

Figure 2

(100%)

3)

a) Assume that a sampled data value is 0.3 V. Given the fact that 9 equally-spaced levels are used to represent the amplitude range of -1 V to 1 V, obtain the digital code (in binary form) of this sampled data value after quantisation using the minimum number of bits. What is the quantisation error for this obtained digital code? 50%

b) Consider an analogue signal that is to be sampled: $x(t) = \sin(100\pi\, t) + \cos(50\pi\, t) + \cos(84\pi\, \mathrm{t})$. What is the minimum sampling frequency that should be used to avoid aliasing? 25%

c) For the signal shown in the figure 3 below, make labelled sketches of the odd and even components. Verify that the addition of the components produces the original signal. 25%

Figure 3

4)

a) Determine the Laplace transform, region of convergence (ROC) and the location of the poles and zeros of $X(s)$ for $x(t) = e^{2t}\,u(t) + e^{-4t}\,u(t)$ where $u(t)$ is the step function defined for $t \geq 0$. Include a sketch of the pole zero diagram in your answer. 40%

b) Find the transfer functions, H(z), of the systems characterised by the following difference equations. Also plot their pole-zero diagrams. 40%

I. y[n] = 2x[n] − x[n − 1] + 3y[n − 1] − 2y[n − 2]
II. y[n] = x[n] − 2x[n − 1] + 2.5y[n − 1] − y[n − 2]
III. y[n] = x[n] + x[n − 2] + y[n − 1] − 0.5y[n − 2]

c) Find the inverse z-transforms of the following signal: 20%

$$X(z) = \frac{(z-1)(z+0.8)}{(z-0.5)(z+0.2)}$$

DATA SHEET

Complex Exponential Fourier Transform

$$X(\omega) = \int_{-\infty}^{\infty} x(t)e^{-j\omega t}dt \qquad -\infty < t < \infty$$

Inverse **Fourier transform**

$$h(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} H(\omega)e^{j\omega t}d\omega$$

Euler Equations

$$e^{j\theta} = \cos\theta + j\sin\theta$$

$$e^{-j\theta} = \cos\theta - j\sin\theta$$

$$\cos\theta = \frac{1}{2j}\left(e^{j\theta} + e^{-j\theta}\right)$$

$$\sin\theta = \frac{1}{2j}\left(e^{j\theta} - e^{-j\theta}\right)$$

Complex Exponential Series

$$c_k = \frac{1}{T_0}\int_{T_0} x(t)e^{-jk\omega_0 t}dt \quad \text{for } k = 0, \pm 1, \pm 2, \ldots$$

$$c_0 = \frac{1}{T_0}\int_{T_0} x(t)dt$$

Table of Laplace transform pairs

$x(t)$	$X(s)$	ROC
$\delta(t)$	1	All s
$u(t)$	$\frac{1}{s}$	$\mathrm{Re}(s) > 0$
$-u(-t)$	$\frac{1}{s}$	$\mathrm{Re}(s) < 0$
$tu(t)$	$\frac{1}{s^2}$	$\mathrm{Re}(s) > 0$
$t^k u(t)$	$\frac{k!}{s^{k+1}}$	$\mathrm{Re}(s) > 0$
$e^{-at}u(t)$	$\frac{1}{s+a}$	$\mathrm{Re}(s) > -\mathrm{Re}(a)$
$-e^{-at}u(-t)$	$\frac{1}{s+a}$	$\mathrm{Re}(s) < -\mathrm{Re}(a)$
$te^{-at}u(t)$	$\frac{1}{(s+a)^2}$	$\mathrm{Re}(s) > -\mathrm{Re}(a)$
$-te^{-at}u(-t)$	$\frac{1}{(s+a)^2}$	$\mathrm{Re}(s) < -\mathrm{Re}(a)$

Table of z-transform pairs

Sequence $x[n]$	z-Transform $X(z)$	ROC
$\delta[n]$	1	All z
$u[n]$	$\frac{1}{1-z^{-1}}$	$\lvert z\rvert > 1$
$a^n u[n]$	$\frac{1}{1-az^{-1}}$	$\lvert z\rvert > \lvert a\rvert$
$na^n u[n]$	$\frac{az^{-1}}{(1-az^{-1})^2}$	$\lvert z\rvert > \lvert a\rvert$
$-a^n u[-n-1]$	$\frac{1}{1-az^{-1}}$	$\lvert z\rvert < \lvert a\rvert$
$-na^n u[-n-1]$	$\frac{1}{(1-az^{-1})^2}$	$\lvert z\rvert < \lvert a\rvert$
$(\cos\omega_0 n)\,u(n)$	$\frac{1-z^{-1}\cos\omega_0}{1-2z^{-1}\cos\omega_0+z^{-2}}$	$\lvert z\rvert > 1$
$(\sin\omega_0 n)\,u(n)$	$\frac{1-z^{-1}\sin\omega_0}{1-2z^{-1}\sin\omega_0+z^{-2}}$	$\lvert z\rvert > 1$
$(a^n\cos\omega_0 n)\,u(n)$	$\frac{1-z^{-1}\cos\omega_0}{1-2az^{-1}\cos\omega_0+a^2z^{-2}}$	$\lvert z\rvert > \lvert a\rvert$
$(a^n\sin\omega_0 n)\,u(n)$	$\frac{1-z^{-1}\sin\omega_0}{1-2az^{-1}\sin\omega_0+a^2z^{-2}}$	$\lvert z\rvert > \lvert a\rvert$