Tanta University

Electronics and Electrical Communications Department

Faculty of Engineering

Course	Electromagnetic Waves (1)	Academic year 2021/2022 Second Semester Exam	Course Code	EEC 2208
Year	2nd Year		Total Marks	85
Date	12/6/2022 (**Final Exam**)	No. of pages: (2) Pages	Allowed Time	3 hrs
Remarks: Answer **ALL** of the following Questions.				

Question # I: (50 Points)

(1) A 50 V voltage generator at 20 MHz is connected to the plates of an air dielectric parallel plate capacitor with a plate area of $2.8cm^2$ and a separation distance of $0.2mm$. Find the maximum value of displacement ~~the~~ current. **(5 Points)**

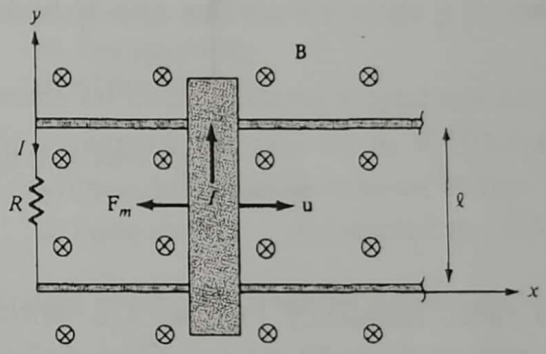
(2) Consider the loop of Fig. 1. If $\bar{\mathbf{B}} = -0.5\ \hat{\mathbf{a}}_z Wb/m^2$, $R = 20\Omega$, $l = 10cm$, and the rod is moving with a constant velocity of $8\ \hat{\mathbf{a}}_x$ m/s, find: **(10 Points)**

a) The induced emf in the rod

b) The current through the resistor

c) The motional force on the rod

d) The power dissipated by the rod.



(3) Starting with Maxwell's equations for time varying fields to derive the wave equation for the electric field propagating in the $+ve$ z direction in free space. You may consider that the electric field strength has only $x-$component. Then write down the boundary conditions between two mediums assume the second medium is perfect conductor. **(10 Points)**

(4) A plane wave $\mathbf{E}(z,t) = 10^{-2}e^{j(2\pi 10^8 t - 20\pi z)}\mathbf{a}_x + E_{02}e^{j(\omega_0 t + \beta z + \theta_o)}\mathbf{a}_y$ V/m is propagating in a lossless medium. Determine: **(10 Points)**

a) The direction of wave propagation and the values of ω_0 and β

b) the values of E_{02} and θ_o for:

i) Linearly polarized wave at 50^o with x axis.

ii) Clockwise circularly polarized wave.

iii) Elliptically polarized wave followeing the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 10^{-2}$

(5) An EMWs incident from a dielectric medium ($z > 0$) having ϵ_{r1} to another medium ($z < 0$) with $\epsilon_{r2} = 16$ are given by: $\mathbf{E}_i(x, z, t) = -10^{-2} e^{j(2\pi \times 10^9 t - 6\pi x + 8\pi z)} \mathbf{a}_y$ V/m. Assume lossless dielectric mediums, **(15 Points)**

a) Obtain type of incidence and type of polarization then Evaluate the value of ϵ_{r1}

b) Evaluate α, β, v_{ph}, η for each plane, θ_i, θ_r, θ_t, R, and T.

c) Obtain an expression for $\mathbf{H}_i(x, z, t)$ and $\mathbf{E}_t(x, z, t)$.

d) Check occurrence of total transmission and total reflection.

Question # II: (35 Points)

(1) Draw the lumped element circuit model for a transmission line and write the general expressions for both voltage and current distributions V(z) and I(z), Then Write down expressions α, β, Z_0 for a distortion-less transmission line. **(7 Points)**

(2) Derive the input impedance Z_{in} of the transmission line then obtain the input impedance in the cases of $\frac{\lambda}{8}$ short circuit line and $\frac{3\lambda}{8}$ open circuit line. **(7 Points)**

(3) A TL 15 km long is terminated in its characteristic impedance 600 Ω. The sending end voltage is $5\angle 0^0$ V at an angular frequency of 10^4 rad/s, and the resulting voltage at the receiving end is measured as $0.88\angle -80^0$ V. Calculate the primary constants of the line (R, L, G, C) per kilometer. **(7 Points)**

(4) For a radio frequency lossless T.L. with $l = 6m$ and operating at $f = 300$ MHz with parameters $L = 10$ mh/m, $C = 4\mu$F/m and the reflection coefficient at the load $\Gamma_L = 0.4\sqrt{3} + j0.4$ obtain the values of: Z_0, Z_L, $VSWR$, Z_{in}, d_{1max}, d_{1min}, Z_{max}, Z_{min}, Z at 2.5m from the load. **(14 Points)**

Constants:
$\epsilon_0 = 8.854 \times 10^{-12}$ F/m, $\mu_0 = 4\pi \times 10^{-7}$ H/m, $c = 3 \times 10^8 m/s$.

Course Examination Committee:
Prof. Mohamed E. Nasr
Dr. Heba Elkhobby
Dr. Nessim Mahmoud

Course Coordinator: Dr. Hussein E. Seleem

Tanta University | Department: Electronics and Electrical Communication Eng. | Faculty of Engineering

Total Marks: 75 Marks

Course Title: Electronic Measurements (2)	**Course Code: EEC2209**	**Year: 2nd year**
Date: 15/6/2022	**Allowed time: 3h**	**No of Pages (5)**

Remarks: (This question paper must be submitted with your answer form. Answer questions No.1 and No. 2 in the electronic answer form and questions No.3 and No.4 in the answer book)

Question (1) Choose the correct answer

1) ---------- instruments are very reliable for static and stable measurement conditions.
   a) Electronic b) Mechanical
   c) Digital d) Electrical

2) The attenuator circuit in the input stage of the electronic voltmeter enables……..
   a) Fixed gain b) Reduced noise level
   c) High input impedance. d) Multi-range selection.

3) ---------- is an example of manual instrument
   a) Wheatstone-bridge b) dial-indicating type instrument
   c) mercury-in-glass thermometer d) Tangent Galvanometer.

4) Which of the following is a disadvantage of electrical voltmeters?
   a) low input impedance b) low sensitivity
   c) human errors of reading d) all the previous.

5) In multi-range DFM …….. provide different time base signals.
   a) Flip flops. b) Crystal oscillators.
   c) Decade counters. d) Pulse shapers.

6) In DC voltmeters, what helps keep the input voltage of the input amplifier within a certain level?
   a) FET amplifier b) direct coupled amplifier
   c) attenuator d) none of the previous

7) The main difference between AC voltmeter circuit and DC voltmeter circuit is the usage of ---------.
   a) an amplifier b) a rectifier
   c) an attenuator d) a voltage divider

8) The types of DVMs are classified based on ……
   a) ADCs b) Counters
   c) Attenuators. d) Digital displays

9) An actuator control signal is fed to ----------.
   a) a relay b) a potentiometer
   c) an amplifier d) an attenuator

10) The peak amplitude of the ac input is within the dynamic range of the AC amplifier is the operating condition of ----------
   a) True RMS responding meter. b) Average responding meter.
   c) differential voltmeter d) DMM

11) To avoid the effect of ambient temperature, you recommend the usage of ……..
a) Differential voltmeter. b) Balanced bridge TVM.
c) Peak responding meter. d) Average responding meter.

12) For a half-wave rectifier, the average voltage of the rectified sinusoidal signal is equal to…….
a) 0.95 Vrms b) 0.90 Vrms
c) 0.45 Vrms d) 0.54 Vrms

13) To measure the noise signal from an electrical or acoustic source, you must use …….
a) True RMS responding meter. b) Peak responding meter.
c) Average responding meter. d) Differential voltmeter.

14) A --------- attenuation is required in DVMs.
a) decimal b) binary
c) BCD d) decade

15) In ramp type DVM, the circuit between the counter and the driver is the ----------
a) ramp generator. b) AND gate.
c) latch d) comparator.

16) In DMM, the alternating current to be measured is first ----------
a) Rectified b) Converted to an alternating voltage.
c) Amplified. d) Filtered.

17) The output waveform of a conventional HWR starts at ---------- volt.
a) zero b) 0.7
c) +1.4 d) -1.4

18) Converting the periodic signal to a pulse signal then counting the number of triggers in one second is the operating principle of ……
a) DMM b) DVM
c) Basic DFM d) LVDT

19) In the function generator, the frequency is controlled by varying the ------- of the current that drives the integrator.
a) magnitude b) phase
c) polarity d) none of the previous

20) In Peak Responding AC Voltmeters, we should select the components' values that satisfy the condition
a) $RC > T$ b) $RC << T$
c) $RC = T$ d) $RC >> T$

21) The primary difference between the peak-responding voltmeter and the average responding voltmeter is the usage of a --------- with the rectifying diode.
a) storage capacitor b) PMMC
c) DC amplifier d) AC amplifier

22) In the function generator, the integrator output waveform is a --------
a) square b) sinusoidal
c) triangle d) trigger

23) The thermocouple transducer is the basic block in ----------.
a) DVM. b) DMM.
c) Reciprocal DFM. d) True RMS responding meter.

24) The wave shaping circuit in measurement instruments is better to be implemented using ------
a) A comparator. b) A Schmitt trigger circuit.
c) A Flip Flop. d) A 555 timer.

25) --------- means to store or save data for revision, analysis, or review of important events.
a) Excitation b) monitoring
c) sensing d) logging

Question (2) Choose True or False

1) Null instruments must have the feedback operation that compares the measurand with the standard value.
a) True b) False

2) The drawbacks of electrical voltameters are overcome by utilizing electronic devices.
a) True b) False

3) In some function generators, the output signal can be phase-locked to a standard frequency source.
a) True b) False

4) Chopper type dc amplifier is used in highly sensitive dc electronic voltmeters.
a) True b) False

5) In the function generator, the voltage comparator MV changes state at a predetermined maximum level, of the integrator output voltage.
a) True b) False

6) Reciprocal DFM is better for measuring high frequencies.
a) True b) False

7) Installing the DAQ card driver provides a monitoring program that allows the user to automatically control the actuator.
a) True b) False

8) Dual slop DVM requires precise ramp voltage and time periods.
a) True b) False

9) The time base is applied to the flip flop in reciprocal DFM.
a) True b) False

10) The Schmitt trigger circuit converts any kind of waveforms into sinusoidal.
a) True b) False

11) In a differential voltmeter, the reference voltage can be implemented by a low voltage Zener controlled precision supply
a) True b) False

12) The loading effect alerts the original circuit situation during the measurements.
a) True b) False

13) In a balanced bridge TVM, the field-effect transistor provides extremely high input capacitance.
a) True b) False

14) Fixed attenuation switches are not available in function generators
a) True b) False

15) One of the components of a DC differential voltmeter is an operational amplifier with positive feedback
a) True b) False

16) It is better to implement the time base circuit (in DFM) using the 555 timer rather than the crystal oscillator.
a) True b) False

17) The scale of the average responding AC voltmeter is calibrated in terms of the RMS value of sinusoidal
a) True b) False

18) The purpose of coupling capacitors and transformers is to strip away any AC voltage and provide a clear path for the DC voltage.
a) True b) False

19) If you design an AC voltmeter with a rectifier after the resistor attenuator, then you need to add an AC amplifier.
a) True b) False

20) Crest Factor is the ratio of the peak value to the rms value of the wave form.
a) True b) False

21) The structure of the AC differential voltmeter includes a null indicator and a 10-volt reference source.
a) True b) False

22) The resistance diode network should not change the slope of the triangular wave at its input.
a) True b) False

23) The clamp meter provides a DC current reading on the digital display.
a) True b) False

24) Capacitance measurements is available in some DMM
a) True b) False

25) In DFM, the time base error gives a reading error that depends on the input frequency.
a) True b) False

Question (3) Complete the missing words.

1) Advantages of digital instruments over their analog counterparts are ---------, --------, and -------.

2) In DC voltmeter ---------- amplifier is simply used to implement the multi-stage dc amplifier.

3) Transformer coupling provides ------ and --------.

4) The main factors that affect the reading accuracy of a true RMS responding AC voltmeter are ---- and ---------.

5) Considering a differential voltmeter, the requirement of a higher reference supply is avoided using ----------.

6) Common parts between the ramp type and the dual slop DVMs include --------, --------, and -------

7) Examples of signal conditioning in DAS are ---------, ---------, and ----------.

8) Types of DAQ cards are --------- and ----------.

9) The block diagram of the basic DFM is shown in Fig.1. The missing names of blocks A, B, and C: are -------, ----------, and -------. The output at D is a ---------- wave.

Question (4)

A sawtooth waveform, shown in Fig.2, is applied to the average responding meter. The scale is calibrated in terms of the RMS value of the sinusoidal signal. Calculate the percentage error in the reading.

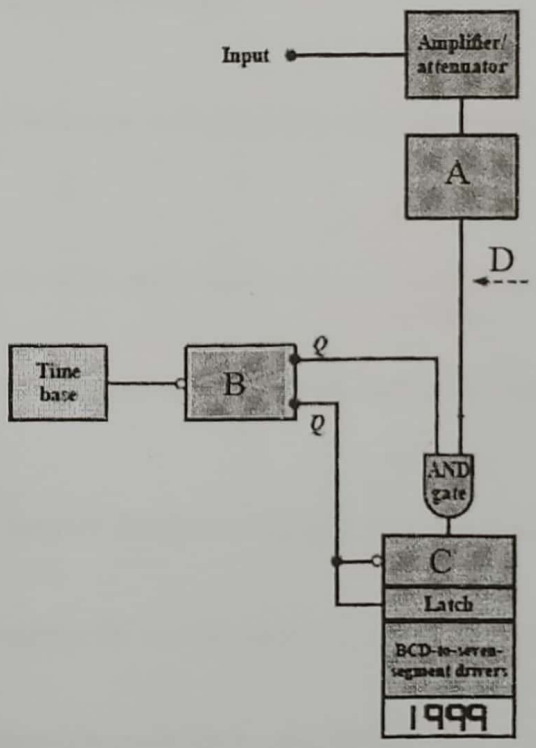


Fig. 1

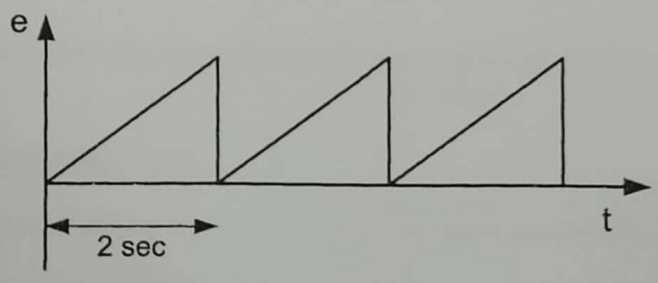


Fig. 2

With Best Wishes

Tanta University | Department: Electronics and Electrical Communication Eng. | Faculty of Engineering

Total Marks: 90 Marks

Course Title: Electronic circuits (2)	Course Code: EEC2206	Year: 2nd year
Date: 19/6/2022	Allowed time: 3h	No of Pages (5)

Remarks: (This question paper must be submitted with your answer form. Answer questions No.1 and No. 2 in the electronic answer form and question No.3 in the answer book)

Question (1) Choose the correct answer

1) The cutoff frequency in a frequency response plot is called .....
   a) corner frequency
   b) break frequency
   c) half-power frequency
   d) all of the pervious

2) An oscillator differs from an amplifier because the oscillator .....
   a) has more gain
   b) require no input signal
   c) require dc supply
   d) is more stable

3) A phase shift oscillator has .....
   a) Three RC circuits
   b) Three LC circuits
   c) T-type circuit
   d) Lead-lag circuit

4) A tuned circuit has a resonance frequency of 800 KHz and a bandwidth of 10 KHz. The value of Q-factor is .....
   a) 50
   b) 80
   c) 40
   d) 60

5) The poles for Butterworth filter lie on a circle of radius ..... and are spaced at equal angles of .....
   a) $w(1/\varepsilon)^{1/N}$, π/N
   b) $w(1/\varepsilon)^{N}$, π/N
   c) $w(\varepsilon)^{N}$, $\pi/2N$
   d) $w(1/\varepsilon)^{1/N}$, $\pi/2N$

6) The order of the filter is the number of ..... in the transfer function.
   a) poles
   b) zeros
   c) poles/zeros
   d) all of the pervious

7) The pass band ripple is the variation in the ..... response.
   a) stop-band
   b) pass-band
   c) transmission-band
   d) none of the pervious

8) The minimum pass band attenuation is the minimum signal attenuation within the .....
   a) pass-band
   b) transmission-band
   c) stop-band
   d) all of the pervious

9) Wideband filters have quality factor (Q) .....
   a) $Q > 5$
   b) $Q < 1$
   c) $Q \leq 1$
   d) none of the pervious

10) For negative feedback, the loop gain (AB) should be positive and .....
   a) $AB >> 1$
   b) $AB > 0$
   c) $AB > 1$
   d) $AB < 1$

11) For a stable filter, the degree of denominator must be ..... The degree of numerator.
a) $<$ b) $>$
c) $\leq$ d) $\geq$

12) For voltage-series feedback having $A=-100$, $\beta=-0.1$, $R_i=10\,k\Omega$, and $R_o=20\,k\Omega$. The voltage gain is .....
a) 10 b) -10
c) 9 d) -9

13) For voltage-series feedback having $A=-100$, $\beta=-0.5$, $R_i=10\,k\Omega$, and $R_o=20\,k\Omega$. The input impedance is .....
a) 110 $k\Omega$ b) 310 $k\Omega$
c) 210 $k\Omega$ d) 510 $k\Omega$

14) For voltage-series feedback having $A=-100$, $\beta=-0.1$, $R_i=10\,k\Omega$, and $R_o=20\,k\Omega$. The output impedance is .....
a) 1.8 $k\Omega$ b) 0.2 $k\Omega$
c) 0.4 $k\Omega$ d) 0.5 $k\Omega$

15) Examples of feedback oscillators using RC circuits are ..... oscillator
a) Wien-bridge b) Phase-shift
c) Twin-T d) all of the pervious

16) Relaxation oscillator uses an RC timing circuit to generate ..... waveform
a) square b) sawtooth
c) triangular d) all of the pervious

17) The most widely used RC feedback oscillator is .....
a) Phase-shift b) Wien-bridge
c) Armstrong d) Hartley

18) Practical Wien-bridge oscillator uses ..... for oscillation sustain.
a) back-to-back zener diode b) two zener diodes
c) potentiometer d) variable resistors

19) The attenuation of RC feedback circuit in phase shift oscillator is .....
a) $1/2\sqrt{6}$ b) $1/\sqrt{6}$
c) 1/3 d) 1/29

20) Passive filter is a circuit with .....
a) no amplifier element b) no external power
c) $gain \leq 1$ d) all of the pervious

21) The equivalent circuit of crystal oscillator consists of ..... circuit.
a) series RLC b) parallel RLC
c) series-parallel RLC d) all of the pervious

22) Crystal oscillator operates in ..... resonance
a) series b) parallel
c) series or parallel d) series and parallel

23) In crystal oscillator, the series resonant frequency is ..... parallel resonant one.
a) Smaller than. b) higher than
c) equal to d) all of the pervious

24) Duty cycle is defined as .....
a) $t_L/(t_H+t_L)$ b) $t_H/(t_H+t_L)$
c) $1+(t_H/t_L)$ d) $1+(t_L/t_H)$

25) The 555 timer consists of .....
a) comparators b) flip-flop
c) discharge transistor d) all of the pervious

Question (2) Choose True or False

1) The band-reject filter is the notch filter.
a) True b) False

2) A complement to the band pass filter is the band-reject.
a) True b) False

3) In practical filter, the transition from pass band to stop band is instantaneous.
a) True b) False

4) In Ideal filter, stop band attenuation will not be infinite.
a) True b) False

5) The cutoff frequency is the maximum frequency can pass.
a) True b) False

6) All poles must be in the left side of the plane to have stability.
a) True b) False

7) A pole is a root of the numerator of the transfer function.
a) True b) False

8) A zero is a root of the denominator of the transfer function.
a) True b) False

9) Butterworth is an example of all-pole filter.
a) True b) False

10) Butterworth filters have ripple in the pass band.
a) True b) False

11) Desensitized gain means gain more sensitive to circuit component variations.
a) True b) False

12) Feedback circuit produces phase shift and provides attenuation.
a) True b) False

13) A feedback oscillator consists of an amplifier and a negative feedback circuit.
a) True b) False

14) A BJT can be used in place of FET to minimize loading effect.

a) True b) False

15) The Schmitt trigger circuit converts any kind of waveforms into sinusoidal.
a) True b) False

16) It is better to implement the time base circuit using the 555 timer rather than the crystal oscillator.
a) True b) False

17) Wien-bridge oscillator circuit consists of inverting amplifier.
a) True b) False

18) Transformer coupling is used to eliminate the loading effect.
a) True b) False

19) Astable multivibrator is a free-running relaxation oscillator.
a) True b) False

20) The transmission zeros of Chepyshev filter are at $w= 0$
a) True b) False

21) Butterworth filter provides greater stop-band attenuation than Chepyshev one.
a) True b) False

22) Chepyshev filter exhibits an equal ripple response in the pass-band.
a) True b) False

23) The filter order is the number of pass-band minima and maxima.
a) True b) False

24) The smaller the value of the Q, the closer the poles is to the jw axis.
a) True b) False

25) An infinite value of Q locates the poles on the jw axis.
a) True b) False

Question (3)

a) ***Complete the missing words***

1. Figure 1 represents transmission characteristics of …….. filter.
2. The filter order equal to ……,
3. w_p is defined as ……,
4. w_s is defined as ……,
5. $w_s - w_p$ is defined as ……,
6. w_s / w_p is defined as ……,
7. A_{max} is defined as ……,
8. A_{min} is defined as ……..…,
9. Optimum value of A_{max} to be ……, A_{min} to be ……, and w_s / w_p to be ……..

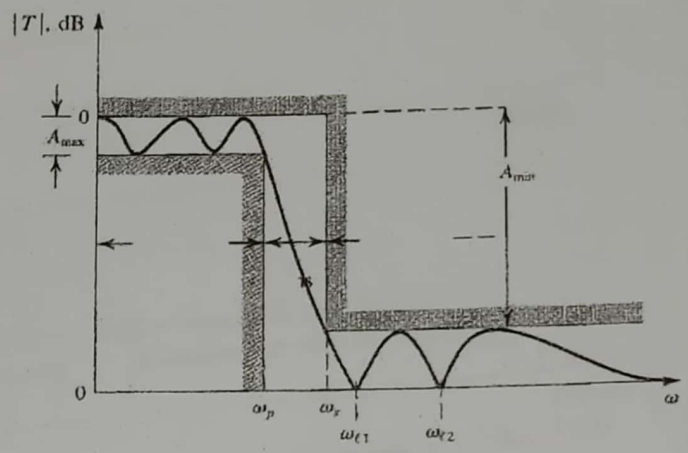


Figure 1

b) Determine the order of the Butterworth filter for which $A_{max}=1\,dB$, $A_{min}\geq 20\,dB$, and $w_s/w_p=1.3$. What is the actual value of minimum stopband attenuation realized? If A_{min} is to be exactly 20 dB, to what value can A_{max} be reduced?

c) Design a Butterworth filter that meets the following low-pass specifications $f_p=10\,KHz$, $A_{max}=2\,dB$, $f_s=15\,KHz$, and $A_{min}=15\,dB$. Find N, the natural modes and T(s). What is the attenuation at 20 *KHz*.

d) Design a first-order op amp RC spectrum shaping network with transmission zero frequency of 1 kHz, a pole frequency of 100 kHz, and a dc gain magnitude of unity. The low frequency input resistance is to be 1 $k\Omega$. What is the high-frequency gain that results? Sketch the magnitude of the transfer function versus frequency.

With Best Wishes

Tanta University | Department: Electronics & Electrical Communications | Faculty of Engineering

Total Marks: (90) Marks

Course Title : Com. Engineering	Course Code: EEC2207	2nd Year: 2021/2022
Date: 22/6/2022	Allowed time: (3) hrs.	No. of Pages: (1)

Answer the following Questions

Q 1 : (16M)

a) What is meant by :

i) Linear modulations

ii-Transmission Impairment and explain each one.

b) When does over-modulation take place and what is its effect?

Q 2 : (18M)

a) Using the VCO block ,show how to generate the following systems:

i) Frequency Modulation (FM).

ii) Phase Modulation (PM).

b) Calculate the sampling rate for signal ; $X(t) = 4\cos(2\pi f_1 t) + 3\sin(2\pi f_2 t)$

Where f_1 is 1.5kHz and f_2 is 3.4 kHz. (Comment on your answer?).

Q3 (18 M)

a) What is the meant by FDM systems ، hence, draw their block diagrams? and FDM Hierarchy

b) Explain ,why is noise immunity of PWM is better than that of PAM?

Q4 (18 M)

a) Using sketches

i- Explain the three step process of PCM system or A/D converter.

ii-Types of quantizers.

b) A signal is quantized using L = 64 levels. Calculate the number of bits per sample 'n'.

Q5 (20 M)

a) Four sources, are multiplexed using TDM system , each source creating 200(8-bit characters) per second. If the interleaved unit is a character and one synchronizing bit is added to each frame, find :

i- The data rate of each source. ii- The duration of each character in each source.

iii- The frame rate. iv- The number of bits in each frame.

b) In FM systems

i-What is the effect of pre-emphasis filter? State haw to compensate this effect.

ii-What is the use of a limiter circuit?

---------- **Good Luck** ----------

Prof. Mohamed Nasr

Tanta University	Physics and Engineering Mathematics Department **FINAL EXAM** Year: **2nd Year Electronics and Electrical Communication Engineering Dep.**	Faculty of Engineering
Date: **June 26th, 2022** (2nd term) Allowed time: **3 hours**	Course Title: **Engineering Mathematics III(B)** Course Code: **PME2210**	Total Marks: **85** No. of pages: **2**

Please answer the following questions:

Question (1) **(45Marks)**

(a) Find all z values of $\sin z = \cos z$.

(b) Solve $[\ln z]^2 + \ln z = -1$.

(c) Consider the function $f(z) = \frac{1}{2}\ln(x^2+y^2) + i\,arg(z)$, defined in the first quadrant. Show that this function satisfies **C.R** conditions. Give a sketch that shows the orthogonality of $u(x,y)$ and $v(x,y)$.

(d) Evaluate the following integrals

(d-1) $I = \int_{-\infty}^{\infty} \frac{1}{(x^2+1)(x^2+9)}\,dx$

(d-2) $I = \oint_C \frac{e^z}{(z-i)^2(z+4)^2}\,dz$, $C: |z| = 3$ along the counterclockwise direction.

(e) If $\text{cosech}^{-1} z = \ln\left(\frac{1+\sqrt{1+z^2}}{z}\right)$, find cosech^{-1} at $z = e^{\frac{\pi}{2}i}$.

(f) Show that $\int_0^a \frac{dx}{\sqrt{\ln(\frac{a}{x})}} = a\sqrt{\pi}$.

Question (2) **(40Marks)**

(a) The following vector represents a complex number. The vector of length $3/2$ beginning at the origin and ending, in the first quadrant, on the circle $(x-1)^2 + y^2 = 1$. State the complex number in the form $a + ib$.

(b) Find a series solution around $x = 0$ for the differential equation

$$xy'' + 5y' + xy = 0$$

(***Hint***: substitute $y = z/x^2$).

(c) Show that $\lim_{z\to 0} f(z) = 0$ if z approaches ***zero*** along any straight line passes through the origin, where

$$f(z) = \frac{xy^3}{\quad} \quad \frac{x^3y}{\quad}$$

(d) Prove graphically and analytically the triangle inequality $|z_1 + z_2| \leq |z_1| + |z_2|$.

(e) Consider the closed contour C shown in Fig. 1 (two lines and ellipse half). Evaluate the following two integrals along C.

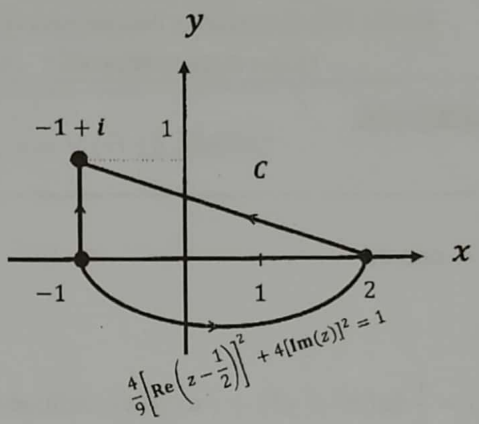


Figure 1

(e-1) $I = \oint_C \left[(3x^2y + 2x^2 - y^3 - 2y^2) + i(3xy^2 + 4xy - x^3)\right]\ dz$

(e-2) $I = \oint_C \left[e^x \cos y + i\, e^x \sin y\right]\ dz$

Best of Luck

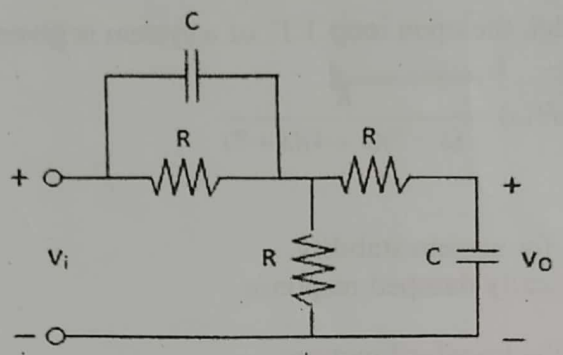
Dr. Ali Mehrez

Tanta University — Department: Computers and Automatic Control — Faculty of Engineering

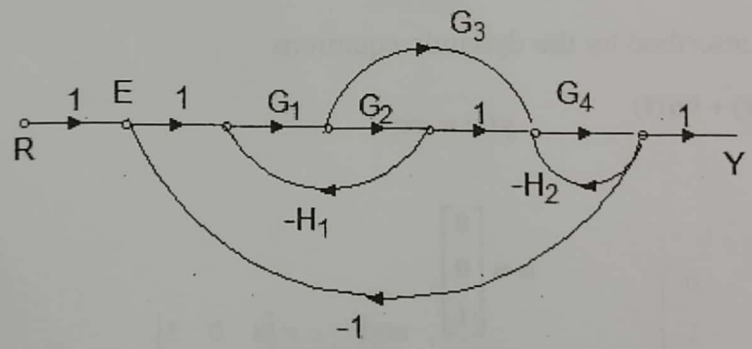
Total Marks: 70 Marks

Course Title: Automatic control Engineering	Course Code: CCE2251	Year: 2nd
Date: 29/6/ 2022	Allowed time: 3 hr.	

Q1: **[a]** Find the transfer function for the following circuit $V_0(s)/V_i(s)$ (8 Marks)



[b] Using signal flow graph, find the transfer function of the system **Y(s)/R(s)** (7 Marks) and **Y(s)/E(s)** (3 Marks)



Q2: **[a]** For each of the following characteristic equations, find the root distribution and determine whether the system is stable, marginally stable, or unstable: (10 Marks

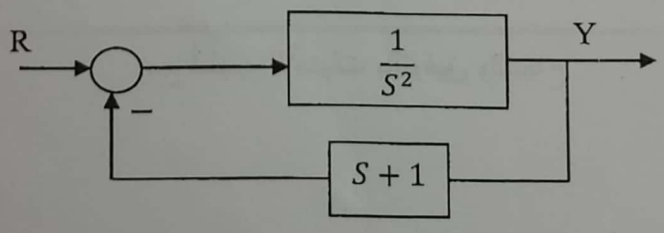
i) $S^6+S^5+2S^4+2S^3+3S^2+2S+5=0$

ii) $S^7+2S^6+2S^5+2S^4+S^3+2S^2+2S+1=0$

iii) $S^5+8S^4+2S^3+4S^2+2S+4=0$

iv) $S^6+S^5+2S^4+3S^2+2S+2=0$

[b] For the following system: (6 Marks)



Find:

1) The open loop and closed loop transfer function.
2) The type and order of the system.
3) The error constants Kp, K_v and K_a
4) The natural frequency, damping ratio, and settling time (2% error) for unit step input

Q3: [a] Find a state space model, the open loop T.F. of a system is given as: (10 Marks)

$$G(s)H(s) = \frac{K}{(s-2)(s+4)(s+7)}$$

1) Sketch the root locus.
2) Determine the range of K for system stability.
3) Find the value of K at critically damped response.

[b] for a control system having the transfer function:

$$G(s) = \frac{(s+3)}{(s+7)}\frac{(s+4)}{(s^2+5s+9)}$$

in the pole-zero form (7 Marks) and other form (3 Marks)

Q4: [a] Given a system described by the dynamic equations

$$\frac{\mathbf{dx(t)}}{\mathbf{dt}} = \mathbf{Ax(t)} + \mathbf{bu(t)} \qquad \mathbf{y(t)} = \mathbf{cx(t)}$$

where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -7 & -5 & -3 \end{bmatrix} \qquad \mathbf{b} = \begin{bmatrix} \mathbf{0} \\ \mathbf{0} \\ \mathbf{1} \end{bmatrix}, \text{ and } \quad c = \begin{bmatrix} 8 & 0 & 3 \end{bmatrix}$$

i) The characteristic equation. (3 Marks)
ii) Find the transfer function Y/U. (3 Marks)

[b] i) For the following system draw the state diagram. (4 Marks)

$$\dot{\underline{X}} = \begin{bmatrix} 0 & 1 \\ -3 & -7 \end{bmatrix}\underline{X} + \begin{bmatrix} 5 \\ 2 \end{bmatrix}u$$

$$y = \begin{bmatrix} 4 & 9 \end{bmatrix}\underline{X}$$

ii) Determine whether the given system in (b-i) is stable, completely state controllable and observable or not. (6 Marks)

مع أطيب الأمنيات بالتوفيق والنجاح