# King Mongkut's University of Technology Thonburi
## Midterm Examination
### Semester 1 -- Academic Year 2013

**Subject:** EIE 326 Electronics Communication Engineering

**For:** Electrical Communication and Electronic Engineering, $3^{rd}$ Yr. ( Inter. program)

**Exam Date:** September $24^{th}$ , 2013        **Time:** 09.00-12.00 AM.

## Instructions:-

1. This exam consists of 6 problems with a total of 13 pages, including the cover.
2. Answer each problem on the exam. papers itself.
3. KMUTT 'rule compiled calculator is allowed.
4. Do not bring any exam papers and answer sheets outside the exam room.

## Remarks:-

- **Raise your hand when you finish the exam to ask for a permission to leave the exam room.**

- **Students who fail to follow the exam instruction might eventually result in a failure of the class or may receive the highest punishment with university rules.**

| Exam No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Full Score | | | | | | | | | |
| Graded Score | | | | | | | | | |

**Name** _____ **Student ID** _____

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**This examination has been approved by the committees of the ENE department.**

(Assoc. Prof. Wudhichai Assawinchaichote, Ph.D.)
**Head of Electronic and Telecommunication Engineering Department**

1.9. What type of noises is found in the HF communication ?

     a. cosmic noise                   b. atmospheric noise

     c. shot noise                      d. thermal noise

1.10. Which one is not the product of non linear circuit?

    a.   L.O. frequency

    b.   The sum of frequencies between LO and RF

    c.   Second harmonics of the LO. Frequency measured at the mixer output.

    d.   Second harmonics of the RF. Frequency measured at the mixer output.

1.11. For maximum power transfer

    a. source impedance and load impedance must be equal

    b. source impedance must be lower than load impedance

    c. source impedance must be higher than load impedance

    d. non of above is correct

1.12 Which one is suitable for SSB amplifier

    a. Class A                        b.Class B

    c.Class C                        d.Class D

1.13 What happen at the resonance frequency of a series resonance circuit?

    a.Z of the circuit is highest.            b. Z of the circuit is lowest.

    c.Voltage across the LC has highest value.      d.None of above is correct.

1.14 What type of the oscillator is not suitable for the Local Oscillator in the broadcasting receiver?

    a.Crystal oscillator                 b.Colpitts oscillator

    c.Clapps oscillator                 d.All of above is correct

1.15 This is the benefits of having the carrier in AM radio

    a. Detection in the receiver is possible with diode     b. Can provide the AGC in the receiver

    c. Can provide the AFC in the receiver         d. All of above is correct.

1.16. What is the detection range of Flip Flop type phase detector?

    a. $\pi$                          b. $+/- \pi$

    c. $+/-2\pi$                    d   no correct answer

1.17.SSB filtering need this process

    a. Balanced modulation              b. very high Q filtering

    c. Low Q filter.                   d. None of above is correct

1.18. What is another name for the SSB detector

    a.   Product detector              b. Diode detector

    c.   Peak detector                 d. RF detector

Name.........................................................ID...............................Class..............................

**Mark "X" over the best choice in the given answer sheet ( 1 pt. each )**

1.1. In EKG monitoring of some medical instrument. Which noise has to be concerned

a. RFI noise

b. Transit time noise

c. 1/f noise

d. none of above is correct

1.2 An AM wave with 150W of total power is fed into an 50 Ohms matched antenna. Calculate the power in each sideband if the modulation index is fixed at 1

a.      25 W

b.      33.3W

c.      66.6 W

d.      none of above is correct

1.3. From above question, If the Modulation Index is 0.8 .Recalculate for the power in each sideband.

a.      12.12 W

b.      13.12 W

c.      15.10 W

d.      18.18 W

1.4. Calculate power that can be reduced if the ambient temperature reduce from +27 to - 243 Celsius

a.      10 dB

b.      11 dB

c.      12 dB

d.      none of above is correct

1.5. In the series R,L,C circuit , what is the relationship of the Q factor to the circuit elements.

a. Q is directly related to R /L

b. Q is directly related to L/C

c. Q is inversely related to R /L

d. none of above is correct

1.6. Calculate the percentage modulation of the picture below
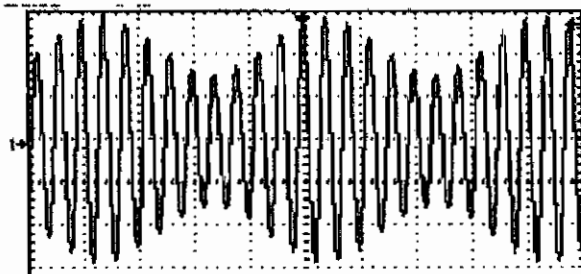


a. 63 %

b. 67 %

c. 70 %

d. none of above is correct

1.7. Which one is true for the adjustable crystal oscillator ?

a. series resonance

b. anti resonance

c. between series and anti resonance

d. none of above is correct.

1.8. Which one is related to the efficiency?

a.   Unloaded Q

b. Loaded Q

c.   Input impedance

d. Output impedance

1.19. Describe the impedance of the crystal at frequency above series resonance

    a. open circuit                                       b. short circuit

    c. inductive                                         d. capacitive

1.20. Crystal oscillator is very stable unless

    a. induced by magnetic field               b. ambient temperature change

    c. induced by electric field                d. non of above is correct

1.21 This diode need reverse bias to operate properly

    a. ring diode                                     b. diode detector

    c. varicap diode                                d. rectifier diode

1.22. What is value of $T_o$ in order to find the Equivalent noise temperature $T_{eq}$?

    a.   273 K                                   b. 290K

    c.   300K                                   d. none of above is correct

1.23. Double balanced mixer is suitable for

    a.   AM modulator                          b. SSB modulator
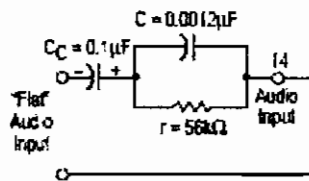
    c.   Phase modulator                      d. FM modulator

1. 24. Which one is the frequency band that is suitable for space communication ?

    a .MF                                        b. HF

    c. VHF                                     d. UHF

1.25. Which one is not the main made noise ?

    a .Noise from the power line            b .Noise from the electrical bulb

    c. Noise from the running motor         d. Noise from the thunder

1.26. What happen to the signal from this circuit ?



    a. Low frequency portion will attenuate     b. high frequency portion will attenuate

    c. Decreasing the noise                          d .no correct answer

1.27. Calculate the $m_f$ of the FM Broadcast transmitter with highest tone input ?

    a.   3                                         b. 4

    c.   5                                         d. 6

1.28. MC145152 can be used in the radio transmitter as ?

    a .IF amplifier                               b. mixer

    c. Oscillator                                d. No correct answer

1.29. Calculate the noise voltage from 1MOhms resistor at 1MHz and 30 celsius ?

        a .215 $\mu$V                            b. 129.39 $\mu$V

        c. 111 $\mu$V                             d .No correct answer

1.30. This parameter may come from the Local Oscillator ?

        a .Harmonics content                  b. Spurious frequencies

        c. Noises sideband                    d . All of above

1.31. Calculate the noise power at 1MHz and 30 celsius ?

        a .-112.8 dBm                        b. -113.8dBm

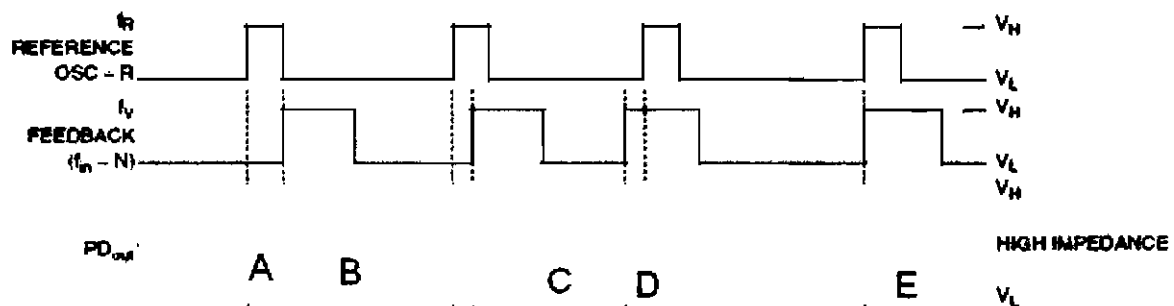        c. -110.5 dBm                       d .-121.6dBm

1.32. Which one is the method of noise reduction ?

        a .Decrease the bandwidth             b. Decrease the temperature

        c. Decrease the input impedance        d. All of above

1.33. Which one is the non linear circuit

        a . AM modulator                     b .SSB amplifier

        c. RF amplifier                      d .RF oscillator

The following figure is for Q.34 - 39



1.34. What will happen at time A ?

        a. PDout is equal to $V_H$             b. PDout is equal to $V_L$

        c. PDout remain high impedance        d. No correct answer

1.35. What will happen at time B ?

        a. PDout is equal to $V_H$             b. PDout is equal to $V_L$

        c. PDout remain high impedance        d. No correct answer

1.36. What will happen at time D?

        a. PDout is equal to $V_H$             b. PDout is equal to $V_L$

        c. PDout remain high impedance        d. No correct answer

1.37. What will happen at time E?

        a. PDout is equal to $V_H$             b. PDout is equal to $V_L$

        c. PDout remain high impedance        d. No correct answer
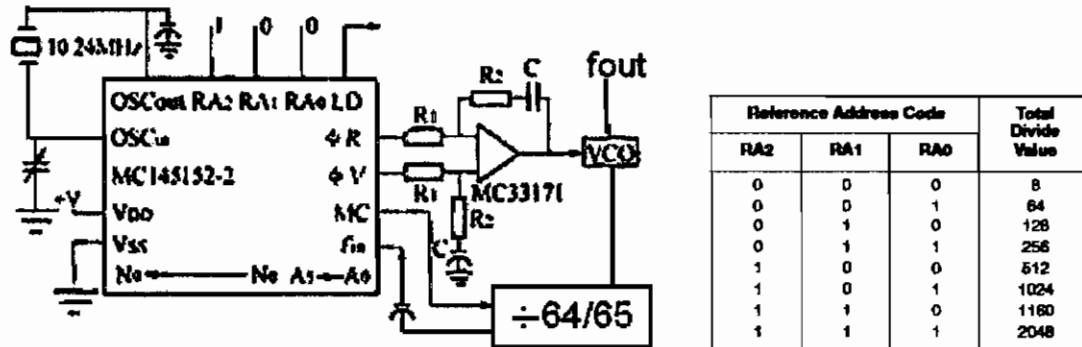
1.38. What kind of techniques used in this phase detector?

    a. Logic AND                 b. Analog multiplier

    c. Exclusive or              d. No correct answer

1.39. Compare PDout Voltage at time B and time C

    a. Voltage at time B > V time C        b. Voltage at time B = Vtime C

    c. Voltage at time B < V time C        d. No correct answer

Use the following diagram to answer Q.1.40 – 1.48, M = 64



| Reference Address Code | | | Total Divide Value |
|---|---|---|---|
| RA2 | RA1 | RA0 | |
| 0 | 0 | 0 | 8 |
| 0 | 0 | 1 | 64 |
| 0 | 1 | 0 | 128 |
| 0 | 1 | 1 | 256 |
| 1 | 0 | 0 | 512 |
| 1 | 0 | 1 | 1024 |
| 1 | 1 | 0 | 1160 |
| 1 | 1 | 1 | 2048 |

1.40. This circuit utilized the technique called

    a. Double loop frequency synthesizer      b. Single modulus frequency synthesizer

    c. Dual modulus frequency synthesizer      d. No correct answer

1.41. Calculate for N if $f_{out}$ is 909.20 MHz

    a. N = 709                      b. N = 710

    e. N = 711                      d. No correct answer

1.42. Calculate for A if $f_{out}$ is 909.20 MHz

    a. A = 11                       b. A = 41

    c. A = 31                       d. A = 20

1.43. From Q41, Calculate maximum output frequency when N is fixed but A can be increased

    a. 909.20 MHz                 b. 910.06 MHz

    c. 919.00MHz                d 918.86 MHz

1.44. If the loop will lock within 3 periods of the $f_{ref}$, What is this value ?

    a. 50 microsecond            b. 150 microsecond

    c. 50 millisecond             d 5 millisecond

1.45. Where is the Hi -Z point in the circuit?

    a. at MC pin                  b. at Op-Amp. Input pin

    c. at VCO input pin            d no correct answer

1.46. What is the purpose of the series R2+C ?

    a. boost the frequency response of the loop      b. decrease the 50 Hz interference

    c. decrease 20 KHz interference      d decrease 1.024 MHz interferenc

1.47. What is the total divided no. of this circuit?

    a. MA      b. NM+A

    c. M A+(N-1)      d. NA+M

1.48. What is the counting number at the beginning of the count ?

    a. MA      b. NM+A

    c. M A+(N-1)      d. NA+M

1.49. What is the characteristic only found in FM radio ?

    a .single sideband      b. suppressed carrier

    c. Capture effect      d. Has large carrier

1.50. Compare -100 dBm and $1 \times 10^{-6} V_{rms}$ for a 50 Ohms load?

    a. Can't compare different units      b. -100 dBm is bigger

    c. -100 dBm is smaller      d. they are equal

1.51 Which one is the condition called " Barkhausen criteria " ?

    a.loop gain amplitude = 3      b. loop phase shift $= 2\pi$

    c.loop phase shift $= \pi$      d. None of above

1.52 Which amplifier circuit has high current gain?

    a. Common collector      b. Common base

    c. Common emitter      d. Push-pull complementary

1.53 Which amplifier circuit has high power gain?

    a. Common collector      b. Common base

    c. Common emitter      d. Push-pull complementary

1.54 Which amplifier circuit has output with phase reversal?

    a. Common collector      b. Common base

    c. Common emitter      d. Push-pull complementary

1.55 Which amplifier circuit has high input resistance?

    a. Common collector      b. Common base

    c. Common emitter      d. Push-pull complementary

1.56 Which amplifier circuit has input between B-E and output between C-E?

    a. Common collector      b. Common base

    c. Common emitter      d. Push-pull complementary

1.57 Which amplifier circuit utilized both NPN and PNP transistor ?

    a. Common collector                 b. Common base

    c. Common emitter                  d. Push-pull complementary

1.58 Which amplifier circuit has low input resistance?

    a. Common collector                 b. Common base

    c. Common emitter                  d. Push-pull complementary

1.59 Which one has widest detection range?

    a. Analog switch type              b. AND gate

    c. RS flip flop                      d. PFD

1.60 Calculate the Carson's bandwidth of the a broadcast FM station when the maximum deviation of 75 KHz and maximum input frequency is 15 KHz .

    a. 15 KHz                         b. 190 KHz

    c. 150 KHz                       d. 180 KHz

2. Describe and draw the block diagram of an indirect FM generator ( 10 points)

    Given the FM Armstrong's signal $= E.\cos\omega t + E._m.\sin\mu t.\sin\omega t$

3. From the matching circuits below when $R_s$ = 600 Ohms and $X_p$ is an inductor.
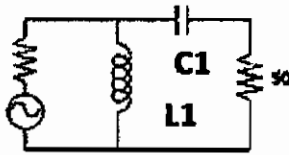


Calculate the values of L and C that produce the specified reactance at 30MHz. by using these formulas.(10 points)

$$Q_S = Q_P = \sqrt{\frac{R_{Larger}}{R_{smaller}} - 1}$$

$$L_1 = \frac{X_L}{\omega_0} = \frac{Q_S R_{smaller}}{\omega_0} = \frac{R_{Larger}}{\omega_0 Q_P}$$

$$C_1 = \frac{1}{\omega_0 X_C} = \frac{1}{\omega_0 Q_S R_{smaller}} = \frac{Q_P}{\omega_0 R_{Larger}}$$

4. Fill in the blanks or answer the question ( 10 points)

4.1. Given

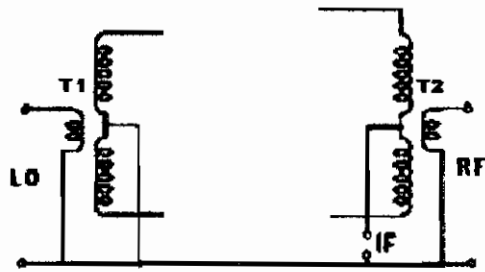$E_c$ is the peak voltage of the carrier before modulation

$\omega_c$ and $\omega_M$ stand for carrier frequency and modulating frequency

$m_f$ is the modulation index for FM

Write down the Instantaneous Voltage of FM signal below ( 3 points)

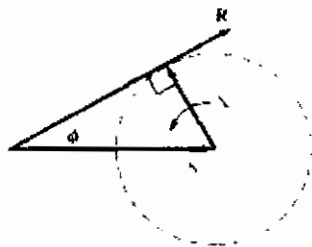4.2. Complete the schematic diagram of the Double balance mixer below ( 3 points)



4.3. The electric field strength (rms) at a receiving station is $10 \mu$V/m. Calculate

(a) the magnetic field strength; ( 2 points)

(b) the amount of power incident on a receiving aerial with an effective area of 1 $m^2$( 2 points)
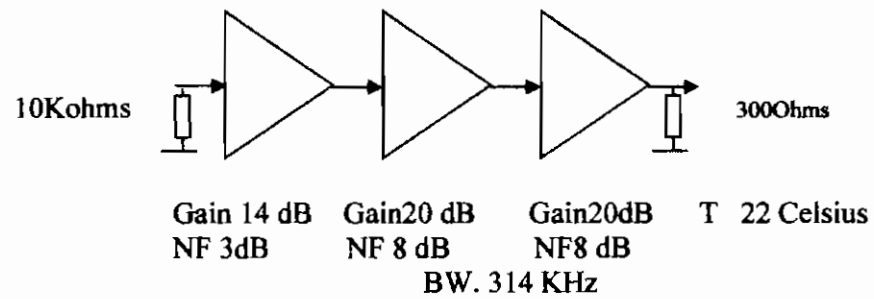
5. Explain the relationship between noise and FM signal from this figure (5 points)

6. From the following information

a) Calculate the noise voltage and power at the input and output of the system ( 3 points)

b) overall noise figure of the system ( 2 points)



10Kohms

300hms

Gain 14 dB    Gain20 dB    Gain20dB    T  22 Celsius
NF 3dB         NF 8 dB       NF8 dB
                        BW. 314 KHz

# Formulas

$$P_n = kT\Delta f$$

$$e_n = \sqrt{4kT\Delta f R}$$

$$i_n = \sqrt{2qI_{dc}\Delta f}$$

%m =( B-A/B+A) x 100%   or      %m  =  (E_i/E_c ) x100%

Sin A Sin B ▪ 1/2cos(A-B) - 1/2 cos(A+B)

Cos A Cos B ▪ 1/2cos(A+B) - 1/2 cos(A-B)

$$Z_{left} = R_{left} + jX_{left} = \frac{1000jX_p}{1000+jX_p} = \frac{(1000jX_p)(1000-jX_p)}{(1000+jX_p)(1000-jX_p)}$$

$$\frac{X_L}{R_{source}} = \frac{R_{load}}{X_c}$$

$$m = \frac{E_i}{E_m}$$

$$e = E_c \sin \omega_c t + \frac{mE_c}{2} \cos(\omega_c - \omega_i)t - \frac{mE_c}{2} \cos(\omega_c + \omega_i)t$$

$$E_{SF} = \frac{mE_c}{2}$$

$$P_t = P_c(1 + \frac{m^2}{2})$$

B.W._carson = 2( $\Delta f + f_m$)   =  $2\Delta f + 2f_m$

NR  =  NR$_1$ + ( NR$_2$ - 1)/PG$_1$  +  (NR$_3$ – 1)/PG$_1$.PG$_2$ ............... noise ratio

$\Delta f$ = $\phi_{rad}$ x $f_m$   ...............................frequency deviation from noise