Menoufia University
Faculty of Electronic Eng.
Department of electronics
and communications Eng.

3rd Year Elective Course (2)
Surface Acoustic Wave Devices
Final Exam., 11 / 1 / 2023
(Max. 70 Marks), Time: 3 hours

Answer the following questions:

1- a- What is the motivation for Surface Acoustic Wave (SAW) technology, and what are the major applications of SAW devices?. Explain, with the aid of a sketch and equations, the calculation of Interdigital Transducer (IDT) parameters. (7 Marks)

b- A SAW is generated on the surface of a piezoelectric substrate by mean of an ac voltage applied to an IDT at f_o = 1GHz. Given that the velocity of the SAW on this material is v = 3488m/s, determine the acoustic wavelength. Compare the value of this wavelength with that of an electromagnetic wave propagating in free space at the same frequency. Determine the ratio between the SAW wavelength and the electromagnetic wave length in this case. Comment on the obtained results. (7 Marks)

2- a- Explain, with the aid of a block-diagram and equations, the overall transfer function of an ideal linear-phase response SAW filter (4 Marks)

b- A SAW filter with nominal linear-phase response employs identical uniformly apodized IDTs in input and output stages. Each IDT has N=80 electrodes. Determine (i) the approximate 4-dB percentage fractional bandwidth of each IDT and (ii) their 3-dB fractional bandwidth; (iii) indicate whether or not the overall 4-dB filter bandwidth will be the same as in (i); and (vi) determine the approximate suppression level (in dB) of the first sidelobes of the filter. (10 Marks)

3- a- Draw and discuss the input/output equivalent circuit for a Surface Acoustic Wave (SAW) filter in the cross-field model at a center frequency f_o. (4 Marks)

b- A SAW filter is fabricated on YZ- $LiNbO_3$. Its input and output IDTs have constant finger overlap. The input IDT has N_p = 50 finger pairs and apodization width W = 100 acoustic wavelengths at a center frequency f_o = 400 MHz. Consider that the capacitance/ finger pair/cm is C_o = 4.6 pf/cm. Determine the numerical values of the unperturbed radiation conductance G_a at f_o. (For YZ-$LiNbO_3$: v = 3488m/s and k^2 = 4.6 %). (10 Marks)

4- a- Sketch an illustrative transceiver for a digital-cellular communications transceiver, such as for the GSM , and indicate the possible location of constituent SAW components. (4 Marks)

b- What are SAW wireless label identification "tags", and what are they used for?. (4 Marks)

c- A SAW convolver has a rated convolution efficiency h_c = - 46 dBm. If the signal input power P_s is 10 dBm (10 mW) and the reference power P_r is 20 dBm (100 mW), what is the correlated output power P_{out}?. If the output noise floor level in the previous SAW convolver is - 75 dBm, determine the output Signal-to-Noise (S/N) ratio. (6 Marks)

5- a- With the aid of a block diagram, define the acoustic wave sensor . What is monitored when the acoustic wave sensor responds to the input stimulus? (4 Marks)

b- How do you distinguish between single-port acoustic wave sensors, such as the TSM resonator, and two-port acoustic wave sensors, including SAW, APM, and FPW devices. (4 Marks)

c- Explain how the use of the SAW technique provides a sensitive, and non-contact method for evaluating the electrical properties of a semiconductor surface. Draw an equivalent circuit model to describe the interaction between a SAW and charge carriers in a thin film overlay. (6 Marks)

Best wishes

Prof. Dr. Taha El-Sayed Taha

جامعة المنوفية

FACULTY OF ELECTRONIC ENGINEERING, MENOUF
ELECTRONIC AND ELECTRICAL COMMUICATIONS DEPARTMENT

SUBJECT: NETWORK THEORY, 3rd YEAR **TIME ALLOWED: THREE HOURS**

DATE OF EXAMINATION: WEDNESDAY, 04 /01/2023 **TOTAL MARKS:70 MARKS**

ANSWER THE FOLLOWING QUESTIONS

1. Find the two Foster realizations of the driving point impedance Z(s) if

$$|Z(j\omega)|^2 = (\omega^4 + 45\omega^2 + 324)/(\omega^4 + 17\omega^2 + 16)$$ **(14 Marks)**

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2. Synthesize the transfer function $H(s) = V_2(s) / V_1(s)$ of a singly 1-Ω terminated FTN using the two port parameters if

$$|H(j\omega)|^2 = \omega^6/(\omega^6 + 1)$$ **(8 Marks)**

3.a: At a frequency, $f = 2$ MHz, and the attenuation, $\alpha = 2.6339$ np, design a prototype symmetrical T-section LPF, suitable for insertion in a 600 Ω. **(6 Marks)**

3.b: Using the results obtained in (3.a), determine the magnitude of Z_{cT} at $f = 2f_c$ and the phase shift, β, at $f = f_c$. **(2 Marks)**

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4. If the transfer function is $H(s) = V_2(s) / I_1(s)$, the impedance level is 10^3 Ω and the amplitude function of the Butterworth filter is $|H(j\omega)|^2 = 1/(1+\omega^{2n})$; n = 1, 2, 3, design a 3rd order Butterworth to stop all radient frequencies between 10^4 rad/sec. and $4x10^4$ rad/sec. **(20 Marks)**

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5. If the transfer function is $H(s) = V_2(s) / V_1(s)$, $\omega_c = 10^4$ rad/sec., $R_o = 1$ Ω and the ripple in the pass-band must not exceed 0.5 dB, synthesize a 3rd order Chebyshev high-pass filter. **(20 Marks)**

GOOD LUCK

Dr. Mohamed El–Halawany

Menofia university	Date: 1-1- 2023
Faculty of Electronic Engineering	Time: 3-hours
Final Exam.	Course Title: Electromagnetic waves
Fall Semester	Code : ECE 312
Dept. of Electrical and Electronic Comm. Eng.	Total mark:90

Question One : (20- marks):

a-Using Maxwell's equation, find the relation between electric and magnetic fields at the interface between two dielectric medium having different characteristics.

b-Drive the wave equation that governs the propagation of electromagnetic wave in the media.

c-Determine the propagation constant , attenuation constant , phase constant phase velocity and intrinsic impedance to a wave propagating in a good Conductor .

Question Two: (20-marks):

a)The wave is incident normally into an interface between two media. Drive an expression to transmission coefficient and reflection coefficient of the wave

b)A large copper conductor ($\sigma= 5.8x10^7$ S/m , $\varepsilon_r=1$, $\mu_r=1$) Determine loss tangent and compute the attenuation constant, propagation constant, intrinsic impedance, wavelength and the velocity of propagation at 10MHz frequency.

b)Consider the boundary between free space and a lossy material having $\sigma=20$ S/m, $\mu_r=1$, $\varepsilon_r=1$. A uniform plane wave with a magnitude of 100 V/m and frequency of 1 GHz is propagating in free space normal to the material surface, find:

1-The time domain fields of incident , reflected and transmitted fields.

2-The average power transmitted through a 5 m^2 surface of the material.

Question four:(25-marks):

Q4:a)A transmission line have an characteristic impedances Z_o is terminated by an impedance Z_R located at z=0, find the voltage reflection coefficient and VSWR.

b)Using solution of transmission line equation, find an expression for input impedance and hence find the relation between characteristic impedance an open and short circuit impedance,

b)A lossless 100 ohm transmission line, terminated by a load 50 + j 50 ohm. Find:

1-VSWR 2-Reflection coefficient 3-Impedance at 0.4λfrom the load

4- The value of maximum and minimum impedance

Question five:(25-marks):

Q5:a)Show that TM_{10} and TM_{01}mode there is not propagate in rectangular wave guide and what is a lower cutoff frequency of TM and TE modes.

b)what is meant by dominant mode. Calculate dominant cutoff frequency and wave length for TE mode. what is the guide wave length and wave impedance

c)Consider a 10 GHZ signal propagating in a rectangular wave guide with internal dimension of 2.3x1 cm. Assuming the dominant mode for signal propagation , find:

1-Cutoff wave length

2-Cutoff frequency and all modes propagate in the guide

3-Guide wave length

4-Charactristic wave impedance of the guide.

مع تمنيـاتـــى بالتـــوفيق

Menoufia University
Faculty of Electronic Eng.
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جامعة المنوفية

3rd Year Elective Course (2)
Surface Acoustic Wave Devices
Mid Term Exam., 19 / 11 / 2022
(Max. 20 Marks), Time: 1 hour

أسم الطالب: ..... فصل رقم: ..... الدرجة: .....

a) Answer the following statements by ✓ (true) or X (false): (5Marks)

(1) Surface Acoustic Waves (SAW) propagate at a speed higher than electromagnetic waves, this reduces the SAW devices size. ( )

(2) The Interdigital Transducer (IDT) is used to make a transducer for SAW devices. It is the simplest way to excite and receive SAW on a piezoelectric substrate. ( )

(3) In order to achieve low cost while preserving accuracy, the materials with high piezoelectric coupling coefficient are mostly selected by SAW devices. ( )

(4) In a uniform periodic IDT with single electrodes, the width of each electrode and the spacing between the adjacent two electrodes are $\lambda/4$, (λ is the SAW wavelength) ( )

(5) In order to reduce the reflections from the electrodes, IDTs with single finger electrodes are typically used. ( )

b) Complete the following: (5Marks)

(1) The most important parameter for SAW device design is the center frequency, which is determined by the ..... of the IDT fingers and the acoustic .....

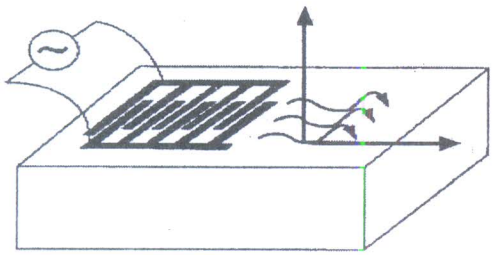
(2) Most efficient operation is achieved for ultrasound transducers with a ..... equal to ..... the wavelength of the desired ultrasound natural resonant frequency.

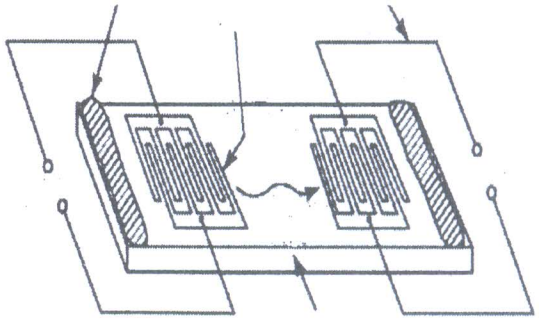
(3) A matching layer provides the ..... between the piezoelectric crystals material and tissue and ..... acoustic impedance mismatches.

(4) The layer on the back of the piezoelectric crystals is used to ..... the backward directed ultrasound energy and ..... ultrasound signals from the housing.

(5) The resonance frequency of an ultrasound transducer is determined by the ..... of piezoelectric crystal and its .....

c) Complete the following sketches: (5Marks)





d) Problems (5Marks)

Problem -1 (3 Marks)

A SAW is generated on the surface of a piezoelectric substrate by mean of an ac voltage applied to an IDT at f_o = 1GHz. (a) Given that the velocity of propagation of the SAW on this material is v = 3488m/s, determine the acoustic wavelength. (b) Compare the value of this wavelength with that of an electromagnetic wave propagating in free space at the same frequency. (c) Determine the ratio between the SAW wavelength and the electromagnetic wavelength in this case.

Problem -2 (2 Marks)

(a) For a piezoelectric material with an ultrasound velocity of 6000 m/sec, what thickness should a disk-shaped transducer have to provide an ultrasound beam with a frequency of 2.5 MHz?. (b) Calculate the thickness of the transducer matching layer.

Solution

University	:	*Menoufia*		*Date*	: *18/01/2023*
Faculty	:	*Electronic Engineering*		*Time*	: *3 Hours*
Department	:	*Electronics & Communications*		*No. pages*	: *1*
Academic evel	:	*3rd year*		*Full Mark*	: *70 Marks*
Course Name	:	*Acoustics & Ultrasonics*		*Exam*	: *Final*
Course Code	:	*ECE313*		*Examiner*	: *Prof. Adel Abdel Masieh Saeeb*

I- (a) Find the attenuation of a sound wave propagating in air caused by geometrical divergence.

(b) Define reflection and absorption coefficients of a material, and explain a method for their measurement.

II- The energy density of sound in a room is E_d J/m^3. Find the rate at which sound is absorbed by the walls of the room.

III- (a) What are the causes of transmission losses of sound in sea water?

(b) Prove that the path of a sound wave through water having a constant positive velocity gradient g m/s per meter is an arc of a circle of radius = c_o / g.

IV- Choose the right answer

(a) The term 'Bass loudspeaker' refers to a type of loudspeaker which enhances ..... frequencies. (i) tracks (ii) low (iii) high (iv) mid.

(b) The moving coil ..... Is commonly used today in direct radiators. (i) principle (ii) galvanometer (iii) aerostat (iv) magnetism.

(c) ..... loudspeaker consists of a thin metal film suspended in a magnetic field. (i) ribbon (ii) carbon (iii) silica (iv) magnetic.

(d) ..... microphones are the most highly directional. (i) ribbon (ii) carbon (iii) cardioid (iv) shotgun.

(e) Factors to be considered while selecting microphones are : (i) impedance (ii) frequency response (iii) pick up pattern (iv) all above.

(f) Balanced microphones carry ..... Wires. (i) four (ii) two (iii) three (iv) no.

(g) ..... Microphone is bidirectional. (i) dynamic (ii) carbon (iii) ribbon (iv) fiber optic.

V- (a) The ultrasonic pulse-echo method is employed to detect possible defects in a steel bar of thickness 0.15 m. If the pulse arrival times are 20 and 60 μs. The defect is at : (i) 5 cm (ii) 10 cm (iii) 15 cm (iv) 20 cm .

(b) Ultrasonic transducer is employed to measure the thickness of a steel plate. If the difference of two adjacent harmonics is found to be 60 KHz. Find the thickness of the plate. The speed of sound is 5000 m/s.

Menofia University

Faculty of Electronic Engineering

3rd year, Electronic and Communication Department, 1st Term Exam.

Optional Course | Mechatronics | Time allowed 3 hours

Prof.Dr. Hossam Ahmed | ECE 315 Title Elective Course (1) | 22 January 2023

Solve all questions:

Q1) For an Experiment Interfacing of Humidity Sensor:

a) Give a separated circuit of power supply with transformer V= 5 V

b) Give a circuit using Humidity sensor, and add Op-amplifier to amplify the analog signal, analog to digital A/D, PIC microcontroller, give the frequency of metal crystal oscillator and the measured value is displayed on the screen of LCD.

c) Give the number of using ICs.

d) Explain the circuit.

Q2) a) Give the Engineering subjects of Foundations of Mechatronics?

b) What are Components required to implement the Computer-Process Interface?

c)-Define sensors and give the physical variables that can measured using Sensors?

Q3) A sensors is designed for: -40 °C to +90 °C and output 3.5V to 1.5V find: upper and lower range, span, input full scale, output full scale and dynamic range.

Q4) Explain the block diagram the Instruction Cycle steps.

Q5) Give a circuit diagram to connect a four RAM 2716 memory with 74LS139 decoder interface 8086.