



Tanta University

Department of Electronics and Communication Engineering
Total Marks: 90 Marks



Faculty of Engineering

Course Title: Wave Propagation and Antennas (1)

Course code: EEC3110

Year: 3rd

Date: 10 January, 2023

Allowed Time: 3 Hours

No. of pages:2

- III. What is the usable frequency range for single-mode propagation?
- IV. What happens at sufficiently high frequencies (outside if the range obtained in part (b))?

Question (4):

- a) If the cutoff frequency of a specific waveguide mode is greater than the operating frequency, the mode will not propagate down the waveguide. Explain why?
- b) A rectangular waveguide with $a = 2.5\text{cm}$ and $b = 1\text{cm}$ is operating below 15.1GHz .
 - I. How many TE and TM modes can the waveguide support if the guide is filled with a medium characterized by $\sigma = 0$, $\epsilon = 4\epsilon_0$, $\mu = \mu_0$?
 - II. Calculate the cut-off frequency of each of these modes.
 - III. Calculate the phase constant, phase velocity and wave impedance for the TE_{10} and TM_{11} modes at the operating frequency of 15GHz .

Question (5):

- a) For a circular waveguide operating in the dominant TM mode, write down expressions for the different field components.
- b) Consider a cylindrical waveguide of radius $a = 5\text{cm}$ filled with a lossy-dielectric material having $\epsilon_r = 9$, $\mu_r = 1$. If the interior of the guide is gold plated, with $\sigma = 1.4 \times 10^7\text{S/m}$. The longitudinal electric field in the guide is given by:

$$E_z(\rho, \phi, z, t) = 10^{-4} e^{-\alpha z} J_0(48.1 \rho) \cos(18\pi * 10^9 t - \beta z) \text{ V/m} .$$

1. Determine the operating mode.
2. Determine f, f_c, β, η and Z_{TM} .
3. α_d if the tangent loss is 0.0004.
4. Calculate the overall loss in dB for a 30 cm length.
5. The first three modes and the operating frequency require passing the third mode.

TABLE 3.4 Values of p_{nm} for TM Modes of a Circular Waveguide

| n | p_{n1} | p_{n2} | p_{n3} |
|-----|----------|----------|----------|
| 0 | 2.405 | 5.520 | 8.654 |
| 1 | 3.832 | 7.016 | 10.174 |
| 2 | 5.135 | 8.417 | 11.620 |

With my best wishes
Dr. Basma Eldosouky



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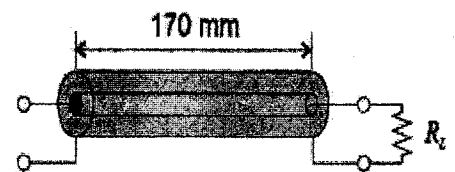
Answer all the following questions:

Question (1):

- For a T.L terminated with open circuit. **Derive** the expressions for the T.L voltage $V(z)$, current $I(z)$, and input impedance Z_{in} . **Plot** the equations $V(z)$, $I(z)$ and Z_{in} .
- Calculate the load reflection coefficient of an open and short-circuited line.
- Compute the VSWR of a 75 ohm transmission line when it is terminated by a load impedance of $50 + j30$ ohm

Question (2):

- Explain with draw how a rectangular waveguide is fed to support both TE and TM modes.
- Consider a lossless coaxial transmission line having distributed parameters $L = 245 \text{ nH/m}$ and $C = 200 \text{ pF/m}$. The line is terminated with a resistor $R_L = 100 \Omega$ as shown. The operating frequency is $f = 1 \text{ GHz}$.
 - Determine the characteristic impedance and phase velocity of the line.
 - Determine the input impedance seen looking into the input terminals of the line at 1 GHz.
 - Determine the VSWR of the load.
 - If the transmission line was shortened, determine the length(s) of line that would result in the same input impedance as part (b).



Question (3):

- State the difference between **transmission lines and waveguides**.
- A parallel-plate transmission line having plate width and plate separation 1 cm is filled with Teflon ($\epsilon_r = 2.08$). The waveguide is oriented along the z-direction. The center conductor of a coaxial cable is extended into space between the plates in the z-direction, exciting a mode(s) propagating in the z-direction with field components $E_z \neq 0$. The source does not excite TEM mode.
 - What type of mode(s) are propagating?
 - Write down the phase constant equation.


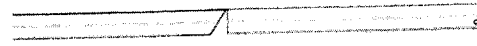
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Remarks: (answer the following questions... assume any missing data ... arrange your answer booklet ... Use blue, black pens or pencils... Be careful when filling the bubble sheet)

Question 1: Choose the best answer for the questions (1-60) and fill-in the bubble sheet [60 points]

- 1- Ray theory is suitable for describing optical signal propagation in ...
 A- Single mode fibers C- Step index profile fibers
 B- Multimode fibers D- Another answer
- 2- An optical fiber has 900 propagating modes at certain wavelength. The expected cladding modes will have of the optical power in the core.
 A- 0.044 C- 22.5
 B- 0.44 D- Other answer
- 3- A step index 60/150 optical fiber has core refractive index of 1.48 and $\Delta=1.2\%$. The acceptance angle will be ...
 A- 3.5° C- 13.255°
 B- 30° D- Other value
- 4- The V parameter at cut-off wavelength for a graded index fiber is...
 A- $2.405/\sqrt{1-(2/g)}$ C- $2.405\sqrt{1+(2g)}$
 B- 2.405 D- $2.405\sqrt{1+(2/g)}$
- 5- The acceptance angle for 60/150 fiber is 0.20 radians and $\Delta=1\%$, so the light velocity in fiber is ...
 A- 3.0×10^8 m/s C- 2.136×10^8 m/s
 B- 2.69×10^8 m/s D- Other value
- 6- The number of propagating modes in GI fibers is less than number of modes in SI fibers by ...
 A- $1/(g+2)$ C- $1/g$
 B- $g/(g+2)$ D- $g/(g+1)$
- 7- The attenuation in an optical fiber is 0.6 dB/km at 1330 nm. At 1550 nm, the attenuation may be ..
 A- 0.8 dB/km C- 0.6 dB/km
 B- 0.7 dB/km D- 0.5 dB/km
- 8- Material Absorption in an optical fiber core can result in ..
 A- Attenuation C- Refractive index change
 B- Light reflection D- Decreasing losses
- 9- The loss in optical fibers occurs due to many factors except ...
 A- Fiber material and impurity ions C- Refractive index profile
 B- Scattering. D- bends
- 10- The linear scattering losses in optical fibers include ...
 A- Rayleigh, Mie scattering C- Rayleigh, Raman scattering
 B- Brillouin, Raman scattering D- Brillouin, Mie scattering
- 11- The non-linear scattering losses in optical fibers include ...
 A- Rayleigh, Mie scattering C- Rayleigh, Raman scattering
 B- Brillouin, Raman scattering D- Brillouin, Mie scattering
- 12- Modulation of the light by the thermal energy in the material of the optical fibers causes ...
 A- Mie scattering C- Raman scattering

- B- Rayleigh scattering D- Brillouin scattering
- 13- Critical bending radius does not depend on ...
 A- Numerical aperture C- Core radius
 B- Core refractive index D- Cladding refractive index
- 14- Critical radius of bend is proportional to ...
 A- $1/NA$ C- $1/NA^3$
 B- $1/NA^2$ D- Another answer
- 15- Critical radius of bend is proportional to ...
 A- $1/\lambda$ C- $1/\lambda^3$
 B- $1/\lambda^2$ D- Another answer
- 16- The critical curvature for a 60/150 SI fiber that has $NA=0.2$, $n_1=1.48$, at $\lambda=850$ nm will be ...
 A- $r_{critical} \approx 37.5 \mu m$ C- $r_{critical} \approx 35 \mu m$
 B- $r_{critical} \approx 37.2 \mu m$ D- another value
- 17- Dispersion in optical fibers can cause ...
 A- Inter-symbol interference C- Neither (A) and (B) are correct
 B- Data-rate reduction D- Both (A) and (B) are correct
- 18- Modal dispersion, Δt_{modal} , in step index multi-mode fibers is insensitive to ...
 A- Number of modes C- Core diameter
 B- Numerical aperture D- wavelength
- 19- A 60/125 SI optical fiber. $\Delta=1.5\%$, $n_1=1.48$. So Δt_{modal} at 1330 nm is approximately ...
 A- 67.6 ns/km C- 74 ns/km
 B- 73 ns/km D- Other value
- 20- A 60/125 SI optical fiber. $\Delta=1.5\%$, $n_1=1.48$. So Δt_{modal} at 1330 nm is exactly ...
 A- 67.6 ns/km C- 74 ns/km
 B- 73 ns/km D- Other value
- 21- Optimal g value in GI optical fibers is independent on ...
 A- n_1 C- Δ
 B- n_2 D- Core diameter
- 22- In GI fibers, modal dispersion is dependent on ...
 A- Δ C- Both A, B
 B- Fiber length D- Neither A, B
- 23- In GI fibers, and if the profile index is optimal, the modal dispersion is proportional to ...
 A- Δ C- Δ^3
 B- Δ^2 D- $\sqrt{\Delta}$
- 24- In GI fibers, the modal dispersion may be a negative value if the profile index, g is ...
 A- Equals to g_{opt} C- Less than g_{opt}
 B- Greater than g_{opt} D- Modal dispersion can't be negative value
- 25- Material dispersion in optical fibers occurs due to ...
 A- Velocity of light is constant inside the fiber C- Materials are inhomogeneous
 B- Refractive index profile mismatch D- Refractive index is dependent on wavelength
- 26- Material dispersion in optical fibers depends on the light's ...
 A- Line width C- Spectral width
 B- Beam width D- Both A, C

- 27- Waveguide dispersion in optical fibers depends on the light's ...
 A- Line width
 B- Beam width
 C- Spectral width
 D- Both A, C
- 28- At 850 nm wavelength, and in a single mode fiber, the waveguide dispersion is ...
 A- Dominant
 B- Greater than material dispersion
 C- negligible
 D- None of these answers are correct
- 29- Waveguide dispersion results from: the propagation constant of a mode being a function of ...
 A- a/λ
 B- λ^2
 C- $1/\lambda^4$
 D- None of these answers are correct
- 30- Total dispersion in an optical fiber can be calculated using...
 A- $\sqrt{\tau_{\text{modal}} + (\tau_{\text{waveguide}} + \tau_{\text{material}})^2}$
 B- $\sqrt{\tau_{\text{modal}} + (\tau_{\text{waveguide}} - \tau_{\text{material}})^2}$
 C- $\sqrt{\tau_{\text{modal}} + (\tau_{\text{waveguide}} + \tau_{\text{material}})^2}$
 D- $\sqrt{\tau_{\text{modal}} + \tau_{\text{waveguide}}^2 + \tau_{\text{material}}^2}$
- 31- At the wave length where zero chromatic dispersion occurs in an optical fiber,
 A- Waveguide dispersion cancels material dispersion
 B- Modal dispersion cancels waveguide dispersion
 C- Modal dispersion cancels material dispersion
 D- Modal dispersion cancels chromatic dispersion
- 32- Waveguide dispersion in silica optical fibers is always ...
 A- Negative value
 B- Positive value
 C- Its sign depends on the operating wavelength
 D- negligible
- 33- Material dispersion in silica optical fibers is always ...
 A- Negative value
 B- Positive value
 C- Its sign depends on the operating wavelength
 D- negligible
- 34- Multi-index optical fibers is designed for ...
 A- shifting zero modal dispersion wavelength
 B- shifting zero waveguide dispersion wavelength
 C- Shifting zero material dispersion wavelength
 D- Shifting zero chromatic dispersion wavelength
- 35- Optical fiber's intrinsic loss factors include ...
 A- Lateral misalignment
 B- Longitudinal misalignment
 C- Refractive index profile mismatch
 D- Angle misalignment
- 36- Optical fiber's extrinsic loss factors include ...
 A- Fiber diameter variation
 B- Non-circularity of fiber mode field
 C- non-concentricity of fiber mode field
 D- Angle misalignment
- 37- This type of optical fiber joint, suffers from ...

 A- Intrinsic loss
 B- Diameter mismatch
 C- Both A, B
 D- Neither A or B
- 38- Return loss in connectors can be reduced by ...
 A- Active alignment techniques
 B- Non-perpendicular cut for the facing ends of fibers
 C- Passive alignment
 D- Perpendicular cut for the facing ends of fibers
- 39- Power distribution profile among propagating modes play a role in... factors of loss.
 A- The extrinsic
 B- The intrinsic
 C- misalignment
 D- None of these answers
- 40- The problem in joining these two fiber ends shown is called:

 A- Fiber ends irregularity
 C- Core field mismatch

- B- Fiber ends not cut square
 D- Cladding field mismatch
- 41- Numerical aperture, NA, mismatch causes losses if ...
 A- NA of the receiving fiber is less than NA of the transmitting fiber
 B- NA of the receiving fiber is greater than NA of the transmitting fiber
 C- Core refractive index is greater than cladding refractive index
 D- Core refractive index is less than cladding refractive index
- 42- The optical fiber coupling efficiency will be degraded if
 A- Core radius of the receiving fiber is less than core radius of the transmitting fiber
 B- Core radius of the receiving fiber is greater than core radius of the transmitting fiber
 C- Core refractive index is greater than cladding refractive index
 D- Core refractive index is less than cladding refractive index
- 43- If the receiving fiber is a step index fiber, while the transmitting fiber is a graded index, then ...
 A- Losses will occur
 B- Losses will not occur
 C- Losses always independent of index profile
 D- None of these answers
- 44- Coupling efficiency of two optical fibers will be ... if the coupling suffers a longitudinal displacement
 A- $\eta = \frac{1}{(1+s/a \sin \theta_c)^2}$
 B- $\eta = \frac{1}{(1+s/a \sin \theta_c)}$
 C- $\eta = \frac{1}{(1+s/a \tan \theta_c)}$
 D- $\eta = \frac{1}{(1+s/a \tan \theta_c)^2}$
- 45- In mechanical splicing, these parts are employed except ...
 A- Electrodes
 B- Holding clamp
 C- Alignment
 D- Index matching gel
- 46- Reflection losses at the fiber joint may be calculated as ...
 A- $[(n-1)/(n+1)]^2$
 B- $1 - [(n-1)/(n+1)]^2$
 C- $[(n+1)/(n-1)]^2$
 D- $1 - [(n+1)/(n-1)]^2$
- 47- Various commercial optical fiber connector types can't include
 A- FC connectors
 B- SMA connectors
 C- LC connectors
 D- MC connectors
- 48- A polarizing splitter can splits the signals into two output channels, but the polarizations in each output are...
 A- in-phase
 B- omnidirectional
 C- orthogonal
 D- bidirectional
- 49- The power division ratio of a star coupler can be calculated through ... [n is the number of output ports]
 A- $PD_{st} = -20 \log(1/n)$
 B- $PD_{st} = 20 \log(1/n)$
 C- $PD_{st} = 10 \log(1/n)$
 D- $PD_{st} = -10 \log(1/n)$
- 50- A 5x5 star coupler is employed to distribute 100 mW to the 5 output optical fibers. The excess loss is 0.5 dB. The output power at each port will be ...
 A- 12.51 dB
 B- 12.51 dBm
 C- 13.01 dB
 D- 13.01 dBm
- 51- Fiber Bragg-grating can be used in ...
 A- Chromatic dispersion compensation
 B- Modal dispersion compensation
 C- Star couplers
 D- T-couplers
- 52- modulation is done by superimposing the modulating (message) signal on the driving current.
 A- Direct
 B- Digital
 C- Indirect
 D- Analog

- 53- When the laser output wavelength drifts with modulating current, this phenomenon is called ...
 A- intermodulation C- Chirping
 B- clipping D- Drifting
- 54- The basic idea behind the construction of Mach-Zehnder modulator is ...
 A- Refractive index profile can be changed by a magnetic field. C- Refractive index profile can be changed by an electric field.
 B- Refractive index can be changed by a magnetic field. D- Refractive index can be changed by an electric field.
- 55- SLDs are ELED-based diodes designed to operate in the ... mode.
 A- Reverse bias C- saturation
 B- active D- superluminescence
- 56- The reflection coefficient in a photodiode can be calculated as:
 A- $\frac{(n+1)/(n-1)}{2}$ C- $\frac{(n-1)/(n+1)}{2}$
 B- $(n-1)/(n+1)$ D- $(n+1)/(n-1)$
- 57- The active region is the portion of the LED where...
 A- Photons are absorbed C- Photons are emitted
 B- Current is fed D- Current is drained
- 58- Drawbacks of LEDs as a source for operating optical fiber links doesn't include
 A- High E/O conversion efficiency C- Large beam width
 B- Large line width (30-40 nm) D- Low output power
- 59- An optical link can be restored from the effect of losses by ..
 A- Adding an optical amplifier C- Adding Bragg grating
 B- Adding circulators D- Another method
- 60- In Fabry-Berot laser resonator, the active region is sandwiched by ...
 A- Two fully reflective mirrors C- A fully reflective and a semi-reflective mirrors
 B- Two semi-reflective mirrors D- Other materials

Question 2: Decide True or False for sentences (1-40) and fill-in the bubble sheet [40 points]

- 1- The V-parameter is important because it determines The number of electromagnetic modes.
- 2- In silica optical fibers, the light absorption dominates at wavelengths above 850 nm .
- 3- Bending attenuation factor depends only on Numerical aperture.
- 4- The two rods alignment technique can be considered a lossy alignment technique.
- 5- In active alignment technique, light is injected and received near the joint.
- 6- In stimulated emission, incident and stimulated photons will have identical polarization only.
- 7- One of optical couplers types is the screen coupler.
- 8- Light injection is a technique for connectors alignment.
- 9- Bi-conical taper is a technique for connectors alignment.
- 10- A directional coupler is a nonreciprocal device.
- 11- For medium-distance, medium-data-rate systems, SLEDs are preferred.
- 12- LEDs always generate light through stimulated emission.
- 13- Electrodes are important part in the fusion splicing process.
- 14- Index matching gel is needed for perfect connector alignment.
- 15- Modal dispersion can be reduced in single mode fibers by using a graded index profile.
- 16- Waveguide dispersion is proportionally dependent on V.
- 17- Fresnel reflections can be considered an intrinsic loss mechanism.
- 18- The losses due to axial misalignment of the fibers depend on the distribution of power in the modes.
- 19- Active taper alignment techniques are common in fiber alignment in temporal fiber connections.
- 20- A polarizing splitter works only for multi-mode optical fibers.

- 21- A directional coupler is a nonreciprocal device that isolates one input from the other.
- 22- Spontaneous emission can result in photons that have random wavelengths.
- 23- LEDs are the preferred optical source for multimode graded index optical fiber-based systems.
- 24- LDs can source light for single mode optical fibers only.
- 25- LDs for the 850-nm region are fabricated using GaAs and AlGaAs.
- 26- Edge-emitting LED (ELED) has a structure that resembles the Fabry-Perot LD.
- 27- SLEDs operate efficiently for bit rates up to 250 megabits per second (Mb/s).
- 28- SLDs are ELED-based diodes designed to operate in the super heterodyning mode.
- 29- Coupling losses of several decibels can easily occur when coupling light from an LD to a fiber.
- 30- The coupling efficiency depends on the type of fiber that is attached to the optical source.
- 31- ELEDs may be used for both single mode and multimode optical fiber systems.
- 32- Turn on delay and resonance frequency are the two major factors that limit the power coupled from the source to the optical fibers.
- 33- Electro-absorption (EA) modulator is always reverse biased.
- 34- In stimulated Emission, an atom in an excited state might be stimulated to emit a photon by another incident photon.
- 35- Semiconductor LEDs emit coherent light.
- 36- Semiconductor lasers emit light spread out over an angle of 10 to 15 degrees.
- 37- External modulation is done by superimposing the modulating signal on the driving current.
- 38- Direct modulation is done after the light is generated.
- 39- In LDs, turn on delay limits the bit rate in the digital systems.
- 40- In electro-absorption (EA) modulator, light absorption is done in the depletion region.

The end of questions

Good luck

Assoc. Prof. Sameh A. Napoleon (Coordinator of the Course)

D12



Tanta University

Department of Electronics and Communication Engineering
Total Marks: 40 Marks



Faculty of Engineering

| | | |
|--|-----------------------|-----------------------|
| Course Title: Management and Marketing | Course code: EEC31H4 | Year: 3 rd |
| Date: 24 January, 2023 | Allowed Time: 2 Hours | No. of pages:2 |

Answer all the following questions and select all of the correct options:

- The four tools STDP,,, and, that would help us to understand, identify our prospective consumers, and then their characteristics.
 - segmentation, targeting, differentiation, and positioning.
 - segmentation, targeting, differentiation, and pricing.
- is the act of designing a set of meaningful differences to distinguish your company's offerings from that of the competitors.
 - Segmentation
 - Differentiation
 - Targeting
 - Positioning
- There is a difference in the way individuals behave when they are alone and when they are in a group.
 - True
 - false
- assumes that the lack of significant differences among the consumers and their requirements and develops an offering, that is, when I say offering, please remember four P's for the whole market.
 - Differentiated marketing
 - Mass marketing
 - Business marketing
 - Consumer marketing
- is defined as utility per cost.
 - Profit
 - Value
 - Exchange
 - Revenue
 - Tangible benefits.
- Which of the following can be marketed?
 - Ideas
 - Services
 - Goods
 - Persons
 - Places
 - Events
 - All of the above.
- of marketing includes actors engaged in producing, distributing, and promoting the offering.
 - External Environment
 - Micro Environment
 - Macro Environment
- The micro model assume that buyer pass through behavioral -affective and cognitive stages in that order. They,, sequence is appropriate and would be relevant for airline tickets or personal computers.



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- Learn, Feel, Do
 - Feel, Do, Learn
 - Do, Feel, Learn
-, the buyer announces something that he wants to buy and then potential sellers compete to get the sale by offering the lowest price.
 - Sealed-bid auctions
 - Dutch auctions
 - English auctions
 - If a marketing manager groups a market based on neighborhoods, then she has chosen the segmentation.
 - Geographic
 - Psychographic
 - Demographic
 - Behavioral
 - The term indicates vital and measurable statistics of human population.
 - Psychographics
 - Demographics
 - Geography
 - Consumer Behavior
 - is a subset of the total market; it is a subset of one identified segment where a specific product is focused for only small pockets of the segment.
 - Undifferentiated marketing
 - Mass marketing
 - Business marketing
 - Niche marketing
 - When designed a product with the following costs: Material costs = \$10, Labor costs = \$10, Overhead = \$10. The **Total Costs** is, then add a markup percentage of 50 %, then the final product price is
 - \$ 20, \$30
 - \$ 20, \$35
 - \$ 30, \$45
 - \$ 30, \$50
 - tries to find out the requirement of the consumer and based on that they create an offering. However, starts with the marketer or the manufacturer.
 - Selling, marketing
 - Marketing, selling
 - Targeting, selling
 - One of the prevalent methods of understanding business model of any organization is, It indicates how a firm will be able to analyze specific activities for competitive advantage.
 - Segmentation
 - Differentiation
 - Targeting
 - Value Chain



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16. are called descriptive bases of segmentation. As, they describe the consumer.
- a) Psychographic and Behavioral b) Geographic and Behavioral
c) Geographic and Demographic d) Demographic and Behavioral
17. are short 3–5-word phrases that capture the essence or spirit of brand positioning.
- a) Imagery b) Brand mantras c) Trade mark
18. The triple indicators of the customer lifestyle are
- a) education, marital status, and income b) marital status, income, and family size
b) occupation, income, and family size d) education, occupation, and income
19. In....., the firm bases its price largely on *competitors' prices*. The firm might charge the same, more, or less than major competitor(s).
- a) going-rate pricing b) perceived-value pricing
c) target-return pricing d) markup pricing
20. is called B2C market. As the name suggests, it is the end consumers of various merchandise like products that are purchased by the consumer for their own or household usage.
- a) The business market b) The institutional market C) The consumer market
21. The organization cannot control the of marketing, but is influenced by it.
- a) macro environment b) micro environment c) internal environment
22. is the act of designing a company's offering and image to occupy a distinctive place in the mind of the target market.
- a) Differentiation b) Targeting c) Positioning d) Segmentation
23. Successful creation of a is the result of an effective positioning. So that consumers get a logic, consumers get a compulsive argument that why I'm going to buy this product.
- a) value proposition b) Brand Mantra c) purchase behavior



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24. There four different levels of competition between companies are brand level, industry level, form level, and generic level. In which, is the highest level of competition.
- a) brand level b) industry level c) form level d) generic level
25. is the most visible element of marketing. It refers to set of activities to communicate the product or service information to the consumer to educate them, to attract them, and finally, encourage them to buy the product.
- a) Positioning b) Promotion c) Differentiation
26. of communication is from the marketer to the consumer, while that is consumers response to the marketer.
- a) The macro model, the micro model b) The micro model, the macro model
27. The only "P" in the marketing mix that produces revenue; all other elements represent costs
- a) Product b) Place c) Price d) Promotion
28. uses the buyers' perceptions of value, not the sellers' cost, as the key to pricing. Price is considered before the marketing program is set.
- a) Value-based pricing b) Cost-based pricing c) Auction-Type Pricing
29. When Companies are plagued with overcapacity, intense competition, or changing consumer wants. the price objective would be
- a) Maximum current profit b) Maximum market skimming
c) Maximum market share d) survival
30. Most companies make some attempt to measure their demand curves using
- a) Statistical analysis of past prices b) Price experiments can be conducted
c) Surveys d) all of them.

With my best wishes
Dr. Basma Eldosouky



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|---|--|----------------------------|--------------|----------|
| Course | Digital Electronics in Communication Systems | Academic year 2022/2023 | Course Code | EEC 3111 |
| Year | 3 rd Year | First Semester Exam | Total Marks | 90 |
| Date | 22/1/2023 (Final Exam) | No. of pages: (4) Pages | Allowed Time | 3 hrs |
| Remarks: Answer ALL of the following Questions. | | | | |

Question # 1: (30 Points)

(a) For each statement, indicate the term or parameter being described. (12 Points)

- 1) Current at an input when a logic 1 is applied to that input.
- 2) Current drawn from the VCC source when all outputs are LOW.
- 3) Time required for an output to switch from the 1 to the 0 state.
- 4) An IC package that does not require holes to be drilled in the printed circuit board.
- 5) Number of different inputs that an output can safely drive.
- 6) When a LOW output receives current from the input of the circuit it is driving

(b) Using Table 1: (12 Points)

| Table 1 | 74 | 74S | 74LS | 74AS | 74ALS | 74F |
|----------------------------|-----|-----|------|------|-------|-----|
| Performance ratings | | | | | | |
| Propagation delay (ns) | 9 | 3 | 9.5 | 1.7 | 4 | 3 |
| Power dissipation (mW) | 10 | 20 | 2 | 8 | 1.2 | 6 |
| Max. clock rate (MHz) | 35 | 125 | 45 | 200 | 70 | 100 |
| Fan-out (same series) | 10 | 20 | 20 | 40 | 20 | 33 |
| Voltage parameters | | | | | | |
| V _{OH} (min) (V) | 2.4 | 2.7 | 2.7 | 2.5 | 2.5 | 2.5 |
| V _{OL} (max) (V) | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| V _{IH} (min) (V) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| V _{IL} (max) (V) | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |

- 1) Calculate DC noise margins for typical 74LS IC.
 - 2) How does this compare with standard TTL noise margins?
 - 3) Which TTL series can drive the most device inputs of the same series?
 - 4) Which TTL series is the best at high frequencies?
 - 5) Which series uses a special diode to reduce switching time?
 - 6) Which series would be best for a battery-powered circuit operating at 10 MHz?
- (c) Why shouldn't totem-pole outputs be tied together? indicating answer with drawings. (3 Points)
- (d) Figure 1 shows how two tristate buffers can be used to construct a bidirectional transceiver that allows

digital data to be transmitted in either direction (A to B, or B to A). Describe the circuit operation for the two states of the DIRECTION input. (3 Points)

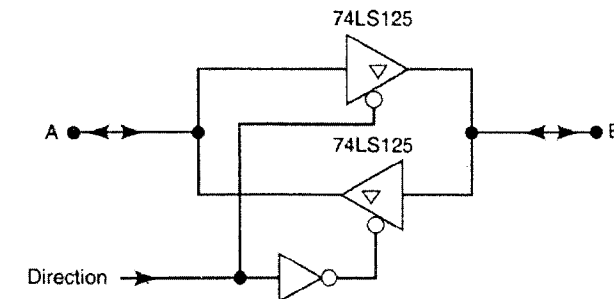


Figure 1

Question # 2: (15 Points)

(a) Choose the correct answer, In the following circuit in Figure 2, X is given by:

- i) $X = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$
- ii) $X = \bar{A}BC + A\bar{B}C + AB\bar{C} + \bar{A}\bar{B}\bar{C}$
- iii) $X = AB + BC + AC$
- iv) $X = \bar{A}\bar{B} + \bar{B}\bar{C} + \bar{A}\bar{C}$

(4 Points)

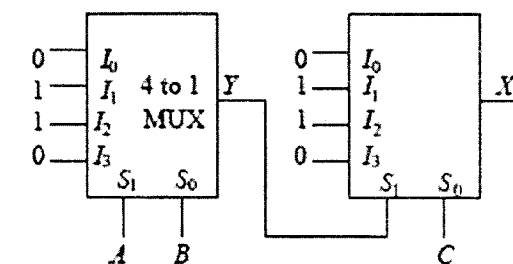


Figure 2

- (b) What is the number of 3-to-8 line decoders required to make an 5-to-32 line decoder? (2 Points)
- (c) What is the number of selector lines required in a single input N-output Demux? (2 Points)
- (d) Figure 3 shows the block diagram of a logic circuit used to control the number of copies made by a copy machine. The machine operator selects the number of desired copies by closing one of the selector switches S1 to S9. This number is encoded in BCD by the encoder and is sent to a comparator circuit. The operator then hits a momentary contact START switch, which clears the counter and initiates a HIGH OPERATE output that is sent to the machine to signal it to make copies. As the machine makes each copy, a copy pulse is generated and fed to the BCD counter. The counter outputs are continually compared with the switch encoder outputs by the comparator. When the two BCD numbers match, indicating that the desired number of copies has been made, the comparator output X goes LOW; this causes the OPERATE

level to return **LOW** and stop the machine so that no more copies are made. Activating the START switch will cause this process to be repeated. Design the complete logic circuitry for the **comparator** and **control sections** of this system. (7 Points)

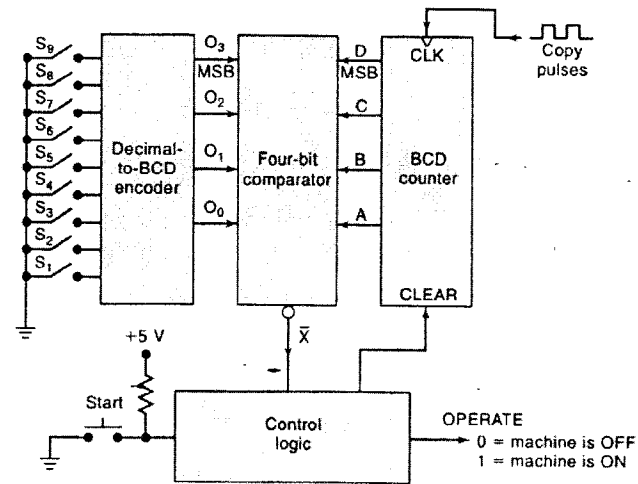


Figure 3

Question # 3:

(45 Points)

- (a) Draw the circuit diagram of the SR latch using **NOR** gates indicating its truth table and its excitation table. Then, show how can you convert SR latch to JK flip-flop. (7 Points)
- (b) Design a **MOD-5** counter using a shift register and feed back logic. (7 Points)
- (c) Design a **4-bit** Serial-In Serial-Out (SISO) **shift right** register. If it is clocked at 20 kHz. How long will the data be delayed in passing through this register? (7 Points)
- (d) Determine the **counting sequence** of the counter in Figure 4. (8 Points)

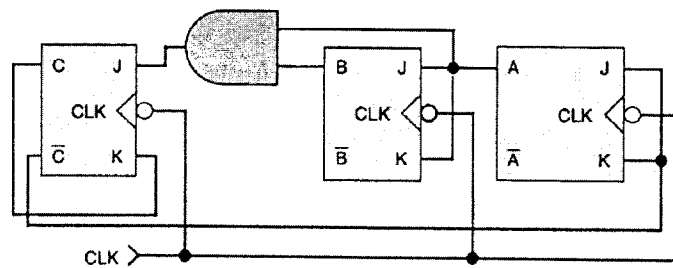


Figure 4

- (e) Design a **3-bit** synchronous counter using a J-K flip-flop that counts only the **even** numbers. Ensure that

the **unused** states go to **110** on the next CLK pulse. (8 Points)

(8 Points)

- (f) Refer to Figure 5, where a 74HC163 has the input signals given in the timing diagram applied. The parallel data inputs are permanently connected as **1100**. Assume the counter is initially in the **0000** state, determine the counter output waveforms. (8 Points)

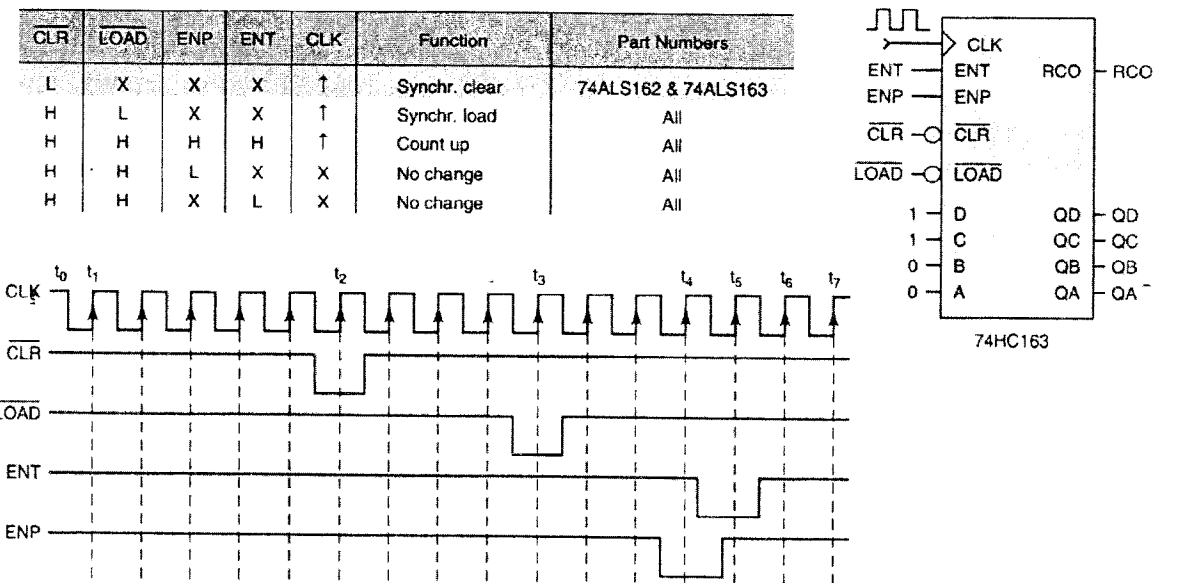


Figure 5

End of Questions

Good Luck

Course Examination Committee:

Prof. Amira Ashour
 Assoc. Prof. Salah Khamis
 Dr. Nessim Mahmoud

Course Coordinator: Dr. Hussein E. Seleem



Please answer the following questions:

Question (1)

(25Marks)

- (a) If function given by $f(x) = \begin{cases} k(1+x), & -1 \leq x < 0 \\ k(1-x), & 0 \leq x \leq 1 \\ 0, & \text{otherwise} \end{cases}$ is probability density of a continuous random

variable X , find:

- (a-1) value of k . (a-2) $P(x = 0.35)$, $P(-0.5 \leq x < 5)$.
(a-3) Cumulative function $F(x)$. (a-4) The mean, variance, and standard deviation.
(a-5) $E[(4x + 1)^2]$ and $V(2x - 3)$.

- (b) The data represent the heights of 50 persons are given as follow:

| Height | 140-150 | 150-160 | 160-170 | 170-180 | 180-190 | 190-200 |
|-------------------|---------|---------|---------|---------|---------|---------|
| Number of persons | 2 | 7 | 15 | 10 | 11 | 5 |

- (b-1) Find the mean and the standard deviation of this grouped data.
(b-2) Find the median and the mode.
(c) A coin is known to come-up heads three times as tails. This coin is tossed 10 times, find probability:
(C-1) Getting three heads. (C-2) Getting at most three heads. (C-3) Getting all tails.

Question (2)

(25Marks)

- (a) Suppose the following data for 9 students

| | | | | | | | | | |
|-----------------------|----|----|----|----|----|----|----|----|----|
| Chemistry grade x_1 | 85 | 74 | 76 | 90 | 85 | 87 | 94 | 98 | 81 |
| Test score x_2 | 65 | 50 | 55 | 65 | 55 | 70 | 65 | 70 | 55 |
| Classes missed x_3 | 1 | 7 | 5 | 2 | 6 | 3 | 2 | 5 | 4 |

- (a-1) Fit a multiple linear regression equation to the data.
(a-2) Estimate chemistry grade for a student has test score 60 and missed 4 classes.
(a-3) Calculate r_{12} , r_{13} , r_{23} , $R_{1,23}$ and $R_{12,3}$.
(b) Find the value of r such that $P(x \leq \mu + r\sigma) \approx 0.2776$.
(c) Determine 95% confidence interval on μ which represent the mean of a population with variance 54.76. If we take a sample with size 50 and mean 6.2 ?

Question (3)

(35Marks)

- (a) The joint probability distribution of two discrete random variables (X, Y) is given by:

| | | x | | | |
|-----|---|-----|----|----|----|
| | | 1 | 2 | 3 | 4 |
| y | 1 | 6C | 3C | 2C | 4C |
| | 2 | 4C | 2C | 4C | 0 |
| | 3 | 2C | c | 0 | 2C |

- (a-1) Find the value of the probability C .
(a-2) Find the marginal mass function of X and Y .
(a-3) Calculate the covariance between X and Y .
(a-4) Determine the correlation of X and Y and its type.
(b) Yahia is making cold sales calls. The probability of a sale on each call is 0.4. what is the probability that he has exactly five failed calls before his second successful sales call?
(c) It is known that articles produced by a factory by four machines **A, B, C** and **D** if 20% come from Machine **A**, 10% from Machine **B**, and 40% from Machine **C**. The percentages of satisfactory articles among those produced are 95% for **A**, 85% for **B**, 65% for **C** and 90% for **D**. An article is chosen at random.
(c-1) What is the probability that it is satisfactory?
(c-2) Assume the article is satisfactory, what is the probability that it was not produced by Machine **B**?
(d) The mean number of sick days an employee takes per year is believed to be about ten. Members of a personnel department do not believe this figure. They randomly survey eight employees. The number of sick days they took for the past year are as follows: 12; 4; 15; 3; 11; 8; 6; 8. Let x is the number of sick days they took for the past year. Should the personnel team believe that the mean number is ten at the 5% significance level?

Best of Luck

Dr. Eman Elghamry, and Examination committee

Answer ALL the following questions.

(يقوم الطالب بإجابة السؤال الأول في ورقة التصحيح الإلكتروني وبإقى الأسئلة فى الكراسة)

Model A

Question (1): Choose the correct answer (40 Marks)

- A specific field of AI which helps to develop the program based on sample data (Training data) instead of hardcoding rules/programming.
 - Artificial Intelligence
 - Machine Learning
 - Activation
 - Regularization
- The network that involves backward links from the output to the input and hidden layers is called
 - Self-organizing maps
 - Perceptron
 - Multi-layered perceptron
 - Recurrent neural network
- Which strategy does not prevent a model from over-fitting to the training data?
 - Dropout
 - Pooling
 - Regularization
 - Early stopping
- Which of the following is perceptron?
 - a neural network that contains feedback
 - an auto-associative neural network
 - a double layer auto-associative neural network
 - a single layer feed-forward neural network with pre-processing
 - None of these
- Training accuracy approaches 95%, but validation accuracy remains at 60%. Your model is likely _____
 - Underfitting
 - Overfitting
 - Fit
 - None of these
- Which of the following types of learning uses labeled training data?
 - Supervised Learning
 - Unsupervised Learning
 - Reinforcement Learning
 - All of the above
- Autoencoder is used for
 - Image classification
 - Speech classification
 - Function approximation
 - Dimensionality reduction
- In autoencoder training, the target output is
 - A fixed constant
 - Identical to input
 - A positive real number
 - Could be either a positive or negative real number
- Adjustments to the synaptic weights of the multilayer perceptron are made on an epoch-by-epoch basis.
 - Unsupervised Learning
 - On-line Learning
 - Batch Learning
 - Reinforcement Learning
- What function is NOT used to make a pooling layer for a CNN?
 - max_pool()
 - avg_pool()
 - min_pool()
 - All of these are used

11. What is back-propagation?

- It is the transmission of error back through the network to adjust the inputs
- It is the transmission of error back through the network to allow weights to be adjusted so that the network can learn.
- It is another name given to the curvy function in the perceptron
- None of the mentioned

12. Which architecture would be most likely to be used to identify objects in an image?

- RNN
- CNN
- LSTM
- None of These

13. In Delta Rule for error minimization

- Weights are adjusted w.r.to change in the output
- Weights are adjusted w.r.to difference between the desired output and actual output
- Weights are adjusted w.r.to difference between input and output
- None of the above

14. Given an image whose dimensions 30x30, and a kernal of size 5x5 with stride length 1 and no padding, how large with the convolved image be?

- 28X28
- 30X30
- 26X26
- 32X32

15. Which of the following is true about dropout?

- Dropout leads to sparsity in the trained weights
- At test time, dropout is applied with inverted keep probability
- The larger the keep probability of a layer, the stronger the regularization of the weights in that layer
- None of the above

16. A 3-input neuron has weights 1, 1.5, and 0.9, the neuron output s is 0.06, and the activation function is bipolar sigmoid. If the inputs are 0.5, -1, and 0.3, respectively, the bias weight b is approximately:

- 2
- 1.17
- 0.85
- 1

17. For a binary classification problem, which of the following activation function is used?

- ReLU
- Softmax
- Sigmoid
- None

18. What are the steps for using a gradient descent algorithm?

- Calculate the error between the actual value and the predicted value.
 - Reiterate until you find the best weights of the network.
 - Initialize random weight and bias.
 - Pass an input through the network and get values from the output layer.
 - Go to each neuron that contributes to the error and change its respective values to reduce the error.
- 3, 5, 4, 1, 2
 - 3, 4, 1, 5, 2
 - 4, 3, 5, 1, 2
 - 5, 4, 3, 2, 1

19. Which of the following is a correct order for the Convolutional Neural Network operation?

- Convolution -> max pooling -> flattening -> full connection
- Max pooling -> convolution -> flattening -> full connection
- Flattening -> max pooling -> convolution -> full connection
- None

20. _____ regularization technique involves each neuron having a probability p of being temporarily "dropped"

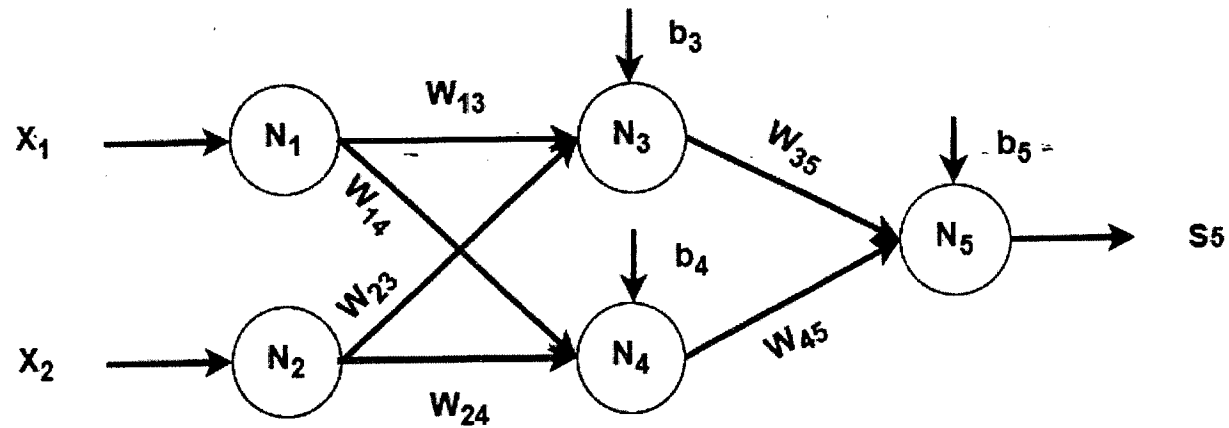
- Dropout
- PCA
- Manifold learning
- Projection

Question (2) (10 Marks)

Design a neural network with two inputs x_1 and x_2 , and a single output neuron that acts as a binary classifier in the x_1 - x_2 plane. Class c_1 (i.e., $S = 0$) represents all input patterns inside a triangle with vertices (1,2), (4,3), and (3,5), while Class c_2 (i.e., $S = 1$) represents all input patterns fall outside that triangle. Show how the designed network will classify the following input patterns: (0,2), (1,1), (3,4) and (5,2).

Question (3) (15 Marks)

For the given neural network, the Input layer consists of neurons N_1 , and N_2 which copy their input into the network. The output layer consists of a single neuron N_5 which produces the final output of the network. Network includes a single hidden layer with 2 neurons. All neurons use a "bipolar sigmoid" activation function.



Assume the training error energy function used is the half-squared error. $E = \frac{1}{2}(d - s_5)^2$

Where d is the desired output and S_5 is the actual output.

The network weights are given as follows:

$$\begin{aligned} W_{13} = 0.2, & \quad W_{23} = -0.8, & \quad W_{35} = 0.18, & \quad b_3 = -0.5 \\ W_{14} = 0.6, & \quad W_{24} = 0.7, & \quad W_{45} = 0.9, & \quad b_4 = 0.3, & \quad b_5 = 0.2 \end{aligned}$$

When the following input [$x_1 = 0.1, x_2 = 0.3$] with target output ($d=0.4$) is applied to the network .

- 1) What is the output of the network?
- 2) What is the gradient of error E with respect to weight parameter W_{35} ?
- 3) What is the gradient of error E with respect to bias weight the parameter b_3 ?

Question (4) (20 Marks)

1. Explain the role of each of the following: (5 Marks)

- a) Dropout layer
- b) Convolution operation
- c) Pooling operation
- d) Regularization
- e) Accuracy parameter

2. What are the evaluation strategies and why it is used? (5 Marks)

3. What is the Difference Between Batch Gradient Descent and Stochastic Gradient Descent? (4 Marks)

4. What are the Different CNN parameters? (2 Marks)

5. Given the following confusion matrix obtained from testing a trained binary classifier of two classes K and L. First, specify T_p , T_n , F_p , and F_n . Then, evaluate the classifier using the following metrics: (4 Marks)

- Accuracy
- Recall
- Specificity
- Error

| | | Predicted | |
|--------|---|-----------|-----|
| | | K | L |
| Actual | K | 510 | 70 |
| | L | 100 | 660 |

*Best Wishes,
Dr. Nada Taha
Dr. Amr Elkholy*