

M.Tech. Examination 2022-2023
Electronics and Communication Engineering
Odd Semester Regular and Supplementary
Theory of Statistical Communication (ECEPGPE01)

Full Marks: 80

Time: 3.00 Hrs

- *Answer all parts of a question in same place.*
- *Figures on the right hand side margin indicate full marks.*
- *Symbols have their usual meaning*

Answer any five questions

Marks

1. (a) Consider the following equation in the four unknowns and find the minimum norm solution

$$x_1 - x_2 + x_3 - x_4 = 1$$

- (b) Find the least square solution to the following set of inconsistent linear equations $Ax=b$ given by,

$$\begin{bmatrix} 1 & 0 & 2 & -1 \\ -1 & 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

8+8

2. (a) Find the Power Spectrum of the following wide-stationary random processes that have the given auto-correlation sequences,

(i) $r_x(k) = 2\delta(k) + j\delta(k-1) - j\delta(k+1)$

(ii) $r_x(k) = \delta(k) + 2(0.5)^{|k|}$

8+8

3. (a) Find the autocorrelation sequence of the following wide-stationary random process that has the power spectral density

(i) $P_x(e^{j\omega}) = 2 + 2\cos\omega$

(ii) $P_x(e^{j\omega}) = 1/(5 + 2\cos\omega)$

8+8

4. (a) Derive the autocorrelation Matrix for the signal $x = [x(0), x(1), x(2)...x(p)]^T$.

- (b) Explain the characteristics and properties of the following random processes.

(i) Autoregressive moving average process (ARMA)

(ii) Autoregressive process (AR)

- (iii) Moving Average process (MA) 10+6
5. Derive the Padé approximation method to find the model parameters for modeling a signal as the Unit Sample Response of Linear Shift-Invariant System having p Poles and q Zeros. 16
6. Suppose that we filter white noise $v(n)$ with a causal linear shift invariant filter having a rational system function with p poles and q zeros. Derive Yule-Walker equations for ARMA process of order (p,q) . 16
7. (a) Find the Padé approximation of second- order to a signal $x(n)$ that is given by
- $$x = [2,1,0,-1,0,1,0,-1,0,1,\dots]^T$$
- Find the coefficients $b(0),b(1),b(2), a(1), a(2)$.
- (b) A third order all pole Pade approximation to a signal $x(n)$ has been found to be
- $$H(z) = \frac{1}{1 + 2z^{-1} + z^{-2} + 3z^{-3}}$$
- What information about $x(n)$ can be determined from this model? 8+8
8. Padé approximation models a signal as the response of a second order filter to a unit sample input $\delta(n)$, Suppose however that we would like to model a signal $x(n)$ as the unit step response of a second order filter having Transfer Function of the form
- (a) Using Padé approximation method with a unit step input, derive the set of equations that must be solved so that $\hat{x}(n) = x(n)$ for $n=0,1,\dots,4$
- (b) If the first eight values of $x(n)$ are $x = [1,0,2,-1,2,0,1,2]^T$, find $b(0), b(1), b(2), a(1)$ and $a(2)$. 8+8
9. Derive the Wiener-Hopf equations for an FIR Filter of order p that define the set of coefficients that minimize the mean square error for $k= 0,1,\dots,p -1$. 16

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Pedagogy Studies
Subject Code: UCEPGAU02
Semester- I

Autumn Semester Examination: 2023

Time: 3 hours

Full Marks: 80

Answer the questions in your own words. Follow the instructions & word limits while answering. Numbers in the right-hand margin indicate marks

1. **Answer any ten questions from the following. (Word limit: 50) 2x10=20**
 - a) Define the term 'Pedagogy'.
 - b) Mention any two benefits of pedagogical knowledge.
 - c) What is meant by effectiveness of pedagogical practices in classroom?
 - d) Define teaching.
 - e) Differentiate between research method and methodology?
 - f) Distinguish between educational aims and objectives.
 - g) Give any two examples of informal education.
 - h) Write down two differences of summative and formative assessment.
 - i) Give a definition of assessment.
 - j) Mention any two differences between Pedagogy and Andragogy.
 - k) Define the term 'Dissemination'.
 - l) Point out any two characteristic features of effective teaching.
 - m) Give the meaning of formal education.

2. **Answer any six questions from the following. (Word limit: 150) 5x6=30**
 - a) Describe the characteristics of learning.
 - b) What is curriculum? Narrate the nature of it. (2+3)
 - c) Explain the need of teacher education in modern context.
 - d) Briefly discuss the scope of pedagogy.
 - e) Illustrate the concept of professional ethics. What are the most important qualities of an Ideal teacher? (2+3)
 - f) State the concept of research design. Write down the importance of research in technical education. (2+3)
 - g) What are the barriers of learning in a formal classroom?
 - h) How can teacher education help in effective pedagogical practices?

3. **Answer any three questions from the following. (Word limit: 300) 10x3=30**
 - a) Illuminate different types of pedagogical approaches.
 - b) Discuss the principles of curriculum construction.
 - c) Elaborate the differences among formal, informal and non-formal education.
 - d) Give the concept of professional development. How does a teacher develop teaching profession. (6+4)

M Tech Examination 2023
Electronics and Communication Engineering
(Odd Semester Regular and Supplementary)
Microwave Devices, Circuits and Antenna (ECEPGPE04)

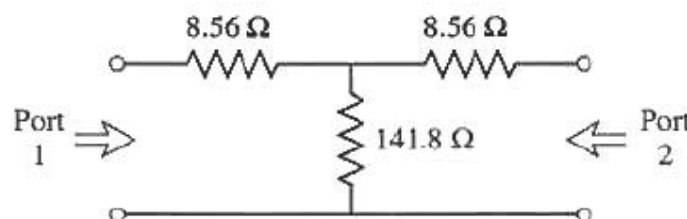
Answer any eight questions.

Symbols have their usual meaning.

Full Marks: 80

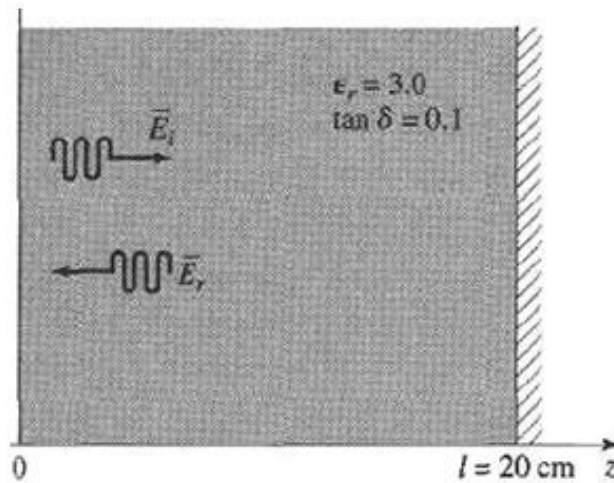
Time: 3.00 Hr

- 1 (a) Write down the operating principle of Reflex Klystron.
 (b) What is Traveling wave tube (TWT)? Write the principle of operation of TWT. 5+5
- 2 Define the following: 2×5
 - (a) Interelectrode capacitance
 - (b) Lead inductance
 - (c) Transit time
 - (d) Skin effect
 - (e) Dielectric loss
- 3 (a) What is a magnetron? 2+2+3+3
 (b) What is the physical arrangement of the magnetron?
 (c) Explain the principle of operation of magnetron?
 (d) How does this arrangement function when energized?
- 4 (a) What are the disadvantages of ordinary power divider over Wilkinson power divider? 3+7
 (b) Write even mode and odd mode analysis of **Wilkinson power** divider with S matrix.
- 5 (a) Write down the Z and Y matrices for N-port microwave network. 2+2+2+4
 (b) Why scattering matrix is used at high frequency?
 (c) What is symmetric network, reciprocal network and lossless network?
 (d) Find the S-parameters of 3 dB attenuator circuit.



6 Compute the input power density P_{in} at $Z=0$ from the total field at $Z=0$. Does $P_{in} = P_r = P_t$?

10



7 A plane wave traveling along the Z axis in a dielectric medium with $\epsilon_r = 2.55$ has an electric field given by $\mathbf{E}_Y = \mathbf{E}_0 \cos(\omega t - kz)$. The frequency is 2.4 GHz and $\mathbf{E}_0 = 30$ V/m.

2+3+5

- (a) Find the amplitude and direction of the magnetic field.
- (b) Find the phase shift between the positions $Z_1 = 0.5$ m and $Z_2 = 1.7$ m.

8 Write five characteristics of Dielectric resonator antenna (DRA).

2×5

9 Write working principle and resonant frequency of the following:

5+5

- (a) Cylindrical DRA
- (b) Rectangular DRA

10 Write short note on any two of the following:

5+5

- (a) Probe-fed DRA
- (b) Microstrip fed DRA
- (c) Slot-fed DRA

M.Tech. Examination 2023
Electronics and Communication Engineering
(Odd Semester Regular and Supplementary)
Optical Communication & Network (ECEPGPC02/ECE605)

Full Marks: 80

Time: 3.00 Hrs

- *Answer any five questions.*
- *Answer all parts of a question in same place.*
- *Figures on the right hand side margin indicate full marks.*
- *Symbols have their usual meaning*

1. **Answer any Four questions** **4x4**
 - (a) An analog video signal has bandwidth $\Delta f = 4$ MHz and has SNR of about 50 dB. Calculate the minimum bit rate required for digital representation of the analog signal. What is its practical value used in telecommunication? 4
 - (b) What are RZ and NRZ modulation formats. Compare them. 2+2
 - (c) Explain briefly why fiber optic communication is needed? 4
 - (d) Calculate the transmission distance over which the optical power will attenuate by a factor of 10 for two fibers with losses of 0.5 and 1 dB/km. Assuming that the optical power decreases as $\exp(-\alpha L)$, What is the value of minimum optical fiber attenuation in dB and at what wavelength? 3+1
 - (e) Calculate the carrier frequency for optical communication systems operating at 1.31 μm . What is the photon energy (in eV)? What is zero dispersion wavelength λ_{zD} ? 4
 - (f) A 1.55 μm p-i-n receiver with $R=0.8$ A/W has to operate at $Q=6$ corresponding to a BER of 10^{-9} . If the receiver is thermal noise limited with thermal noise of 80nA, Calculate the receiver sensitivity in dB. 4
2.
 - (a) Write down the wave equation in cylindrical coordinates for E_z for step index fiber with core radius 'a' and refractive indices of core and clad are n_1 and n_2 respectively. 4
 - (b) Solve it by the method of separation of variable and express the solution in terms of Bessel functions for core and clad.. 12
3.
 - (a) Define group velocity dispersion (GVD) and find an expression of GVD. How it is expressed as the sum of material and waveguide dispersion terms? Draw the dispersion curves showing total dispersion, material dispersion, waveguide dispersion and zero dispersion wavelength. 8+2+2
 - (b) Find an estimation of BL product at 1.3 μm for $D=1$ ps/(km-nm) and $\Delta\lambda = 4$ nm. 4
4.
 - (a) How direct or internal intensity modulation is carried out in optical sources? What are two major drawbacks of direct intensity modulation scheme? 2+2
 - (b) On which principle external optical modulators work? With suitable mathematical expression and diagram explain the operation of an optical phase modulator. 2+6
 - (c) A lithium niobate strip waveguide phase modulator designed to operate at a wavelength of 1.3 μm is 2 cm long with a distance between electrodes of 25 μm . Determine the voltage required to provide a phase change of 180° . Given the electro-optic co-efficient for lithium niobate is 30.8×10^{-12} mV^{-1} and its refractive index is 2.2 at 1.3 μm . 4
5.
 - (a) What do you understand by receiver sensitivity? 2

- (b) Derive an expression of bit error rate and hence find an expression of sensitivity in thermal noise limit. 4+4
- (c) A 1.3- μm digital receiver is operating at 100 Mb/s and has an effective noise bandwidth of 60 MHz. The $p-i-n$ photodiode has negligible dark current and 90% quantum efficiency. The load resistance is 100 Ω and the amplifier noise figure is 3 dB. Calculate the receiver sensitivity corresponding to a BER of 10^{-9} ? 6
6. (a) What are power budget and rise-time budget in relation of the design of fiber optic communication system? Write down the power budget equation in dB and RMS system rise-time equation and explain each term in these equations. 8
- (b) Make the rise-time budget for a 0.85- μm , 10-km fiber link designed to operate at 50 Mb/s. The LED transmitter and the Si $p-i-n$ receiver have rise times of 10 and 15 ns, respectively. The graded-index fiber has a core index of 1.46, $\Delta = 0.01$, and $D = 80$ ps/(km-nm). The LED spectral width is 50 nm. Can the system be designed to operate with the NRZ format? 8
7. (a) What do you understand different lightwave system architectures? Briefly discuss Hub and Bus topologies for distribution networks. 4+6
- (b) A star network uses directional couplers with 0.5-dB insertion loss to distribute data to its subscribers. If each receiver requires a minimum of 100 nW and each transmitter is capable of emitting 0.5 mW, calculate the maximum number of subscribers served by the network. 6
8. (a) What are different functional types of Optical Amplifiers? Compare between optical amplifiers and optical repeaters. 3+3
- (b) Explain with the help of E-B diagram, the principle of operation of EDFA. 6
- (c) Explain the effect of pump power and fiber length on EDFA's gain characteristics 4
9. **Write shot notes on any two of the following.** **8x2**
- (a) Intensity Modulator 8
- (b) Non linear scattering effects of optical fiber 8
- (c) 16 channel WDM System in c-band 8
- (d) Optical Ethernet 8

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M.Tech Examination-2023
Electronics and Communication Engineering
(Odd Semester Regular and Supplementary)
Advanced Digital Signal processing (ECEPGPC01)

Full Marks: 80

Time: 3 Hours

- Answer any 5 questions. All correct part answers will be credited. All parts of a question (a, b, c, etc.) should be answered at one place.
- Do not attempt more than FIVE questions on this paper.
- Symbols have their usual meaning. Missing data any may be suitably assumed. Figures on the right-hand side margin indicate full marks.

1. a) What is multirate system? Give a suitable example. 2+2
 b) Discuss the time domain characteristics of the sampling rate alteration devices with suitable example. 2+2
 c) Derive the relations between the spectra of the input and the output of a factor-of-L up-sampler. Also show diagrams of the spectra of the input, intermediate and output sequences. What is ‘Imaging’ occurred in up-sampler? How can it be removed? 3+2+3

2. Derive expressions for the output of the decimator, $y[n]$, in the z-domain and frequency domain as a function of the spectra of input signal, $x[n]$. Also show diagrams of the spectra of the input, intermediate and output sequences. What is ‘aliasing’ effect occurred in down-sampler? How can it be prevented? 8+3+5

3. a) Prove the following Noble Identity in Multirate signal processing. 6

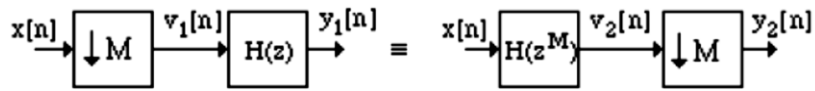


Fig. 1

- b) Show that the up-sampler is a linear time varying system. 4
- c) Show that the two possible cascade configurations of a factor-of-L up-sampler and a factor-of-M down-sampler shown in Fig. 2 are equivalent if and only if L and M are mutually prime. 6

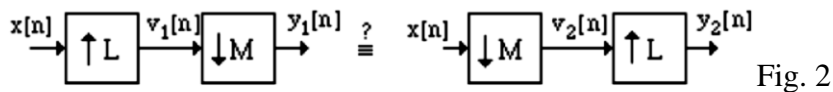


Fig. 2

4. a) Analyze the structure and determine its input-output relations. Comment on your results. 6

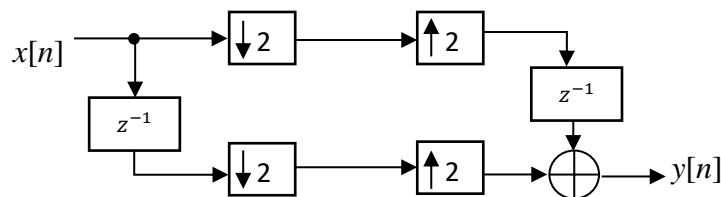


Fig. 3

- b) Explain Decimation and Interpolation with suitable block diagrams. 4
- c) Implement computationally efficient interpolator and decimator structures using type-I polyphase decomposition. 6

5. a) Develop a two-band polyphase decomposition for the following transfer function 8

$$H(z) = \frac{1 - 2z^{-1}}{1 + 3z^{-1}}$$

- b) Consider a length-9 FIR transfer function given by
 $H(z) = h[0] + h[1]z^{-1} + h[2]z^{-2} + h[3]z^{-3} + h[4]z^{-4} + h[5]z^{-5} + h[6]z^{-6} + h[7]z^{-7} + h[8]z^{-8}$ Develop a 3-branch polyphase realization of $H(z)$ in the form of a figure and determine the expressions for the polyphase transfer functions $E_0(z), E_1(z)$ and $E_2(z)$. 8
6. a) Draw the block diagram of a generic adaptive filter and briefly state its aim. 4
 b) What are the common characteristics that can be used to measure the goodness of an adaptive algorithm? Briefly explain each. 2+10
7. a) What are the four basic classes of adaptive filtering applications? Draw block diagrams and explain briefly to show a generic adaptive filter embedded in all architecture. For each, give some relevant applications. 2+14
8. For the adaptive filtering problem with a mean square cost function, show that the optimal weight vector for the Wiener filter is $\mathbf{w}_{opt} = \mathbf{R}^{-1}\mathbf{p}$ where \mathbf{R} is correlation matrix and \mathbf{p} is cross correlation. Assume that all the signals and filter coefficients are real. Discuss about the limitations of Wiener filter theory. 14+2
9. Let $\mathbf{w}(\mathbf{n})$ be the estimate of the weights at the n th sample or iteration. Show that for Newton's algorithm, the update equation is $\mathbf{w}(\mathbf{n} + 1) = \mathbf{w}(\mathbf{n}) - \mathbf{H}^{-1}\nabla J$ where $J(\mathbf{w})$ denotes the cost function to be minimized and \mathbf{H} is called Hessian. What are the disadvantages of Newton's algorithm? 14+2

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ARABIC

(USE SEPARATE ANSWER SHEET FOR ARABIC)

Q. 1. Attempt any ten, each question carries equal marks 2×10=20

i. Identify the following words either 'Noun' (اسم) or 'Verb' (فعل) :

مِرْوَاحَةٌ، لَنْ نُبْرَحَ، قَدْ ذَهَبَ، بِالسِّيَّارَةِ

ii. Merge the following letters and make a word:

ن+س+ت+ع+ي+ن ، ل+م+ت+ن ،

iii. Identify the letters and Split the following words: فَأَهْلَكْنَاَهُمْ، الْمُسْتَقِيمُ

iv. Choose either False or True. هذه باب، تلك قلم، ذلك نافذة

v. Change the Gender of following words:

أَصْفَرٌ، مهندسة، زائرٌ، كاتبة.

vi. Identify the following words either definite (المعرفة) or indefinite (النكرة) :

بَابٌ أَحْمَدُ قَلَمٌ حَامِدٍ خَيْرٌ

vii. Write down the two example of Noun (الاسم) from parts of speech.

viii. How many kinds of sentence are in Arabic write their name.

ix. What do you Know about Madd.

x. Change the Nominal sentence into verbal sentence and Verbal sentence into

Nominal Sentence. قرأ الطالب الكتاب الأستاذ كتب على السبورة

xi. What you know about Shaddah.

xii. How many kinds of Tanween in Arabic? Write down with example.

Q. 2. Attempt any two Questions, each question carries equal marks. 5×4=20

i. Write the details of Demonstrative Pronouns in Arabic (اسم الإشارة) with example.

ii. Write the Name of Months of Arabic.

iii. Write down the any five signs of Noun (الاسم) from the parts of speech (أقسام الكلام) by citing of example.

iv. Write the importance of Arabic Language in modern age.

v. Write down the Sun Letters and Moon Letters in Arabic separately.

vi. How to identify Definite Noun (المعرفة) Write any five with example.

vii. Draw a pen picture with Pronouns of Arabic (الضمائر)

Examinations 2022-2023

Autumn (Odd) Semester

PG Programme

Course Code I.. - - - -

Course Title: Compulsory Islamic Studies

Answer Any Four Question :

5x4=20

1. Write a short note about the life of the Prophet Muhammad (PBUH).
2. What is the definition of Tawheed and its types? Describe it.
3. Discuss about the five daily prayers.
4. What is the Concept of "Risalah" (Prophethood) in Islam? Explain it.
5. Describe the significance of Zakat.
6. Write a short note about Roja (Fasting).

