34 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - RF and Microwave Engineering *(EX752)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary figures and Chart are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Design a single short and open-circuited shunt matching network for a transmission line using Smith Chart by considering an output reflection coefficient $\Gamma_L = 0.5\angle 51°$ Ohm and surge impedance $Z_0 = 50$ Ohm. [8]
2. Indentify and explain the properties of a microwave passive device having following S-Matrix. [8]

$$\begin{bmatrix} S_{11} & S_{12} & S_{13} & S_{14} \\ S_{21} & S_{22} & S_{13} & -S_{14} \\ S_{13} & S_{13} & 0 & 0 \\ S_{14} & -S_{14} & 0 & 0 \end{bmatrix}$$

3. Sketch a flowchart for designing a microwave amplifier using a GaAsFET. Consider the following S-parameters and find maximum gain for both bilateral and unilateral model. Also using the calculated value of Γ_{in} and Γ_{out} trace Z_{in} and Z_{out} in the smith chart. [4+4+4+4]

$$[S] = \begin{bmatrix} 0.656\angle 146.7° & 0.122\angle 46.1° \\ 2.30\angle 44.7° & 0.172\angle -117.1° \end{bmatrix}$$

4. Synthesize stability parameters of input matching network for the attached sketched smith chart. [8]
5. Choose a proper microwave measurement tool to test an antenna as a DUT; and explain its working principles. [8]
6. Explain in detail the designing steps of microwave filters. Illustrate an example of passive HPF using microstrips. [6+4]
7. Express field equations of a rectangular waveguide for TM mode. [10]
8. Write short notes on: (any two) [6×2]
   i) Effect of SAR as microwave radiation hazards
   ii) Features of microwave frequency band
   iii) Backward Wave Oscillator
   iv) Microwave Cavity Resonators

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$$K = \frac{1+|\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}.$$

$$\Delta = (S_{11}S_{22}) - (S_{12}S_{21}),$$

$$\mu = \frac{1-|S_{11}|^2}{|S_{22} - \Delta S_{11}^*| + |S_{21}S_{12}|}$$

$$\Gamma_S = \frac{B_1 \pm \sqrt{B_1^2 - 4|C_1|^2}}{2C_1},$$

$$\Gamma_L = \frac{B_2 \pm \sqrt{B_2^2 - 4|C_2|^2}}{2C_2}, \text{ where}$$

$$B_1 = 1+|S_{11}|^2 - |S_{22}|^2 - |\Delta|^2,$$

$$B_2 = 1+|S_{22}|^2 - |S_{11}|^2 - |\Delta|^2,$$

$$C_1 = S_{11} - \Delta S_{22}^*, \text{ and}$$

$$C_2 = S_{22} - \Delta S_{11}^*$$

$$C_L = \frac{(S_{22} - \Delta S_{11}^*)^*}{|S_{22}|^2 - |\Delta|^2}$$

$$C_S = \frac{(S_{11} - \Delta S_{22}^*)^*}{|S_{11}|^2 - |\Delta|^2}$$

$$R_L = \frac{|S_{12}S_{21}|}{|S_{22}|^2 - |\Delta|^2}$$

$$R_S = \frac{|S_{12}S_{21}|}{|S_{11}|^2 - |\Delta|^2}$$

$$G_{Tmax} = \left(\frac{1}{|1-S_{11}\Gamma_S|^2}\right)|S_{21}|^2\left(\frac{1-|\Gamma_L|^2}{|1-S_{22}\Gamma_L|^2}\right)$$

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Digital Signal Processing *(EX753)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *The figures in the margin indicate <u>Full Marks</u>.*
- ✓ *Assume suitable data if necessary.*

1. What are the basic elements of Digital Signal Processing (DSP) system? Explain Analog to Digital conversion process in brief. [3+4]
2. Define recursive and non recursive system with the suitable examples. State the condition for the stability and causality of LTI system in terms of ROC and pole zero. [3+3]
3. Impulse response of an LTI system is given as $h(n) = \{2,2,-1,1\}$. Find the output $y(n)$ of the system to an input $x(n) = \{1,2,1,2\}$. [6]
4. Define Z-transform. How is it related to DTFT? Explain scaling property of Z-transform with suitable example. [3+3]
5. Find the inverse Z-transform of $X(z) = (2z^3 + 2z^2 + 3z + 5) / (z^2 - 0.1z - 0.2)$, ROC: $|z| < 0.4$ [5]
6. Discuss the computational efficiency of FFT algorithm. Find DFT of a sequence given a $x[n] = \{1,1,0,0,0\}$ using DIT FFT algorithm. [2+5]
7. What is zero padding? Find the linear convolution through circular convolution with padding of zeros for the following sequence: $x[n] = \{-1,1\}$ and $h[n] = \{2,3,1,-2\}$. [2+6]
8. Write short notes on: [2+2]
   i) IIR filter
   ii) Kaiser window
9. Draw lattice-ladder structure for given IIR system. [5+1]

   $H(z) = (0.62 + 0.42z^{-1} - 0.25z^{-2}) / (1 + 0.27z^{-1} + 0.06z^{-2} - 0.75z^{-3})$

   Also check the stability of given system.
10. Design a digital low-pass filter with the following specification: [9]
    i) Pass-band magnitude characteristics constant to 0.7 dB below the frequency of 0.15π
    ii) Stop-band attenuation of at least 14 dB for the frequencies between 0.6π to π.

    Use Butterworth approximation as a prototype and use bilinear transformation method to obtain the digital filter.
11. Why Remez exchange algorithm is required? Describe Remez exchange algorithm with a flow chart. [5]
12. What is Gibb's phenomena? Explain how it occurs while designing FIR filter based on windowing technique. How can it be minimized? [1+4]
13. What are the various DSP processor chips? Explain Bit-Serial implementation in DSP architecture. Why is it used? [2+4]

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV/ II	Time	3 hrs.

Subject: - Wireless Communication *(EX751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt All questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. Compare and contrast the first, second, third and forth generation of mobile communication standards in terms of technology advancement. [6]
2. a. Why does minimizing reuse distance maximize spectral efficiency of a cellular system? [4]
   b. For a seven cell reuse pattern, find the minimum distance between centers of co-channel cells. Area of each cell is uniform and is equal to 23 square km. [4]
3. Estimate the feasibility of a 10-km wireless link in suburban area, with one access point and one client radio, using Okumura model for path loss. The median attenuation value is 20 dB and gain due to environment is 13 dB. The height of access point antenna is 100 m and that of client antennal is 10 m: [12]
   a. Access point is connected to antenna with 5-dBi gain, with a transmitting power of 20-dBm and a receive sensitivity of –80-dBm
   b. Client is connected to antenna with 20-dBi gain, with a transmitting power of 15-dBm and a receive sensitivity of –75-dBm
   c. Cables in both systems are short, with a loss of 3-dB at each side at 2.4-GHz frequency of operation.
4. What is known as scattering? Derive an expression for two ray ground reflected model. [2+8]
5. Explain the operation of OFDM with an appropriate block diagram. [8]
6. Why is there a need to implement diversity? Describe the various diversity combining techniques. [4+6]
7. Describe the operation of any two source coders used in speech coding. [6]
8. Explain the principle of Frequency Hopping Multiple Access. Briefly describe two hybrid spectrum multiple access technique which can mitigate near-far problem. [4+6]
9. Write short notes on any two: [5+5]
   a. Specifications of GSM.
   b. Regulatory issues
   c. Convolutional encoding and decoding

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Exam.	Regular		
Level	BE	Full Marks	40
Programme	BCE, BME, BEL, BEX, BCT, BGE,B.Agri.	Pass Marks	16
Year / Part	IV / II	Time	1 ½ hrs.

Subject: - Engineering Professional Practice *(CE752)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. (a) Write down in brief the Characteristics Features of Society. What are the elements of Community. (5)

   (b) What are the duties and Liability of an Engineer and Architect? (5)

2. (a) What do you understand by Negligence, Tort and Liability. What are the elements of Negligence. (5)

   (b) Define Ethics. What is moral and non-moral action? Write briefly the perspectives of Professional ethics. (5)

(3) (a) What are the methods of recruitment of consultant. Explain the purpose of **EOI and RFP.** (5)

   (b) Define Contract. What are the "essentials elements in the Valid Contract? (5)

(4) A RCC Bridge was designed by the Designer on behalf of Consultant. This was Constructed by the reputed "A" Class contractor. After the Completion of the Construction, traffic was allowd on the bridge. After Six Months of operation there were crack in the Bridge. A Probe Team was established by Road department. The Design Procedure was Okay, but it was found that quality of steel material used was not duly tested. The Contractor argued that the procedure of construction was in accordance with the instruction of Engineer and specification. There was also lack of proper supervision by the Consultant. The Design load for the Bridge was 20 tons. It was also reported that there happen to pass more than 20 tons vehicles also. The Consultant was good friend of Contractor. Being a member of Probe Team, what is your judgment on the failure of this bridge? (10)

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Wireless Communication *(EX 751)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Briefly describe the evolution of wireless communications from second to third generation. [4]
2. a) Explain how cell splitting and sectoring improve coverage and capacity in cellular system? [5]
   b) What is cell dragging? How is hand off processed in cellular system? [2+4]
3. a) Explain in brief the three basic radio wave propagation mechanisms. [3]
   b) Determine the propagation path loss for a radio signal 900 MHz cellular system operating in a large urban city, with a base station transmitter antenna height of 100 m and mobile receiver antenna height of 2m. The mobile unit is located at a distance of 4 km. Use the Hata propagation path loss model. [7]

   (Hints: $L_{50} = 69.55 + 26.16\log f_c - 13.82 \log h_t - \alpha(h_r) + (44.9 - 6.55 \log h_t)\log d$
   $\alpha(h_r) = (1.1\log f_c - 0.7)h_r - (1.56\log f_c - 0.8)$ Small to Medium City
   $8.29(\log 1.54h_r)^2 - 1.1$ (Large City ($f_c \leq 300$MHz)
   $3.2(\log 11.75h_r)^2 - 4.97$ (Large City ($f_c > 300$MHz)
4. Explain QPSK modulation with its appropriate equation, constellation diagram. [7]
5. a) Why equalization is needed in wireless communication? Explain training and tracking modes of operation for adaptive equalizers in detail. [1+3]
   b) What is a RAKE receiver and how it exploits the concept of time diversity? [3]
6. a) With the help of a block diagram explain the operation of a vocoder. [4]
   b) Briefly explain the types frequency domain coding of speech. [4]
7. a) What are the advantages of CDMA cellular system over TDMA cellular system? [4]
   b) With a neat block diagram, explain the operation of Frequency Hopping Spread Spectrum. [4]
8. a) Explain the operation of Network Switching Subsystem in GSM architecture. [4]
   b) With an appropriate block diagram explain pilot and sync channels in IS-95 forward link. [6]
9. Write short notes on: (any three) [3×5]
   a) Rayleigh and Ricean fading distribution
   b) Regulatory issues related to spectral licensing
   c) Viterbi decoding
   d) GSM System Architecture

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3 TRIBHUVAN UNIVERSITY
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Exam.	Regular		
Level	BE	Full Marks	40
Programme	All (Except B.Arch.)	Pass Marks	16
Year / Part	IV / II	Time	1 ½ hrs.

Subject: - Engineering Professional Practice *(CE752)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) What are the major activities to be governed by the society for its survival? Illustrate the impacts of computer on Nepalese society. [4]
   b) Explain how individual freedom balances societal goals. [4]
2. a) What do you mean by Profession? Explain its characteristics. [4]
   b) What is ethics? Write in short the code of ethics for engineering profession. [4]
3. a) What are the preparations to be made before inviting competitive bidding notice? How the contract can be interpreted in case of ambiguity? Define percentage contract and in which category of procurement, this form of contract is adopted? [4]
   b) What is intellectual property right? Write in briefly the working hour provision of labour law. Differentiate between public and private company. [4]
4. a) Explain business law and labour law in Nepal. [4]
   b) Explain globalization and cross cultural issues. [4]
5. Write short notes on: (Any four) [2×4]
   a) Jurisdiction of Nepal Engineering Council
   b) Job description of fresh graduates
   c) Detailed duties and liabilities of an engineer and architect
   d) Nepal Engineers Association
   e) Society and development

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - Digital Signal Processing *(EX 753)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Explain the general application areas of digital Signal Processing. Consider a continuous time signal x(t) = sin2000πt+ 5cos12000πt+ 10sin 6000πt.
   a) What is the discrete time signal obtained after sampling the signal at a sampling rate of 5000 samples per second for $0 \le n \le 3$? [3+4]
2. Define causal and stable system with examples. [3]
3. Find a convolution between two signals x[n] and h[n] where,
$$x[n]=\begin{cases}1 & 0\le n\le 4\\ 0 & \text{otherwise}\end{cases} \text{ and } h[n]=\begin{cases}a^n & 0\le n\le 6\\ 0 & \text{otherwise}\end{cases} \quad (a>1).$$ [8]
4. Using long division determine the inverse Z-transform of,
$$X(z)=\frac{1}{1-\left(\frac{3}{2}\right)z^{-1}+\left(\frac{1}{2}\right)z^{-2}} \text{ when, ROC : } |Z|>1 \text{ and ROC: } |Z|<\frac{1}{2}$$ [6]
5. Define ROC. Explain the properties of ROC with suitable examples. [1+4]
6. Why we need a DFT? Find 8-point DFT of sequence x[n] = {1,0,2,0,-1,1,1} using Decimation in Time Fast Fourier Transform (DITFFT) algorithm. [1+6]
7. State Multiplication of two DFTs property of DFT. Find $x_3[n]$ if DFT of $x_3[n]$ is given by $X_3(k) = X_1(k)X_2(k)$ where $X_1(k)$ and $X_2(k)$ are 5-point DFT of $x_1[n] = \{1,2,3,-1,5\}$ and $x_2[n] = \{2,1,-3\}$ respectively. [1+5]
8. For a system with poles at 0.45±j1.06 and zero at 0.58±j2.06. Plot the location of poles and zeroes in the z-plane and also plot the magnitude response of the system. [8]
9. Convert the following filter into a lattice ladder structure.
   $H(z) = 1+2z^{-1}+2z^{-2}+z^{-3}$ [6]
10. Design a low pass digital filter by Bilinear Transformation method to an approximate Butterworth filter, if passband edge frequency is 0.25π radians and maximum deviation of 0.99 dB below 0 dB gain in the passband. The maximum gain of -14.85 dB and frequency is 0.59π radians in stopband, Consider sampling frequency 0.5 Hz. [11]
11. List out the key points of windowing and design the symmetric FIR low pass filter for which desired frequency response is expressed as
$$H_d(\omega)=\begin{cases}e^{-j\omega\tau} & \text{for} |\omega|\le\omega_c\\ 0 & \text{elsewhere}\end{cases}$$
The length of the filter should be 7 and ωc = 1 radians/sample. Use Hanning window as a prototype. [2+7]
12. Explain a bit serial adder implementation in Digital Signal Processor. [4]

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

Subject: - RF and Microwave Engineering *(EX752)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ ***Necessary formula, graph and figures are attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. Classify signal frequency in different bands of waves and rays. What are the advantages and disadvantages of using microwave signal? [3+5]
2. By assuming a complex inductive load of an antenna which is mismatched with the line impedance of 78.0 ohm, design a double-stub short-circuited matching network. Show both electrical and physical connections. [8+2]
3. Why S-parameter is important in microwave network analysis? Write down the properties of a 3-port network. [4+4]
4. Suppose there are two identical radar transmitters and few passive devices in equipment stock. A particular application requires twice more input power to an antenna than either transmitter can deliver. As a RF engineer, give your appropriate solution for the above problem with necessary figures, mathematics and sufficient explanation. [8]
5. What do you mean by slow backward wave structure? Explain the construction and working principle of a LNA. [2+6]
6. Show a flow diagram that explain designing of an amplifier using a FET transistor. With self-defined parameters and the help of a smith chart define conditional stability of a microwave amplifier. [10]
7. Justify and describe how a microwave filter is designed using insertion loss method. [2+6]
8. Define major microwave measurement parameters and explain the working principle of a low microwave power measurement device. [8]
9. Write short notes on: (any two) [2×6]
   a) RF/MW radiation hazards and safety practices
   b) Directional Couplers
   c) TE mode circular wave guide

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Supplied Formulas:

$$\frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{12}||S_{21}|}$$

$$\Delta = (S_{11}S_{22} - S_{12}S_{21})$$

$$\mu = \frac{1 - |S_{11}|^2}{|S_{22} - \Delta S^*_{11}| + |S_{21}S_{12}|}$$

$$\Gamma_S = \frac{B_1 \pm \sqrt{B_1^2 - 4|C_1|^2}}{2C_1}$$

$$\Gamma_L = \frac{B_2 \pm \sqrt{B_2^2 - 4|C_2|^2}}{2C_2}$$

Where, $B_1 = 1 + |S_{11}|^2 - |S_{22}|^2 - |\Delta|^2$

$B_2 = 1 + |S_{22}|^2 - |S_{11}|^2 - |\Delta|^2$

$C_1 = S_{11} - \Delta S^*_{22}$

$C_2 = S_{22} - \Delta S^*_{11}$

$$C_2 = \frac{(S_{22} - \Delta S^*_{11})}{|S_{22}|^2 - |\Delta|^2}$$

$$\frac{(S_{11} - \Delta S^*_{22})}{|S_{11}|^2 - |\Delta|^2}$$

$$R_L = \frac{|S_{12}S_{21}|}{|S_{22}|^2 - |\Delta|^2}$$

$$R_S = \frac{|S_{12}S_{21}|}{|S_{11}|^2 - |\Delta|^2}$$

$$G_{max} = \left(\frac{1}{1 - |\Gamma_S|^2}\right)|S_{21}|^2\left(\frac{1 - |\Gamma_L|^2}{|1 - S_{22}\Gamma_L|^2}\right)$$

For unilateral mode $S_{12} = 0$, $\Gamma_S = S^*_{11}$ and $\Gamma_L = S^*_{22}$