2014-15
B.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
RF SYSTEM DESIGN
EL-410

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

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<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
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| 1(a)  | i) Briefly explain how roaming improves as wireless services upgrades from 2G to 4G.  
     ii) Compare the performances of TDMA, CDMA and OFDMA techniques. | [2½]  
| 1(b)  | What is a cognitive radio (CR)? What makes it more adaptive as compared to software defined radio (SDR)? Explain. | [5]  
| 1(c)  | There are various competing rf technologies (see Fig. 1) to realize the goal of a Global Information Multimedia Village (GIMV). Which one do you think provide more cost effective solution? | [5]  

![Diagram](Diagram.png)

OR

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| 1'(a) | i) Can anybody covertly read out the information stored on electronic tags? Explain.  
     ii) 2G and 3G communications are centred around 900MHz and 2GHz frequency bands, respectively. Compare the two bands in terms of data rate and coverage area. | [2½]  
| 1'(b) | A national level company with 2000 employees utilizes GSM technology to broadcast messages to their employees. What could be an alternative wireless solution if their employees are located in the same city? Use appropriate figure (s) to illustrate your understanding. | [5]  

Contd...
1'(c) What are image-reject receivers? Use relevant theory to justify why image filter is not required in this kind of receiver. [5]

2(a) Why power Amplifier (PA) is crucial block of transmitter? The major noise in a radio transmitter arises from its mixer and ensuing amplifier i.e. PA. If the mixer has a noise figure of 10 dB and the amplifier a noise figure of 8 dB. Calculate the overall noise figure if amplifier gain is 14 dB. [5]

2(b) Enumerate the role of negative resistance in design of radio frequency oscillator. Draw the circuit diagram of a common source Colpitts Oscillator. Derive its frequency of oscillation if MOSFET capacitances i.e. C_{GS}, C_{GD} and C_{DS} are not neglected. [5]

2(c) How port isolation in mixer can be improved? An input signal of frequency \( f_I \) is applied to MOSFET square law mixer along with a local oscillator (LO) at \( f_0 \) as shown in Fig. 2. Calculate and sketch the spectrum at the output of the mixer. [5]

(OR)

2'(a) Why CMOS technology is considered suitable for PCS applications? Derive expression for \( Z_{IN} \) for circuit shown in Fig. 3. Assume MOSFET is modeled by parameters \( g_m, C_{GS} \) & \( C_{DS}. \) Neglect all other parameters. [5]

2'(b) What is a low noise amplifier (LNA). Make use of appropriate analytical expression to explain that LNA used in the receiver (see Fig. 4) is a critical block. [5]
2'(c) Show that the conversion gain \( G_C \) in double balanced MOS mixer can be expressed as:

\[
G_C = \left( \frac{4}{\pi} \right) g_m R
\]

Where \( g_m \) = transconductance of the MOSFET and \( R \) = drain load resistance

3(a) What do you mean by radio frequency (rf) model? Enumerate various steps involved to develop such model.

3(b) Fig. 5 shows the rf model of the MOSFET operating in linear region with \( V_{DS} = 0 \). Give the physical origin of the parasitic resistance \( R_G \) used in the model.

![Diagram of MOSFET model](image)

Fig. 5

Carry out \( y \)-parameter analysis of the model to show that:

(i) \[ R_G = \frac{\text{Re}\{Y_{11}\}}{\text{Im}\{Y_{11}\} \times \text{Im}\{Y_{12}\}} \]

(ii) \[ R_D = \frac{\text{Re}\{Y_{21}\} - \text{Re}\{Y_{12}\}}{\text{Im}\{Y_{12}\}^2} \]

4(a) Give design flow of power amplifier (PA) and briefly explain the various steps involved.

4(b) Differentiate between the power match and the noise match. Is it possible to achieve both type of matches in radio circuit design? Explain.
What is the effect of $C_{GD}$ on input impedance-matching of common source LNA?

Show that $\text{Re}[Z_{IN}]$ for the model shown in Fig. 6 can be expressed as:

$$\text{Re}[Z_{IN}] = \frac{(g_m/C_{GS})L_s}{1 + 2(C_{GD}/C_{GS})}$$
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Answer any FOUR questions.
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<tr>
<td>1(a)</td>
<td>Discuss the realization of (i) Switch and (ii) Floating Resistor using MOS transistor(s).</td>
<td>[8]</td>
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<td>1(b)</td>
<td>Perform small signal analysis of active loaded common source amplifier to find gain and bandwidth.</td>
<td>[7]</td>
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<tr>
<td>2(a)</td>
<td>Discuss in detail the design of two stage CMOS operational amplifier.</td>
<td>[10]</td>
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<tr>
<td>2(b)</td>
<td>Design a differential input current amplifier circuit with a gain of 1.8.</td>
<td>[5]</td>
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<tr>
<td>3(a)</td>
<td>Show the Analog IC design process by means of a flow diagram explaining each step.</td>
<td>[8]</td>
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<tr>
<td>3(b)</td>
<td>What is bandgap reference? Design its circuit.</td>
<td>[7]</td>
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<tr>
<td>4(a)</td>
<td>How can parasitic insensitive switched-capacitor integrator be realized? Design the circuit for a</td>
<td>[5]</td>
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<tr>
<td></td>
<td>time constant 0.1ms.</td>
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<tr>
<td>4(b)</td>
<td>Realize a switched capacitor amplifier for a gain of 10.</td>
<td>[5]</td>
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<tr>
<td>4(e)</td>
<td>Analyze the cascode current mirror for output resistance.</td>
<td>[5]</td>
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<tr>
<td>5</td>
<td>Write detailed technical notes on Field Programmable Analog Arrays.</td>
<td>[15]</td>
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<tr>
<td>6(a)</td>
<td>Define Substrate Coupling.</td>
<td>[3]</td>
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<tr>
<td>6(b)</td>
<td>What is unit matching principle?</td>
<td>[3]</td>
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<tr>
<td>6(e)</td>
<td>What is Common Centroid layout technique?</td>
<td>[3]</td>
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<tr>
<td>6(d)</td>
<td>What is the need of multifinger transistor?</td>
<td>[3]</td>
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<tr>
<td>6(e)</td>
<td>What are the problems of laying a CS amplifier near a NAND gate?</td>
<td>[3]</td>
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2014 – 2015
B Tech (Winter Semester) Examination
(Electronics Engineering)
Digital System Design
EL – 415
Credits: 4

Maximum Marks: 60

Duration: Three Hours

Notes:
1. Answer all questions.
2. Make suitable assumptions wherever necessary.

1 (a) Write a Verilog code and a testbench for an (8x8) stack (LIFO). Assume the signals required for its implementation.

OR

1' (a) Write a Verilog code and a testbench of a (8x8) RAM with three asynchronous 8-bit read ports and one synchronous write port. Assume the signals required for its implementation.

1 (b) What is triangular optimization? Explain the different optimized parameters.

1 (c) Write a Verilog Code of a 4 bit by 4-bit multiplier using successive addition.

2. (a) Realize the following function with the help of logic cells shown in Figure 1 and Figure 2

\[ F(x, y, z) = \Sigma(1, 2, 4, 7) \]

2. (b) Why is a PAL preferred over a PROM in a PLD? Justify your answer.

2. (c) Draw an architectural block diagram of a system that implements the following function by using an optimum number of processors that consist of a multiplier and an adder. Also find out the number of clock cycles needed to compute the result.

\[ P_7(x) = \sum_{i=0}^{7} P x^i \]

contd... 2
3 (a) Write a microprogram to compute $Y = 4(A-B)$ for the data subsystem shown in Figure 3. Assume that the ALU supports only ADD, SUB and XOR operations and only one byte of input vector is to be loaded at a time.

OR

3' (a) Write a microprogram to compute $Y = 8(A+B)$ for the data subsystem shown in Figure 3, where 'A' and 'B' are 8-bit vectors and 'Y' is also of 8-bits. Assume that the ALU supports only ADD, AND and INC operations and only one byte of input vector is to be loaded at a time.

3. (b) Explain the different steps required to implement a design in a field programmable gate array with the help of a block diagram.

4. Design a micro-programmed control unit for the RISC-SPM shown in Figure 4. The processor supports only ADD, SUB, NOT and RD operations. Make suitable assumptions.

OR

4' (a) Write a Verilog code for the data subsystem of the RISC-SPM shown in Figure 4.

4' (b) Write the FSM for the control unit of a RISC-SPM by assuming that it only supports ADD and NOT instructions.
2014-15
B.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
FIBER OPTIC COMMUNICATION
EL-456

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.  Question  M.M.

1(a). Using simple ray theory, describe the mechanism for the transmission of light within an optical fiber. Briefly discuss with the aid of a suitable diagram what is meant by the acceptance angle for an optical fiber. Show how this is related to the fiber numerical aperture and the refractive indices for the fiber core and cladding. An optical fiber has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Determine:

(i) the acceptance angle for the fiber in water which has a refractive index of 1.33.

(ii) the critical angle at the core-cladding interface.

Comment on any assumptions made about the fiber.

1(b). Briefly discuss, with suitable diagrams: (i) mode coupling (ii) W-fibers.

1(c). The material dispersion in an optical fiber defined by \( |d^2n_1/d\lambda^2| \) is \( 4.0 \times 10^{-2} \mu \text{m}^{-2} \).

Estimate the pulse broadening per kilometer due to material dispersion within the fiber when it is illuminated with an LED source with a peak wavelength of 0.9 \( \mu \text{m} \) and an rms spectral width of 45 \( \text{nm} \).

OR

1'(a). Describe the techniques employed and the fiber structures utilized to provide:

(a) dispersion-shifted single-mode fibers

(b) dispersion-flattened single-mode fibers

1'(b). Briefly explain the reasons for pulse broadening due to material dispersion in optical
fibers. Derive an expression for the rms pulse broadening due to material dispersion in an optical fiber and define the material dispersion parameter. The material dispersion parameter for a glass fiber is 20 ps nm\(^{-1}\) km\(^{-1}\) at a wavelength of 1.5 μm. Estimate the pulse broadening due to material dispersion within the fiber when light is launched from an injection laser source with a peak wavelength of 1.5 μm and an rms spectral width of 2 nm into a 30 km length of the fiber.

1(c). A graded index fiber with a parabolic index profile supports the propagation of 742 guided modes. The fiber has a numerical aperture in air of 0.3 and a core diameter of 70 μm. Determine the wavelength of the light propagating in the fiber. Further estimate the maximum diameter of the fiber which gives single-mode operation at the same wavelength.

2(a). Compare stimulated Brillouin and stimulated Raman scattering in optical fibers, and indicate the way in which they may be avoided in optical fiber communications.

**OR**

2(a'). Discuss about the Rayleigh and Mie scattering in context with optical fiber communication.

2(b). A 15 km optical fiber link uses fiber with a loss of 1.5 dB km\(^{-1}\). The fiber is joined every kilometer with connectors which give an attenuation of 0.8 dB each. Determine the minimum mean optical power which must be launched into the fiber in order to maintain a mean optical power level of 0.3 μW at the detector.

2 (c). What are the different subcarrier intensity modulation techniques used in fiber optic communication. Explain any one of them with suitable diagrams.

2(d). What are the different types of amplifiers used in optical fiber communication system? Discuss briefly.

3(a). Discuss about the detection technique that is being employed for PSK modulation. Give clear diagrams.

3(b). Obtain the receiver sensitivity of FSK optical fiber coherent detection system.

3(c). Outline the major practical constraints associated with coherent optical transmission.
and discuss the techniques which have been adopted to overcome them.

4(a). What is "OFDM"? Explain.

4(b). Compare Coarse WDM and Dense WDM techniques.

4(c). Discuss about the performance of different topologies used in distribution system of optical fiber communication.

OR

4(c'). Write a brief note on SONET/SDH.
B.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
MOBILE COMMUNICATION
EL 457

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q. No.  

1(a) Consider a cellular system with hexagonal cells of radius \( R = 1 \) Km. Suppose the minimum distance between cell centers using the same frequency must be \( D = 6 \) Km to maintain required signal-to-interference ratio. Find the required reuse factor \( N \) and the number of cells per cluster.

1(b) How sectorization helps to improve the capacity of a cellular system?

1(c) How interferences in a cellular system can be reduced by power management and channel assignment?

1(d) How dynamic channel allocation facilitates soft handoff in a TDMA system?

1(e) Why cell splitting is a complicated process in TDMA system compared to CDMA system?

2(a) In a wireless system, the received power at a reference distance \( d_0 = 1 \) Km is 1 microwatt, \( f = 1800 \) MHz, \( h_T = 40 \) m, \( h_r = 3 \) m, \( G_t = G_r = 0 \) dB. Determine the pathloss (in \( dB \)) at a distance of 3 Km using two-ray ground reflection model.

2(b) Give the expressions for impulse response of a NB and WB wireless channels.

2(c) In a mobile system, channel estimation is performed every 4.615 ms. If the carrier frequency is 900 MHz, determine the approximate mobile velocity for which system will work satisfactorily.

Contd...2.
2(d) What is the approximate cell size if maximum delay spread in the system is 100 microsecond?

2(e) The power delay profile in a particular environment is found to have two components occurring at 0 and 1 microsecond with power level of 0 dB each. If QPSK modulation is used, what is the maximum bitrate that can be sent through the channel without needing an equalizer?

OR

2'(a) What is the pathloss (in dB) in free space of a signal whose transmit power is 1W and carrier frequency is 2.4 GHz if the receiver is at a distance of 1.6 km from the transmitter? Assume that the transmitter and receiver antenna gains are 1.6 and the reference distance is 1 meter.

2'(b) What is the reason for time variation in the wireless channel? What parameters characterize time variation?

2'(c) Drive a formula for the power outage probability of Rayleigh faded signal. Assume an application that requires a power outage probability of 10% for the threshold \( P_0 = -80 \text{ dBm} \). What value of the average signal power is required?

2'(d) Show that the significant delay spread of wireless channel introduces frequency selective distortion.

3(a) Determine the necessary SNR (in dB), in order to detect BPSK signal with an average BER of \( 10^{-5} \) for a Rayleigh fading channel.

3(b) Consider a 2-path diversity system with channel gains

\[ h_1 = \left[ 1/\sqrt{2} + j1/\sqrt{2} \right] \quad \text{and} \quad h_2 = \left[ 1/\sqrt{2} - j1/\sqrt{2} \right] \]

Find the optimal weights for maximal ratio combining. Also, find the SNR at the combiner output.

3(c) Consider an OFDM system with total passband bandwidth \( B = 1 \text{ MHz} \). The channel

Contd....3.
has a maximum delay spread of $T_m = 5 \mu s$. Assume an OFDM system with 16QAM modulation applied to each subchannel. To keep the overhead small, the OFDM system uses $N = 128$ subcarriers to mitigate ISI. The length of the cyclic prefix is set to $\mu = 8$ to insure no ISI between OFDM symbols. For these parameters, find the subchannel bandwidth, the total transmission time associated with each OFDM symbol, the overhead of the cyclic prefix, and the data rate of the system.

3(d) What are the advantages and disadvantages of CDMA access techniques for mobile system?

4(a) Show that the GSM system allocates gross RF data rate of 33.854 kbps/user.

4(b) Discuss briefly different common and dedicated channels in GSM system.

4(c) Discuss how low activity speech period is utilized to save mobile power as well as interference reduction in the reverse link of IS-95 system?

4(d) How orthogonal and long PN codes are used in the forward and reverse links of IS-95 system?

**OR**

4'(a) Compute the frame efficiency of GSM system.

4'(b) Discuss briefly the interleaving used in GSM system.

4'(c) The IS-95 system uses a rate 1/2 convolution encoding in the forward channel and a rate 1/3 convolution coding in the reverse channel. What were the reasons for doing so?

4'(d) Discuss briefly the main features of 3G and 4G systems.