1. Each part of the question requires a brief explanation and/or figure(s) where appropriate to illustrate your understanding.

   i) What do you mean by Global Information Multimedia Communication Village? Suggest the possible cost effective rf solution to realize such village?

   ii) Suggest suitable rf technology that can be used to automate the toll collection at the Yamuna Expressway.

   iii) Make a comparison between 40 GHz and 60 GHz wireless PANs. Briefly discuss the devices required for their design.

1'. Each part of the question requires a brief explanation and/or figure(s) where appropriate to illustrate your understanding.

   i) What is VELCRO approach to design multi-mode radio? How it is different from re-configurable software defined radio?

   ii) Differentiate between 3rd generation 3G and 4th generation 4G wireless systems. Give brief comments on their use in India.

   iii) Why RFID technology is mostly operated in LF band? State the potential disadvantages of using this technology in rf/microwave band?

2(a) What is a low noise amplifier (LNA)? Make use of an appropriate analytical expression to explain that LNA is the crucial block of radio receiver.

2(b) Determine input impedance \( Z_{IN} \) of the circuit shown in Fig. 1. Ignore parasitic effect and assume MOSFET \( M_1 \) is modeled by ONLY \( g_m \) and \( C_{GS} \).

2(c) Give brief answer to the followings:
   (i) CG LNA is noisier than CS LNA. Explain.
   (ii) PAs used in personal wireless system are mostly operated in class AB. Explain.
2' (a) What are the various oscillator's characteristics required for cell phone radio? Derive an expression for the frequency of oscillation for the circuit shown in Fig. 2. State the assumptions if any.

![Fig. 1]

![Fig. 2]

2' (b) Explain the following terms in context with a mixer:
   i) Conversion gain;
   ii) Port Isolation.

2' (c) Make a comparison between nano-scale CMOS and HEMT device technologies. Explain why GaAs is not preferred for personal wireless circuit design.

3(a) Enumerate the various steps involved to develop rf models. Explain how it is different from analog models.

3(b) Carry out small-signal analysis of the model (see Fig. 3) to show that

\[
C_m = \frac{\text{Im}(Y_{21})}{\omega} - g_m R_G (C_{GS} + C_{GD}) - C_{GD}
\]

![Fig. 3]

3(c) State the physical origin of \( R_{OS} \) in the model shown in Fig. 4. Carry out \( y \)-parameter analysis of the model to show that

\[
R_{os} = -\frac{\text{Re}(Y_{12})}{\omega^2 C_{GD}^2}
\]
<table>
<thead>
<tr>
<th>4(a)</th>
<th>Make use of noise theory to show that for state-of-art CMOS processes optimum device width, ( W_{\text{OPT}} ) in ( \mu m ) can be approximated as: ( 500/f ), where ( f ) is the frequency in GHz.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4(b)</td>
<td>Why efficiency of class E power amplifier (PA) is higher than class C amplifier? Design a class E power amplifier to deliver 1.5 W for 900MHz wireless system. Assume the supply voltage ( V_{dd} = 3.0 ) V and quality factor ( Q=15 ).</td>
</tr>
<tr>
<td>4(c)</td>
<td>Differentiate between the power match and the noise match. Can you think of a situation where it is possible to achieve both type of matches simultaneously?</td>
</tr>
</tbody>
</table>
2013-14  
B.TECH. EXAMINATION  
ELECTRONICS ENGINEERING  
ANALOG IC DESIGN  
EL-412

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Discuss the realization of (i) Switch and (ii) Resistor using MOS transistor(s).</td>
<td>[08]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Analyze an active loaded common source amplifier for gain and bandwidth, considering the parasitic capacitances of transistors.</td>
<td>[07]</td>
</tr>
<tr>
<td>2(a)</td>
<td>Explain the circuit of Figure 1, identify the various parasitic capacitances and calculate Slew-Rate if ( V_{DD} = 5 \text{V} ) and load capacitance at output node is 10pF.</td>
<td>[08]</td>
</tr>
</tbody>
</table>

![Figure 1](image)

| 2(b)  | Design a differential input current amplifier circuit with a gain of 2. | [07] |
| 3(a)  | Show the Analog IC design process by means of a flow diagram discussing each step in detail. | [09] |
| 3(b)  | How can capacitors be implemented in MOS technology? | [06] |

OR

| 3'(a) | Explain clearly the design of a two-stage CMOS opamp circuit and derive expressions for important parameters of the circuit. | [15] |
| 4(a)  | Write a detailed technical note on “Analog Layout Techniques.” | [15] |

OR

| 4'(a) | Write detailed technical notes on Field Programmable Analog Arrays | [15] |
2013-14
B.TECH. (WINTER) SEMESTER EXAMINATION
(ELECTRONICS ENGINEERING)
DIGITAL SYSTEM DESIGN
(EL-415)

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Write a Verilog Code and a testbench of a Digital System that computes the following expression: ( y(x) = 4x^3 + 4x^2 ), assume that 'x' is an 8-bit unsigned number. Suggest the changes required in case 'x' were a signed number.</td>
<td>[06]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Write a Verilog code of a stack memory with 8 locations each of 8-bits.</td>
<td>[05]</td>
</tr>
<tr>
<td>1(c)</td>
<td>What is the importance of an FPGA? Explain the FPGA design flow with the help of a block diagram.</td>
<td>[04]</td>
</tr>
<tr>
<td>2(a)</td>
<td>Which programmable implementation technology is most appropriate for the realization of fast control logic? Justify your answer.</td>
<td>[03]</td>
</tr>
<tr>
<td>2(b)</td>
<td>Realise the following function of four variables with the help of logic cells shown in Figure 1. ( F(w,x,y,z) = \sum(1,5,7,9,10,12,13,15) ) OR ( F(w,x,y,z) = \sum(1,3,6,7,10,11,14,15) )</td>
<td>[05]</td>
</tr>
<tr>
<td>2(b)'</td>
<td>Realise the following function of four variables with the help of logic cells shown in Figure 2.</td>
<td>[05]</td>
</tr>
<tr>
<td>2(c)</td>
<td>Explain the architecture that implements the following function by using optimum number of processors that consist of a multiplier and an adder. Also draw the architecture in case there is only a single multiplier and an adder. ( P_9(x) = \sum_{i=0}^{9} px^i )</td>
<td>[07]</td>
</tr>
</tbody>
</table>

Contd...
3(a) Design a micro-programmed control unit to count the number of 0's in a 16-bit input vector for the data subsystem shown in Figure 3. Assume that the ALU supports only ADD, SUB and XOR operations. The input to the data system is only one-byte long.

OR

3(a') Design a micro-programmed control unit to compute $Y = 4(a + b - c)$ for the data subsystem shown in Figure 3. Assume that the ALU supports only ADD, SUB and XOR operations. $Y$, $a$, $b$ and $c$ are of one byte only.

3(b) What is the importance of RTL description of a Digital System?

3(c) What is the difference between a CPLD and an FPGA?

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

4(b) Write a Verilog code of the control unit of the RISC-SPM of Figure 4 that supports only ADD, SUB and RD operations.

OR

4' Design a micro-programmed control unit of the RISC-SPM shown in Figure 4 that supports only NOT, ADD, SUB, RD, WR and BR operations. Also write its complete Verilog code.
Figure 3

Figure 4
2013-14
B.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
COMPUTER COMMUNICATION NETWORKS
EL-431N

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all questions.
Indicate clearly if any assumptions are made.
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>What are some of the possible services that a link-layer protocol can offer to the network layer? Which of these link-layer services have corresponding services in IP? In TCP?</td>
<td>[04]</td>
</tr>
</tbody>
</table>

OR

<table>
<thead>
<tr>
<th>1(a')</th>
<th>A 100 km long cable runs at T1 data rate. The propagation speed in the cable is 2/3 the speed of light in vacuum. How many bits fit in the cable?</th>
<th>[04]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(b)</td>
<td>Suppose a header consists of four 16-bit words: 11111111 11111111, 11111111 00000000, 11110000 11110000, 11000000 11000000. Find the Internet checksum for this code.</td>
<td>[04]</td>
</tr>
</tbody>
</table>

OR

<table>
<thead>
<tr>
<th>1(b')</th>
<th>Consider the PPP byte-stuffing method. What are the content of following received sequence of bytes after byte de-stuffing: 0x7D 0x5E 0xFE 0x24 0x7D 0x5D 0x7D 0x5D 0x62 0x7D 0x5E</th>
<th>[04]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(c)</td>
<td>Suppose that instead of Go-Back-N ARQ, N simultaneous Stop-and-wait ARQ processes are run in parallel over the same transmission channel. Each frame is assigned to one of the N processes that is currently idle. The processes that have frames to send take turns transmitting in round-robin fashion. The frames carry the binary send sequence number as well as an ID identifying which ARQ process is belong to. Acknowledgements for all ARQ processes are piggy backed onto every</td>
<td></td>
</tr>
</tbody>
</table>
frame.

(i). Quantitatively, compare the relative performance of this protocol with Go-Back-N ARQ and with Stop-and-wait ARQ. For simplicity, you may look at a sequence of N consecutive frames passing through the system, and compare different behaviours under these two protocols.

(ii). How does the service offered by this protocol differ from that of GO-Back-N ARQ.

2(a) The Ethernet standard specifies a minimum MAC frame size (there is a pad field in the 802.3 MAC frame to achieve this minimum size if the packet is too short). This is necessary because a node may not detect a possible collision before it completes its transmission of a very short packet. In a maximum size 10BaseT (10-Mbps, baseband, twist-pair) Ethernet, the longest propagation delay (including repeater delays) is 51.2 $\mu$s. The propagation speed in copper is approximately $2 \times 10^8$ m/s. Find the minimum frame size.

2(b) Use IEEE 802.3 and IEEE 802.11 to discuss three differences between wired and wireless LANs.

2(c) Explain the difference among non-persistent, 1-persistent and $p$-persistent CSMA. Show that the throughput of non-persistent CSMA is given by

$$S = \frac{Ge^{-ad}}{G(1+2a) + e^{-ad}},$$

where $G$ is the normalized offered load to the network and $a$ is the vulnerable period during which a transmitted packet can suffer a collision.

OR

2'(a) Consider a slotted ALOHA network where the attempt process is Poisson with rate $G$. Under the condition of maximum throughput, what is the fraction of empty, successful and collision slots?

2'(b) Suppose that a 1 MHz channel can support a 1 Mbps transmission rate. The channel is to be shared by 10 stations. Each station receives frames with exponential inter-arrivals and rate $\lambda=50$ frames/second, and frames are constant...
length L=1000 bits. Compare the total frame delay of a system that uses FDMA to a system that uses TDMA.

2'(c) Let \( \tilde{\eta}_1 \) and \( \tilde{\eta}_2 \) be independent Poisson random variables with rates \( \alpha \) and \( \beta \) respectively. Define \( \tilde{\eta} = \tilde{\eta}_1 + \tilde{\eta}_2 \). Show that \( \tilde{\eta} \) has the Poisson distribution with rate \( \alpha + \beta \).

3(a) What are different ways in which routing algorithms can be classified? Discuss them in brief.

3(b) With the help of an example explain the Bellman-Ford algorithm. Do you agree that the Bellman-Ford algorithm responds slowly to the reaction to link failure? What is meant by count-to-infinity problem? Discuss one possible solution for this problem.

OR

3(b') Consider the network shown in Fig. 1.

![Network diagram](image)

(i). Use the Dijkstra algorithm to find the set of shortest paths from node 4 to other nodes.

(ii). Find the set of associated routing table entries.

3(c) Explain how leaky bucket algorithm is used to perform traffic shaping.

4(a) Determine the classes of the following classful IP addresses:

(i) 208.34.54.12

(ii) 114.34.2.3

(iii) 238.34.2.1

(iv) 129.14.6.8

4(b) If you saw the following entries in a routing table: 54.210/16 and 54.211/16, is there a way to combine them. If yes, what would the alternative entry or entries look like?

4(c) Suppose a router receives an IP packet containing a payload of 600 bytes and has to forward the packet to a network with maximum transmission unit of 200 bytes. Assume the IP header is 20 bytes long. Show the fragments that are created and relevant values in head fragment header.

4(d) Explain the following terms in context of IPv4: CIDR and Supernetting.
# 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.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>What is the difference between Acceptance angle, Critical angle and Numerical aperture? A Step Index fiber has a core and cladding refractive index of 1.50 and 1.46 respectively. What is the value of Critical angle and Numerical aperture of the fiber.</td>
<td>[05]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Explain overall dispersion in single mode fiber. Compute the maximum dispersion for an optical fiber with refractive index of core = 1.46 and Δ = 0.03. The length of fiber is 5 km.</td>
<td>[05]</td>
</tr>
<tr>
<td>1(c)</td>
<td>What is attenuation? How it limits the performance of optical communication? Discuss the mechanism by which attenuation is caused in optical signal propagation along the fiber.</td>
<td>[05]</td>
</tr>
<tr>
<td>2(a)</td>
<td>Explain link power budget. A 5 km length optical fiber link has a fiber cable which has an attenuation of 4 db/km. The splices are 0.7 db/km and connector losses at the source and detector are 4 and 3.5. Considering no dispersion on the link, calculate the total channel loss.</td>
<td>[05]</td>
</tr>
</tbody>
</table>
| 2(b)  | Explain  
  (i) ASK, FSK, PSK modulation.  
  (ii) System design consideration for optical communication.                                                                                     | [05] |
| 2(c)  | Define Dispersion. What are the different types of dispersion management techniques? Explain any two.                                                                                                     | [05] |

OR

2'(a) What are the requirements of a photodetector? Calculate the efficiency of a PIN silicon photodiode if the responsivity is 0.374 A W⁻¹ at 1300 nm wavelength. | [05] |

2'(b) Using the Gaussian approximation, determine the required SNR (optical and electrical) to maintain a BER of 10⁻⁹ on a baseband binary digital optical fiber link. It may be assumed that Decision threshold is set midway between one and zero and that 2×10⁻⁹ =erfc 4.24. | [05] |
<table>
<thead>
<tr>
<th>Question</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'(c)</td>
<td>Give the major reasons which have led to the development of optical amplifiers, outlining the attributes and application areas for these devices. Explain each application areas with diagrams.</td>
</tr>
<tr>
<td>3(a)</td>
<td>What is Coherent Detection? How many kinds of coherent detection systems may be designed? Explain the advantages of Coherent detection system over Direct detection.</td>
</tr>
<tr>
<td>3(b)</td>
<td>Outline the major techniques employed to achieve non-synchronous optical ASK and FSK Heterodyne detection. Indicate the benefits of these schemes over the corresponding synchronous demodulation schemes.</td>
</tr>
<tr>
<td>3(c)</td>
<td>Outline the major practical constraints associated with coherent optical transmission and discuss the technique which have been adopted to overcome them.</td>
</tr>
<tr>
<td>3'(a)</td>
<td>Calculate the number of received photons per bit in order to maintain a BER of $10^{-9}$ in</td>
</tr>
<tr>
<td></td>
<td>(i) ASK Heterodyne synchronous detection.</td>
</tr>
<tr>
<td></td>
<td>(ii) ASK Heterodyne non-synchronous detection.</td>
</tr>
<tr>
<td>3'(b)</td>
<td>What are the different modulation schemes used in coherent optical communication system? Explain any two.</td>
</tr>
<tr>
<td>3'(c)</td>
<td>Write short notes on</td>
</tr>
<tr>
<td></td>
<td>(i) Detection principle of coherent optical fiber system.</td>
</tr>
<tr>
<td></td>
<td>(ii) Heterodyne synchronous demodulation.</td>
</tr>
<tr>
<td>4(a)</td>
<td>Define WDM. Explain WDMA-single hop and multihop networks.</td>
</tr>
<tr>
<td>4(b)</td>
<td>Define multiplexing and demultiplexing in optical networks. What are its different types? What are the components of optical multiplexer?</td>
</tr>
<tr>
<td>4(c)</td>
<td>Write short notes on any two of the following:</td>
</tr>
<tr>
<td></td>
<td>(i) Bit Interleaving in OTDM.</td>
</tr>
<tr>
<td></td>
<td>(ii) SONET/SDH.</td>
</tr>
<tr>
<td></td>
<td>(iii) OADMs.</td>
</tr>
</tbody>
</table>
1(a) Discuss how cell splitting can be used to improve the capacity of a cellular system. [04]

1(b) Figure 1 shows the partial frequency plan of a 7-cell 3-sectored system, where the numbers indicate the channel group number. The network uses fixed channel assignment with channel borrowing. Discuss the channel borrowing rules that satisfy the adjacent channel criteria.

Fig. 1 Partial frequency plan of a 7-cell 3-sectored system

1(c) What are the advantages of soft handoff over hard handoff? [04]

2(a) What parameters are used to characterize time variation of a wireless channel? [03]

2(b) What is the coverage of a base station that transmits a signal at 2 kW given that the receiver sensitivity is $-100$ dBm, the pathloss at the first meter is 32 dB, and the

contd... 2
pathloss exponent $n = 4$?

2(c) When a narrowband or wideband fading model is used?

2(d) The typical value of maximum delay spread in a microcell system is of the order of few micro seconds. Justify this argument.

OR

2'(a) The following table lists a set of empirical pathloss measurements.

<table>
<thead>
<tr>
<th>Distance from transmitter (m)</th>
<th>$P_r/P_t$ (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>-60</td>
</tr>
<tr>
<td>25</td>
<td>-80</td>
</tr>
<tr>
<td>65</td>
<td>-105</td>
</tr>
<tr>
<td>110</td>
<td>-115</td>
</tr>
<tr>
<td>400</td>
<td>-135</td>
</tr>
<tr>
<td>1000</td>
<td>-150</td>
</tr>
</tbody>
</table>

Find the parameters of a simplified pathloss model plus log normal shadowing that best fit this data.

2'(b) 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 $P_o = -80$ dBm. What value of the average signal power is required?

3(a) Consider a 3-branch selection combiner in which each branch receives an independent Rayleigh fading signal. If the average SNR is 30 dB, determine the probability that the SNR will drop below 10 dB. Compare the result with a case without any diversity.

3(b) Discuss briefly the key advantages of OFDM over single carrier systems.

3(c) Discuss briefly the advantages and disadvantages of CDMA access techniques for...
Mobile system.

OR

3'(a) Drive an expression for SNR at the combiner output for selection combining in the Rayleigh fading environment.

3'(b) A wireless system is to be designed for user data rate of 1Mbps. Typical outdoor channels show RMS delay spread ($\sigma_{rms}$) of 10$\mu$s. Determine whether ISI will occur in a single carrier system: If yes, propose a multicarrier system that would avoid ISI. Please note that channel coherence bandwidth is defined as, $Bc = 1/5\sigma_{rms}$ and frequency selectivity occurs when $10 \sigma_{rms} >$ symbol duration.

4(a) Why different error protection for voice and data is used in GSM system?

4(b) How is the transmission of variable data rates handled in the uplink and downlink of IS-95 system?

4(c) What are the main problems when transmitting data using 2G systems that were made for voice transmission? What are the possible steps to mitigate the problems and to raise efficiency?

OR

4(c') Discuss how 2G GSM systems is evolving to provide 3G services.

5(a) Discuss briefly the physical layer characteristics of IEEE 802.11b WLAN standard.

5(b) Discuss the structure of an IEEE 802.11a physical layer packet data unit (PPDU).

5(c) How does IEEE 802.11 solve the hidden terminal problem?
2013-2014
B. TECH (VIII SEMESTER) EXAMINATION
(ELECTRONICS ENGG)
Course No. EL-458
TV & RADAR ENGINEERING
Credits - 04

Maximum Marks: 60

Duration: Three Hours

Note: (i) Answer all the questions.
(ii) Assume any suitable data if missing.
(iii) Symbols have their usual meanings.

| Q1 | A, Define and explain briefly the followings
i, Aspect ratio
ii, Resolution
iii, Luminance
iv, Chroma

OR
A', Describe the two photoelectric effects used for converting variations of light intensity into electrical signals.

B, Determine the possible increase in vertical resolution if the video frequencies were allowed upto 5 MHz in NTSC system.

C, What is meant by equal vertical and horizontal resolution? Derive an expression for the highest modulating frequency in a television system and show that it is nearly 5 MHz in the 625-B monochrome system.

| Q2 | A, What is HDTV? Explain why it has an increased aspect ratio over regular TV.

OR
A', Explain how by frequency interleaving the colour information is accommodated within the same channel bandwidth of 7 MHz.

B, Explain how the differential phase-error is continuously corrected in the PAL system

C, Discuss the relative merits and demerits of the three television colour systems. Why the colour burst signal is transmitted after each scanning line?

contd... 2
### Question 3

A ground based surveillance radar operates at a frequency of 1300MHz. Its maximum range is 200 nmi for detection of a target with a radar cross section of one square meter. Its antenna is 12m wide by 4 m high and antenna aperture efficiency is 0.65. The receiver minimum detectable signal is $10^{-13}$ W. Determine the following:

1. Antenna effective aperture and antenna gain numerically and in dB.
2. Peak transmitted power.
3. Pulse repetition frequency to get maximum unambiguous range of 200 nmi.
4. Average transmitted power if pulse width is 2 microseconds.
5. Duty cycle.

B. By what factors pulse repetition frequency is governed? What is meant by ambiguous range? Explain different types of radar resolutions.

**OR**

B'. Why is the clutter undesired? What methods are used to minimize it?

### Question 4

A. What is the cause of Doppler shift? How large is it for typical radar frequencies and targets? What is the sign of the change it causes when the target and radar are closing on each other?

**OR**

A'. What is the basic structure of a radar receiver? Explain how AFC is achieved in the radar receiver.

B. Compare the performance of the conical scan and monopulse tracking methods.

**OR**

B'. What is the highest frequency that a radar can be operated if it is required to have maximum unambiguous range of 200 nmi and no blind speeds less than 600kt.

C. A radar measures an apparent range of 7 nmi when PRF is 4000Hz and about 18.6 MHz when PRF is 3500Hz. What is the true range in nmi?