INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY, TRIVANDRUM
DEPARTMENT OF HUMANITIES
QUIZ 1: MARCH 2022
HS 321: PRINCIPLES OF MANAGEMENT SYSTEMS

Maximum Marks: 20 **Time allowed: 1 hour**

Note: Questions 1 and 2 carries 7 marks each and Question 3 carry 6 marks.

1. A timber company cuts raw timber-oak and pine logs-into wooden brands. Two steps are required to produce boards from wooden logs. The first step involves removing the bark from the logs. Two hours are required to remove the bark from 1000 feet of oak logs and three hours per 1000 feet of pine logs. After the logs have been demarked, they must be cut into boards. It takes 2.4 hours per 1000 feet of oak logs and 1.2 hours per 1000 feet of pine logs to cut them into boards. The bark removing machine can operate up to 60 hours a week while the cutting machines are limited to 48 hours per week. The company can buy a maximum of 18000 feet of raw oak logs and 12000 feet of pine logs each week. The profit per 1000 feet of processed logs is Rs.1800 and Rs.1200 for oak and pine logs, respectively. Solve the problem to determine how many feet of each type of log should be processed each week in order to maximize profits.

2. A firm uses three machines in the manufacture of three products. Each unit of product A requires 3 hours on machine I, 2 hours on machine II and one hour on machine III. Each unit of product B requires 4 hours on machine I, one hour on machine II and 3 hours on machine III, while, each unit of product C requires 2 hours on each of the three machines. The contribution margin of the three products is Rs.30, Rs.40 and Rs.35 per unit respectively. The machine hours available are 90, 54 and 93 hours respectively. Obtain the optimal solution to the above problem using the simplex method and comment on which of the three products shall not be produced by the firm? Why? {Note: Use only integers and fractions to populate the simplex table}

3. Read the case study below and explain how the principles of scientific management could be used to combat the rise in Covid-19 cases. Write your answer in points substantiating your answer from the readings in the case.

   As part of the response to COVID-19, virtually all countries affected by the virus have introduced strict restrictions to social and economic life, including social distancing and even full lockdowns. The big question is now how to manage these restrictions, and how to go back to a new normal of living with SARS-CoV-2; a social and economic life that coexist with the virus. To avoid new peaks in the number of cases, overstretching health system capacities, infection rates need to remain suppressed until a vaccine or effective treatment are found. If all confinement strategies are lifted, however, the infection rate is expected to rebound in a matter of weeks. A strategy is needed about when and how to relax confinement, and when and how to re-tighten some of them when necessary. This is needed to minimize the risk of further peaks of the outbreak or, at least, to win as much time as possible between the successive peaks. A number of factors need to be in place to achieve this goal. First, healthcare capacity and resources need to be increased to ensure safe and effective management of future severe COVID-19 cases. Second, we need to understand the virus better, including: the incubation period and infectiousness of the disease at different stages; the extent of asymptomatic spread; immunity and its duration in those who contracted the virus; and the impact of changes in temperature on the disease spread. Third –information about the presence and propagation of SARS-CoV-2 in the population needs to improve significantly. For this, widespread testing and effective contact tracing, including cases with no or only mild symptoms, are key components of the post-lockdown strategy. Better information will help achieve these three goals.

******BEST OF LUCK******

Indian Institute of Space Science and Technology

Avionics

AVM-863 RF Integrated Circuits

Quiz -1 (25.02.2022)

Time: 1 hour | Maximum marks: 20 | Number of questions: 2 out of 3

Answer any TWO of the following questions

1.

a. An LNA senses a -80 dBm signal at 2.410 GHz and two -30 dBm interferers at 2.420 GHz and 2.430 GHz. What IIP3 is required if the IM products must remain 25 dB below the signal? Assume 50Ω interfaces at the input and output. (Since gain is not given, find α1/α3 ratio and solve.) (7 marks)

b. A receiver is required to have a sensitivity of -100 dBm for a QPSK modulation scheme at 100 kbps. The minimum SNR required is 10dB. The effective bandwidth of the receiver is 60 kHz. What should be the noise figure of the receiver at room temperature (300K) to support this requirement? (3 marks)

2.

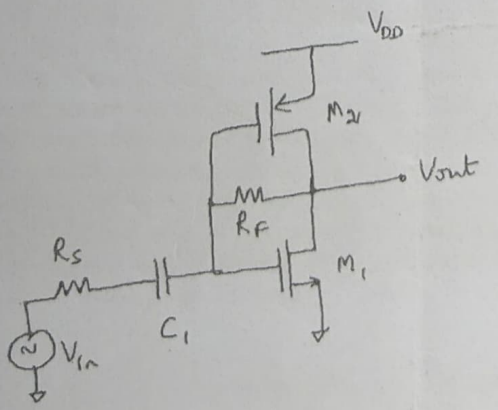
a. Design a π-match network with a Q of 5, to transform a 25Ω impedance to 50Ω at 30 GHz. (5 marks)

b. Derive an expression for the amplitude of each of the two intermodulation tones at the output of a non-linear system characterized by $y(x) = \alpha_1 x + \alpha_2 x^2 + \alpha_3 x^3$, where $x(t) = A_1 \sin(\omega_1 t) + A_2 \sin(\omega_2 t)$ and $A_1 \neq A_2$. (5 marks)

3.

a. A receiver chain has a bandpass filter (Loss of 1.5 dB), followed by LNA (Gain = 20 dB, NF = 2.5 dB), and then a mixer (Conversion gain = 5 dB, NF = 4 dB) and a low pass filter (Gain = 25 dB, NF = 10 dB). Calculate the effective noise figure of the receiver. (3 marks)

b. Derive and calculate the noise figure of the following LNA, if γ = 0.9, $g_{m1} = g_{m2} = 10mS$ and $R_F = 5K\Omega$ $R_s = 50\ \Omega$. C1 is a DC block capacitor. (7 marks)



INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

VLSI Technology
Electronics and Telecommunication Engineering (VI SEM)
Quiz 1: Total Marks 20
Date: 02/03/2022
You are allowed to make assumptions with proper justification.

1. Derive the expression for threshold voltage (Vt) of an ideal MOS structure. Draw the charge vs. gate voltage diagram and explain the entire region (accumulation, depletion and Inversion) in detail. Derive the expression for Current-Voltage characteristics of MOSFET.

Marks: (3+2+5).

2. A n-MOS has uniform P-type doping of 1.45×10^{16}/cm3 and gate oxide thickness 200 nm. The gate material is heavily dope polysilicon.
   a. *What is the value of threshold voltage for an ideal oxide?*
   b. *Intrinsic carrier concentrations of Si is 1.5* $\times 10^{10}/cm^3$

Marks: 2.5 +2.5

3. A MOS capacitor having the gate oxide thickness t_{ox}=100nm and substrate Boron Doping density $10^{15}/cm^3$ is biased in Depletion mode with agate Voltage Vg. If the surface potential is 0.2 V for this bias condition, determine the followings
   a. Peak Electric Field in the Si substrate
   b. Electric Field in the Oxide
   c. The gate Voltage Vg

Marks: (1+2+2)

Given:

ε_o=8.854 $\times 10^{-14}$ F/cm

ε_s=12 for Silicon

Intrinsic carrier concentrations of Si is 1.5 $\times 10^{10}$/ cm^3

ε_{ox}=4 for SiO_2

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

AV 322 : POWER ELECTRONICS

QUIZ – I

Time: 60 minutes | *Answer all questions.* | Maximum marks: 30 | Date: 22 Feb 2022

Note : Use linear approximation for all waveforms. Derive the formulae used (except basic formulae).

I. In the boost converter shown in Figure-1, Vs=40V, R=20 Ω. The switching frequency is 5 KHz. The ON-state voltage drops of switches S1 and S2 are 0.8V and 0.6V respectively. The input source has an internal resistance of 0.01 Ω and inductor has a parasitic resistance of 0.05 Ω. Duty ratio of switch S1 is 0.6

a. Evaluate the output voltage of the converter.
b. Evaluate the efficiency of the converter.
c. Evaluate the conduction losses in switches S1 and S2. *(11 Marks)*

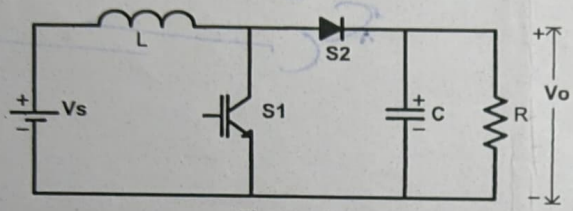


Figure-1

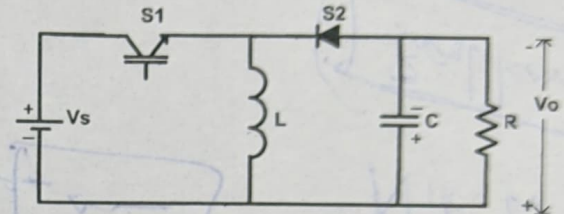


Figure-2

II. The buck-boost converter shown in Figure-2 is operating with the following parameters. Vs=30V, R=50 Ω, L= 50 μH. The switching frequency is 50 KHz and the duty ratio of the switch S1 is 0.5. All components are ideal. *(10 marks)*

a. Determine the mode of operation of the converter (CCM or DCM).
b. Evaluate the output voltage of the converter.
c. Sketch the waveform of the voltage across the switches (S1 and S2) and mark the salient points.

III. A switched mode power converter operating in CCM with three switching states is shown in Fig.3. When any one of the switches (S1, S2, S3) is ON the other two switches will be OFF. Switching frequency is 50 KHz. In a switching period, at first S1 is turned ON for 10 μS then S2 is turned ON for 6 μS and for the remaining time S3 is turned ON. Vs=24V, L=60μS, C=100μF, R=5Ω. All components are ideal.

a. Determine the steady state output voltage.
b. Sketch the inductor current waveform at steady state and mark all salient points and slopes.
c. Evaluate the peak to peak ripple in the output voltage.

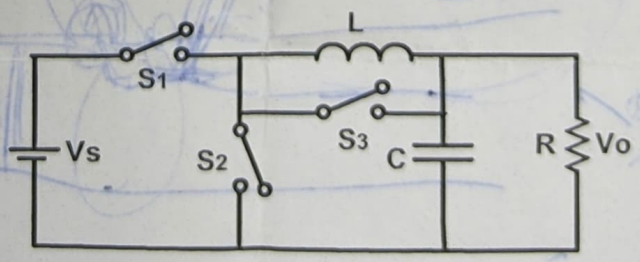


Figure-3

(9 Marks)

Indian Institute of Space Science and Technology
AV324 - Communication Systems II
Department of Avionics

Quiz 1 for B.Tech Semester VI on 28/02/2022

Note to the student

1. There are **4 questions** in this question paper on **2 pages**, for a total of **20 marks**.
2. Answer **all** questions. State your assumptions clearly. Please write legibly.

Question 1 (6 marks): Briefly explain the three major challenges faced in a baseband point to point digital communication link (each challenge should be explained in at most two sentences). For each challenge briefly explain a method which can be used to mitigate that problem.

Question 2 (4 marks):

1. Draw the block diagram of a baseband point to point digital communication link. Clearly state each block's function in the system. Using an example sequence of bits, clearly illustrate what is the signal at each point in the block diagram.
2. What is intersymbol interference in a baseband system? Explain how sinc based pulse shaping is used to mitigate intersymbol interference.

Question 3 (4 marks): Consider the signal flow diagram shown in Figure 1. Assume that the bits $(B_0, B_1, \ldots, B_M)$ are randomly chosen from $\{0, 1\}$ (you can assume that B_i are independent and Bernoulli with probability of $B_i = 1$ being 0.5). The blocks are LTI with the impulse responses as shown. Here $p(t)$ is the triangular signal shown in the figure and $\delta(t)$ is the usual delta function. Assuming that M is large, draw the eye diagrams for the signals at (A) and (B) as shown.

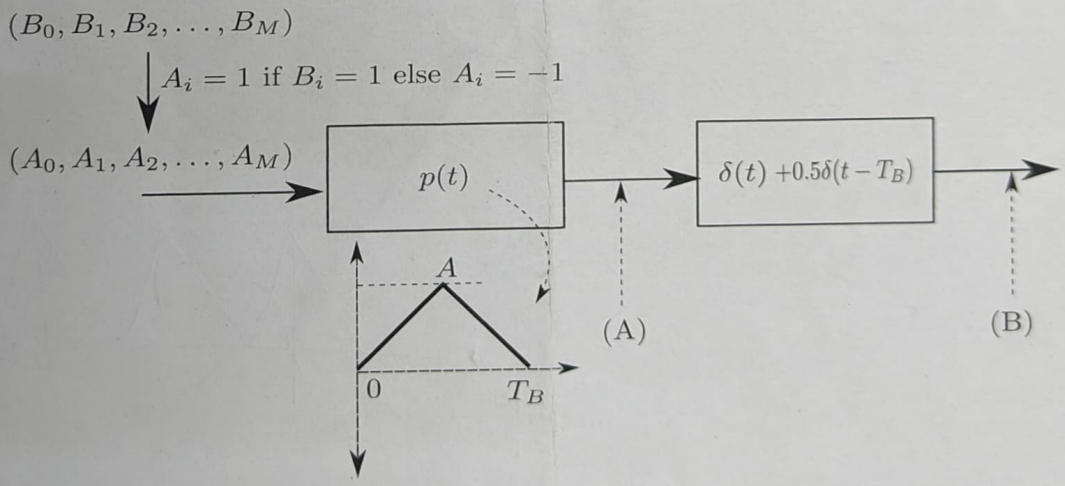


Figure 1: Block diagram for question 3

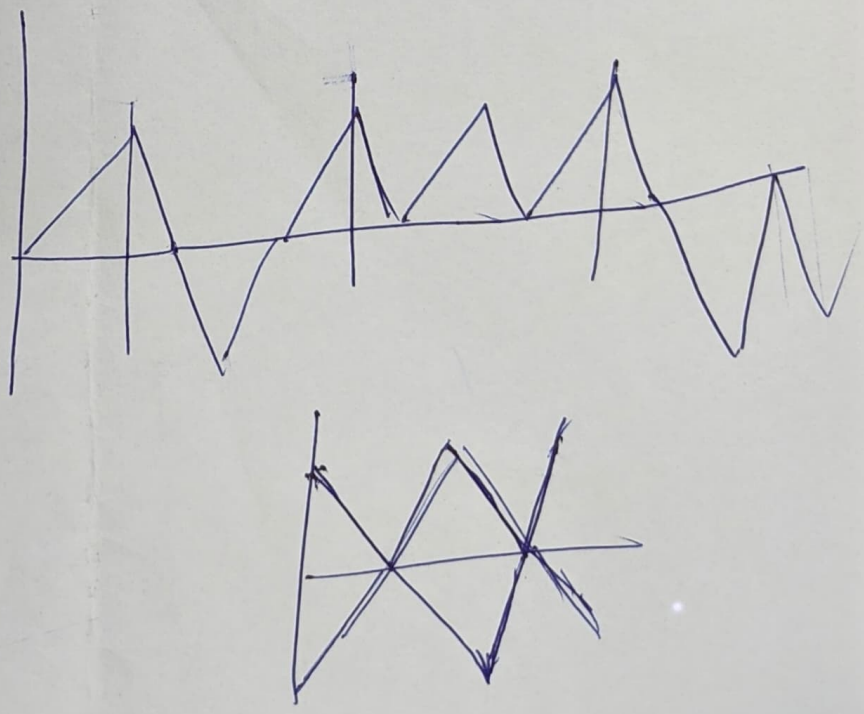
Question 4 (6 marks): Suppose a communication channel is modelled by a filter with impulse response $h(t)$. We assume that the output of this communication channel is fed into an equalizer with impulse response $q(t)$, so that the effective pulse shape from the input to the channel to the output is $g(t) = h(t) \star q(t)$ (here $\star$ denotes convolution). Assume that in order to obtain a duobinary design we require that

$$\begin{aligned} g(0) &= 1, \\ g(T_b) &= 1, \\ g(nT_b) &= 0, \text{ for } n = -1, \pm 2; \end{aligned}$$

where T_b is the sampling period (or bit duration). Design the equalizer impulse response $q(t)$ assuming that $q(t)$ is a tapped delay line filter (with delays of magnitude T_b). Note that the design should therefore specify the values of the tap weights of the filter. Assume that $h(t)$ is defined as

$$h(t) = \begin{cases} 1, & \text{for } 0 \leq t \leq 2T_b, \\ 0, & \text{otherwise.} \end{cases}$$

End of question paper.



Indian Institute of Space Science and Technology
Department of Avionics

Quiz-I AV 321: Computer Networks, January-May 2022

Name: Barath. D Student Number: SC19B077

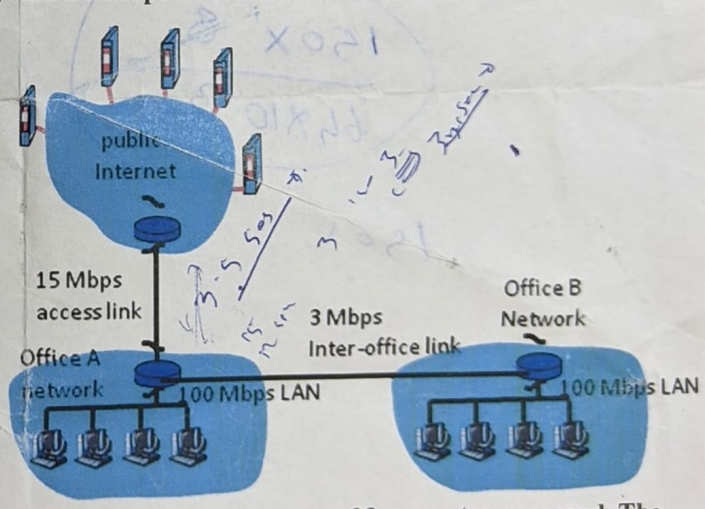
Date: 21/02/2022 Max Score: 20

Assume suitable data necessary, if any. However, clearly state the assumptions made.

1. **(6 points) Consider a 10Mbps link that is used by many users in a network. Each user is typically active only at 20% of the time and when a user is active, the data generated is 1Mbps. Estimate the following: *(a)* the number of users that can be supported if the network is circuit switched and *(b)* the probability of the network facing the situation of eight times the number of users estimated in the above case *(a)* being active at any given time. Can the network support the users mentioned in the case *(b)*?**

2. **(6 points) In a packet switched network, derive an expression for estimating the end-to-end delay experienced between two hosts separated by *K* network devices where each packet faces a queuing delay Dq. The propagation delay of each link is Dprop. Also estimate the time delay experienced in generating a 150byte packet from the analog signals produced by a human voice source.**

3. **(8 points) Consider you designed the network for an R&D center with one main rocket office (Office A) and another satellite office (Office B) that need connectivity to the Internet as shown in the figure below. You have connected the satellite office, Office B, with the rocket office, Office A, with a 3 Mbps link and Office A is connected to the Internet with a 15Mbps link. You modeled the total average response time from Office A to the Internet as the sum of the average access delay (that is, the delay from the Office A router to the Internet) and the average Internet delay. Further, you modeled the response delay from the Office B to the Internet as the sum of the delay faced on the link between Offices A and B, the average access delay between Office A and the Internet, and the average Internet delay. For the average access delay over any given link, you used X/(1-XY) where X is the average time required to send an object over the access link and Y is the arrival rate of objects to the access link. You also assumed that the 100 Mbps LANs at both Offices A and B added negligible delay.**



The average request arrival rate that Office A gets is 15 requests per second which include the requests that Office B generates at the rate of 3 requests per second. The average object size is 1,000,000 bits and the amount of time it takes from when the router on the Internet side of the access link forwards the request until it receives the response is 3.5 seconds on average. Note that all requests are from either Office A or B to the Internet only, no request goes from Office A to Office B. All requests from Office B go through Office A to reach the Internet. Find the following:

a.) What is the average response time for requests from Office A? 10.1
b.) What is the average response time for requests from Office B? 3.3

How will a single web cache/proxy with hit rate 40% will help improve the delay? Where will you place the web cache/proxy?

Best of luck

Indian Institute of Space Science and Technology
AV324 - Communication Systems II
Department of Avionics

Quiz 2 for **B.Tech Semester VI** on **06/04/2022**

Note to the student: There are **4 questions** in this question paper on **2 pages**, for a total of **20 marks**. Answer **all** questions. Clearly state all assumptions.

Question 1 (4 marks):

1. Explain what maximum likelihood (ML) and maximum aposteriori (MAP) decision rules are. Illustrate both rules using an example.
2. When is the ML decision rule equivalent to the MAP decision rule? Why do you say that they are equivalent?

Question 2 (5 marks):

1. Consider the following signal flow diagram showing how a frame consisting of $M+1$ bits is transmitted using binary phase shift keying (BPSK) over a passband channel. Write down what $p(t)$ is, and what are the functions of the blocks A, B, C, and D.

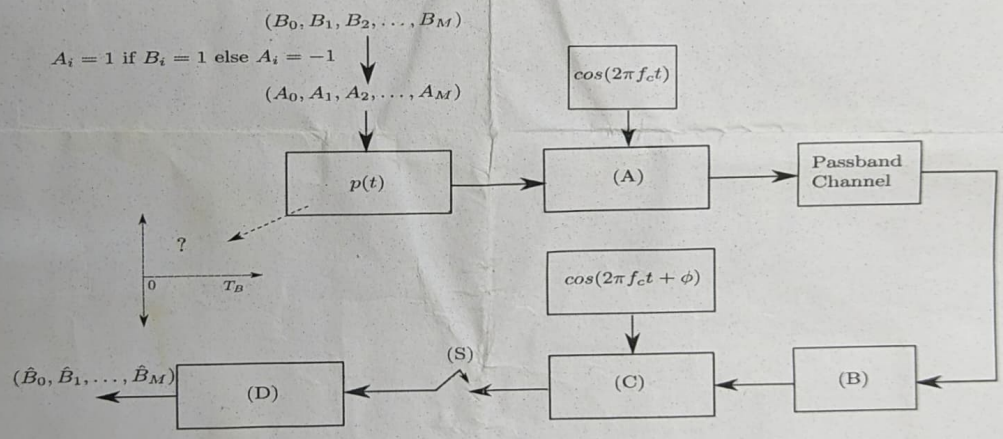
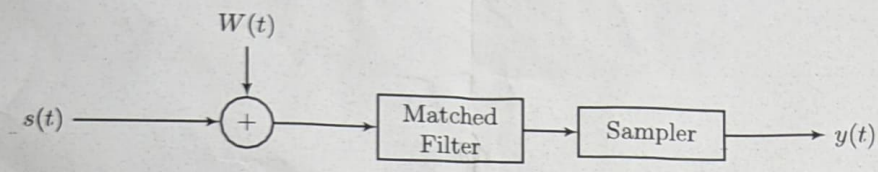


Figure 1: Signal flow diagram for question 5

2. Suppose the system has noise. Assume that at the point of sampling (shown as (S)), the m^{th} sample contains additive noise N_m which is Gaussian with mean 0 and variance σ^2.
3. Also assume that the receiver local oscillator produces a carrier which is ϕ radians out of phase with the received carrier signal.
4. Derive the bit error rate ($Pr\{B_m \neq \hat{B}_m\}$) of the system taking points (2) and (3) into account.

Question 3 (6 marks) Using block diagrams, briefly explain non-coherent demodulation for the following passband signalling schemes: (a) BASK and (b) BFSK.

Question 4 (5 marks): Consider the following system:



Here $s(t)$ is a time-limited signal in the time interval $[0, T_b]$ (i.e. $s(t)$ is zero outside the interval $[0, T_b]$) and $W(t)$ is a zero mean white Gaussian noise process with power spectral density $\frac{N_0}{2}$. The sampler block samples the output of the matched filter at T_b. Derive the response of the matched filter which is used to maximise the SNR of $y(t)$ at the sampling instant T_b. What is this maximum SNR at the sampling instant T_b?

End of question paper.

Indian Institute of Space Science and Technology
Department of Avionics

Quiz-II **AV 321: Computer Networks, Jan-June 2022**

Name: **Roll No:**

Date: 30/03/2022 **Duration: As per IIST Q-2 schedule** **Max Score: 20**

Make suitable assumptions and clearly state the assumptions.

1. (5 points) **Derive the expression for the following in a M/M/1/K queuing system.**
   a. **Traffic Intensity.**
   b. **Mean packets in the system.**
   c. **Mean packets in the queue.**
   d. **Mean waiting time in the system.**
   e. **Mean waiting time in the queue.**
   f. **Mean packets in service.**
   g. **Mean time in service.**

2. (5 points) **Consider a satellite, serving two ground terminals, where the satellite uses a single channel of total channel capacity 2Mbps. Packet arrival rate from each ground terminal is 150 packets/s. Packet arrival rate is poison distributed and packet length is exponentially distributed with average length 2000 bits. The satellite has finite buffer and single transceiver at both the input and output, respectively, to receive from ground terminals and forward to the ground station. Estimate the following:**
   a. **What should be the buffer size for ensuring that probability of packet loss to be less than 0.5%?**
   b. **What is the utilization of the system?**
   c. **Is the system stable? If not, specify three ways to make it stable?**
   d. **What is the average number of packets in the queue?**
   e. **What is the delay experienced by the packets due to the queuing and servicing at the satellite?**

3. (5 points) **What are the different dimensions of a bit? In an RF wireless communication network, a symbol is created using four information bits. The devices in the network uses 1500-byte packets. Transmitter/receiver antennas use unitary gain. If the data rate of the physical layer channel is 11 Megabits per second, estimate the following:**
   a. **The physical length of the symbol?**
   b. **The temporal duration of the symbol?**

4. (5 points) **What is DNS? Explain services of DNS and how the DNS system works.**

-Best of Luck-

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY, TRIVANDRUM
DEPARTMENT OF HUMANITIES
HS 321: PRINCIPLES OF MANAGEMENT SYSTEMS
QUIZ: 2, APRL 2022

Maximum marks: 20 **Time: 60 Minutes**

Note: All questions carry equal marks. In case of doubt, clearly state the assumptions made and answer the question.

1. (i) Which organization structure is typically used in Research and Development Organizations?
(ii) Which of organization structures are merged to create the above type of organization structure?
(iii) Draw a neat diagram of the above organization structure.
(iv) Describe the advantages of the above type of organization structure.
(v) Describe the disadvantages of the above type of organization structure.

2. A company wishes to get at least 160 million 'audience exposures', the number of times one of the advertisements is seen or heard by a person. Because of the nature of the product the company wants at least 60 million of these exposures to involve persons with family income of over Rs. 10,000 a month and at least 80 million of the exposures to involve persons between 18 and 40 years of age. The relevant information pertaining to two advertising media under consideration; magazine and television is given below:

	Magazine	Television
Cost per advertisement (Rs. Thousand)	40	200
Audience per advertisement (million)	4	40
Audience per advertisement with month income over Rs.10,000 (million)	3	10
Audience (per advertisement) in the age group of 18-40 (million)	8	10

Formulate the above as a linear programming problem and determine the determine the number of advertisements to be released by the company each in magazine and television so as to keep the advertisement expenditure to minimum.

3. Six machines M_1, M_2, M_3, M_4, M_5, and M_6 are to be located in six places P_1, P_2, P_3, P_4, P_5 and P_6. C_{ij} the cost of locating machine M_i at place P_j is given in the matrix below:

	P_1	P_2	P_3	P_4	P_5	P_6
M_1	20	23	18	10	16	20
M_2	50	20	17	16	15	11
M_3	60	30	40	55	8	7
M_4	6	7	10	20	25	9
M_5	19	19	28	17	60	70
M_6	9	10	20	30	40	55

Solve the above problem using the Hungarian algorithm.

4. Read the following case "Planning for a rebound in Volkswagen" and answer the questions that follows:

Planning for a rebound in Volkswagen

Volkswagen AG, based in Germany, is one of the largest automobile manufacturers in the world. Historically, Volkswagen (VW) has prospered while manufacturing reliable and affordable cars such as the Jetta and the Golf for the average consumer. In fact, Volkswagen literally means

"the people's car". Despite Volkswagen's past success as a company that produces mid-priced automobiles, the company's leaders modified the company's direction.

During a recent study of the automobile industry, Volkswagen's executives attempted to better understand the company's product line. The executives listed all of the different model segments in the automobile industry such as "big SUVs" and "hatchbacks" and compared the list against all of the automobiles that Volkswagen produced. Study results clearly showed that Volkswagen did not offer products in the luxury market to compete with other German automobile manufacturers such as BMW and Mercedes-Benz.

Based upon the study, VW introduced a new line of luxury automobiles. One of the company's luxury models, known as the Phaeton, included a driver's seat with a lower-back massager. The Phaeton also had Italian leather seats and solar cells in the sunroof that controlled the car's ventilation system. Despite all of these features, the company was surprised when consumers purchased only a fraction of the company's projected sales. After a few years of disappointing sales, VW discontinued the Phaeton altogether.

The plan to enter the luxury segment did not meet the expectations of VW's leadership. In fact, the poor performance of the Phaeton caused VW's new CEO Martin Winterkorn, to formulate a different plan for the company. Specifically, the introduction of the luxury cars caused consumers to think that VW had abandoned its roots as a company for the "common" consumer. In fact, VW's research suggests that some consumers believe that the company's automobiles are too expensive for entry-level buyers. To undo these perceptions, VW has introduced a new plan to focus on its popular, low-cost models such as the Rabbit, Jetta and Beetle. Using a series of marketing techniques, the company hopes to remind consumers that VW products high quality-yet affordable-automobiles.

The evidence suggests the VW's plan to enter the luxury segment did not reach objectives. To reverse the company's fortunes. VW's new CEO has instituted a new plan that focuses the company's efforts on its historical strengths. When preparing, reviewing and modifying this new plan, perhaps VW's new management team will be able to review the pitfalls of the Phaeton Plan, because organizational leaders can learn from both planning successes as well as planning failures.

Questions:

(a) What steps have to be taken to meet the challenges of introducing a new SUV? Answers in points from the case study above.

(b) Would you have the Volkswagen CEO or an appointed planning executive do the planning for the new SUV? Why?

*******ALL THE BEST*******

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
VLSI Technology (AV323)
Electronics and Telecommunication Engineering (VI -SEM)
Quiz 2: Total Marks 20
Date: 07/04/2022
You are allowed to make assumptions with proper justification. There are no Step-marks

1. Draw the GaAs structure and mention the coordinates. What is the difference between GaAs and Si structures?

   Calculate

   i. The number of atoms in {111}, {110} and {100}.

   ii. Identify two planes having the shortest distance.

   iii. Find out the Atoms/area of each plane.

   ……*Marks: 10 (2+2+2+2+2)*

2. Based on the Deal Grove model of Silicon Oxidation,

   a. Please derive the expressions of SiO2 thickness for long and short durations.

   b. Please refer to Table 1 and justify the following observations with the help of the

   I. Wet oxide thickness is higher as compared to Dry oxidation. Why?
   II. Oxide thickness increases with temperature. Why?
   III. The linear rate constant increases with temperature. Why?
   IV. The parabolic rate constant decreases with temperature. Why?

Table 1:

Temperature (oC)	Type	A (μm)	B (μm ^{2}/h)
920	Wet	0.5	0.203
	Dry	0.235	0.005
1200	Wet	0.05	0.72
	Dry	0.04	0.045

Equilibrium concentration Oxidizing species in SiO_2 are $C^*=5.2\times 10^{16}$ /cm^3(DRY) and 3×10^{19} / cm^3 (WET)

Marks: 10 (5+1+1+1+2)

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

AV 322 : POWER ELECTRONICS

QUIZ – 2

Time: 60 minutes | *Answer all questions.* | Maximum marks: 20 | Date: 31 March 2022

Note : Use linear approximation for all waveforms. Derive the formulae used (except basic formulae).

1. A flyback converter operating in DCM is shown in Figure.1. It delivers a voltage of 15V to the load of R=10 Ω. Vs=48V. The secondary winding conducts for one half of the OFF time of the active switch (S). The switching frequency is 20KHz. C=100μF. Turns ratio N1:N2= 1:0.5.
   (a) Evaluate primary inductance and secondary inductance.
   (b) Sketch the waveforms of primary current and secondary current and mark all salient points.
   (c) Evaluate the ratio of the energy stored in the converter to the energy delivered to the load in a switching period. *(10 Marks)*

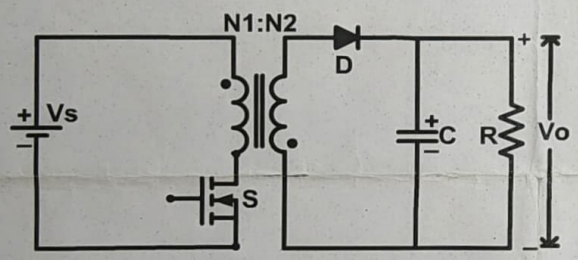


Figure-1

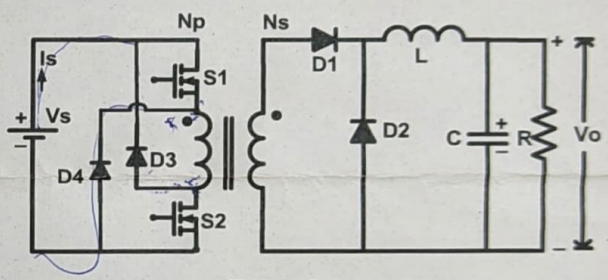


Figure-2

2. The two switch forward converter shown in Figure.2 is operating with the following parameters: Input voltage (Vs)=100V, Load resistance R=2 Ω, L=24 μH. Duty ratio D=0.4. Switching frequency is 50KHz. Primary magnetizing inductance is 4mH. The switches S1, S2, D1, D2, D3 and D4 have a voltage drop of 1V in the ON-state. Turns-ratio Np:Ns= 1 : 0.25.
   (a) Evaluate the output voltage.
   (b) Sketch the waveform of the primary current.
   (c) Evaluate the power returned to the source
   (d) Evaluate the efficiency of power conversion.

(10 Marks)

Indian Institute of Space Science and Technology
Department of Avionics
AVM 863 RF Integrated Circuits
Quiz 2
Date: 29th March 2022

Note:

1. You have a choice between Qn. 1 and Qn. 2. All other questions are compulsory.
2. Total time: 1 hour
3. Total marks: 20

Questions:

1. Consider the design of an inductively degenerated CS LNA. Derive the input impedance of this structure. The device is biased such that it has an f_t of 65 GHz. What is the degeneration inductor required? If the LNA is designed for operation at 5 GHz, what is the gate inductor required? Take C_{gs} to be 10 fF. (5 marks)

(OR)

2. The noise figure of the inductively degenerated CS LNA is given by

$$NF = 1 + g_m R_s \gamma \left(\frac{\omega_0}{\omega_T}\right)^2$$

A designer simulates his inductively degenerated LNA and finds it to have a higher noise figure than what his spec demands. He wants to control the width and bias current of the input transistor. What should he do to improve the noise figure? If he does that, how will L_S and L_G need to be changed to preserve the input match? (5 marks)

3. The input to a single-balanced active mixer consists of a $0.5V_{pp}$ tone at 2.55 GHz, $0.1V_{pp}$ tone at 2.3 GHz, $0.05V_{pp}$ tone at 7.24 GHz. The LO is a 50% duty-cycle square wave at 2.4 GHz. Draw the output spectrum after mixing + low pass filtering. What is the conversion gain for each of these tones? (5 marks)
The fourier expansion of a square wave toggling between ± 1 is given by

$$S(f) = \frac{4}{\pi} \sum_{n=1,3,5..}^{\infty} \frac{1}{n} \sin\left(\frac{2n\pi f}{T}\right)$$

4. Take a standard common gate LNA and convert it into a differential CG LNA. How will you scale the widths of the transistors to ensure matching is done for the differential case? How will the gain change? (3 marks)

5. A receiver has a low noise transconductance amplifier followed by a current-driven passive mixer. The low pass filter at the output of the mixer has a bandwidth of 20 MHz. If the RF input is at 10.4 GHz and a direct conversion architecture is used, what is the equivalent bandwidth at the input of the mixer at RF? (2 marks)

6. In the case of a single-balanced active mixer, the current through the transconductor is 1mA. The output DC is fixed at 0.9 V, with a supply voltage of 1.2V. What is the value of the load resistance used? In order to get a conversion gain of 6 dB, what is the gm that is required? (3 marks)

7. Define and describe how SSB noise figure, DSB noise figure, 1-dB compression point of a mixer are measured. (2 marks)

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
VLSI Technology (AV323)
Electronics and Telecommunication Engineering (VI -SEM)
End Sem Exam: Total Marks 40
Date: 17/05/2022
You are allowed to make assumptions with proper justification. There are no Step-marks

1. Consider thermal oxide of thickness 0.50 μm is grown on a silicon wafer using either wet or dry oxidation,
   a. What thickness of the substrate is consumed?
   b. Where are the top and bottom surfaces of the resulting oxide layer located relative to the original surface of the water?
   c. Does any of this depend on crystal orientation (i.e., will results differ on [100] and [111] wafers)? Why or why not?

   (Assume a density of elemental silicon as 2.33 g/cm3 and a density of amorphous silicon dioxide, i.e., fused quartz or quartz glass, as 2.27 g/cm3.)

   Marks: 2+1+2

2. Kindly consider a Nano transistor with a subthreshold slope:
   a. Derive the expression of the best possible subthreshold slope, that can be achieved at room temperature.
   b. A transistor has a subthreshold slope of 100 mV/decade and threshold voltage (Vt) is 0.3 V at room temperature. If the on current is 1mA/μm, then what is the off-state current?
   c. Suppose that the transistors are cooled down to 100°K. Then what is the subthreshold slope?
   d. At low temperature, Vt also increases slightly due to bandgap widening, and the on current also increases[since the improvement in mobility more than compensates for increased Vt]. Suppose the new Vt at 100°K is 0.32V and on current is 1.5mA/μm. Then what would be the off-state current?

   Marks: 5 + 3+3+3

3. In a High K Gate Dielectric Technology, the gate insulator consists of a hybrid stack of an Ultrathin SiO2 layer and a High-K insulator on Top. If the SiO2 thickness is 1nm, and the High K insulator on top of the SiO2 has a thickness of 5nm with relative permittivity 20.

a. then what is the EOT (Effective Oxide Thickness) of this gate insulator stack?
b. What is the per-unit gate capacitance density?

Marks: 3 + 3

4. For Nanoscale transistor
   a. Explain the DIBL with band diagram in detail
   b. What is Threshold voltage swings?
   c. How was this resolved (both DIBL and Threshold voltage swings)?

[Give a detail process flow with recipes. Draw the cross-sectional schematic in one column and provide the process description in the other column. Show only N channel MOSFET. The justification should be there against each and every process steps.

[Hints: Source & Drain Engineering with different doping levels and profile.

Similarly, Channel engineering with Halo implantation.]

Marks: 3+2+10

General Informations:

$\varepsilon_o = 8.854 \times 10^{-14}$ F/cm

$\varepsilon_s = 12$ for Silicon

Intrinsic carrier concentrations of Si is 1.5×10^{10}/ cm^3

$\varepsilon_{ox} = 4$ for SiO_2

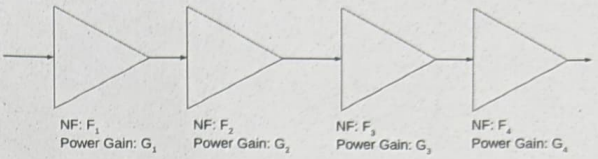
Indian Institute of Space Science and Technology
AV324 - Communication Systems II
Department of Avionics

Final Exam for **B.Tech Semester VI** on **13/05/2022**

Note to the student: There are **5 questions** in this question paper on **2 pages**, for a total of **40 marks**. Answer **all** questions. Please write all steps concisely and be direct in your answers. Clearly state all assumptions.

Question 1 (5 marks):

1. Derive the Friss's equation for the combined noise figure for a receiver which is composed of different stages as shown in the figure. The noise figures and power gains of each stage are denoted as F_i and G_i respectively (these are not in dB).
2. Using the Friss's equation explain why it is important to have a low noise figure for the first receiver stage.



Question 2 (10 marks): Consider a point to point radio link (such as a satellite link) with link parameters: (a) EIRP: 50 dB, (b) Frequency of operation: 14 GHz, (c) distance between transmitter and receiver: 50000 km. There are no other losses. The receiver of the radio link is as shown in Figure 1. The gains (absolute power gains, not in dB) and equivalent noise temperatures of each block are shown either above or below the respective block. Assuming that the link uses BPSK modulation, what is the maximum rate of transmission for a bit error rate of 10^{-6}? (You can assume that the $Q(x)$ function is approximated by $\frac{1}{2}e^{-x^2/2}$.). (assume link safety margin is 0).

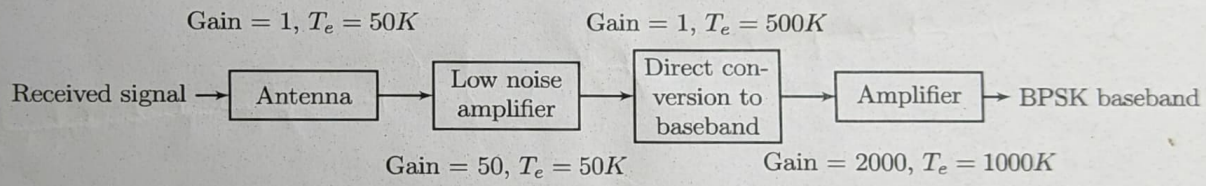


Figure 1: Receiver for the point to point link

Question 3 (10 marks): Consider the 4-PAM digital modulation scheme. Derive an upper bound on the symbol error rate for this scheme. Make and state suitable assumptions on the received signal constellation. Under high signal to noise ratio conditions, can you suggest a method to improve (or tighten) the upper bound.

Question 4 (10 marks): Consider a baseband digital communication system as shown in Figure 2. The frame of bits which is transmitted over the baseband channel has 40 bits. The first 7 bits are $1, 1, 1, 0, 0, 1, 0$ which is a Barker code of length 7. The rest (i.e., 33 bits) are data bits which are chosen uniformly at random from $\{0, 1\}$. The frame of bits is converted into a baseband signal using a line coder that uses a rectangular pulse of amplitude $+1$ and duration T_b for transmitting a 1 and a rectangular pulse of amplitude -1 and duration T_b to transmit a 0. The frame is transmitted over a channel which: (a) has a gain of 1, (b) has infinite bandwidth, and (c) has an unknown delay which is a multiple of T_b, but which is uniformly distributed in $\{1, 2, 3, \ldots, 30\}$.
Assume that the transmitter starts sending the baseband signal at time 0. Note that before time 0 and after the frame is transmitted, the input to the channel is 0. The delayed signal through the channel is corrupted by zero-mean additive white Gaussian noise $N(t)$ with a power spectral density of $N_0/2$. Assume that the receiver is switched on at time 0. The receiver obtains a noise corrupted delayed baseband signal after the unknown delay. The delayed signal is matched filtered and sampled at the end of every bit time, assuming that perfect symbol timing synchronization is achieved. However, the receiver is unaware of when the frame actually starts, i.e., the receiver does not have frame synchronization.

Derive the maximum likelihood rule for the receiver for finding the start time of the frame (note that this will be a multiple of T_b). What is the relationship between the maximum likelihood rule that you have derived and the method used in class/lab?

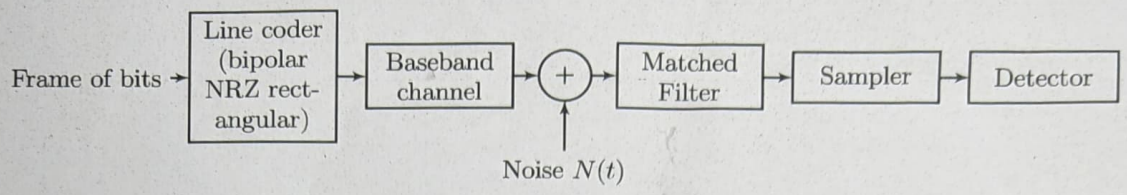


Figure 2: Baseband digital communication system for Question 4

Question 5 (5 marks): Consider the baseband digital communication system shown in Figure 3. The communication system transmits bits which are chosen uniformly at random from $\{0, 1\}$. The bits are converted into a baseband line code, which uses a rectangular pulse of amplitude 1 and duration T_b to transmit a 1, while for transmitting a 0, the transmitter does not transmit anything for a duration of T_b (i.e., a baseband on-off signalling scheme). The line code is transmitted over an ideal channel which has unit gain, infinite bandwidth, and no delay. The output of the channel is corrupted with zero-mean additive white Gaussian noise with power spectral density of $N_0/2$.
The channel output is connected to the receiver via a connector. This connector can either be connected correctly (direct) or reversed. If the connector is connected correctly then the output signal of the connector is the input itself. If the connector is reversed, the output signal is $-1\times$ the input signal.
The output of the connector is filtered using a low pass filter of two sided bandwidth W which is assumed to pass the line code without any distortion. Since the signalling is on-off, an engineer decided to take the absolute value of the signal using the Abs(.) block before sampling and taking decisions. The receiver is assumed to have perfect symbol timing synchronization so that the received bits can be sampled at the middle of the bit times.

1. Suppose the detector is a threshold detector with a threshold of 0.5. Derive the probability of bit error conditioned on 0 being transmitted
2. Derive the probability of bit error conditioned on 1 being transmitted
3. What is the detection rule that minimizes the probability of bit error for this system?

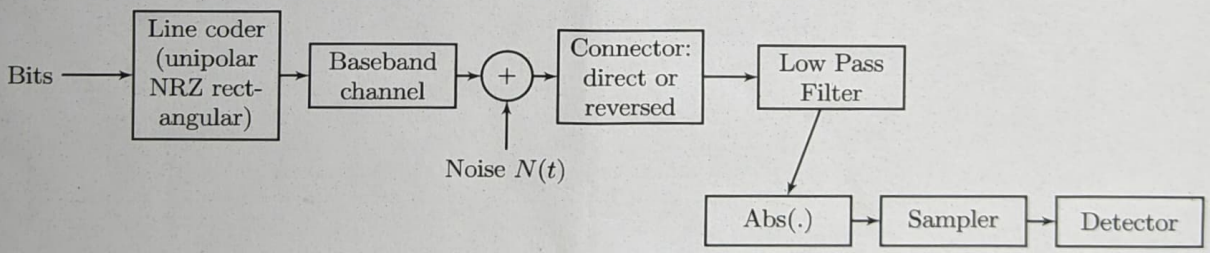
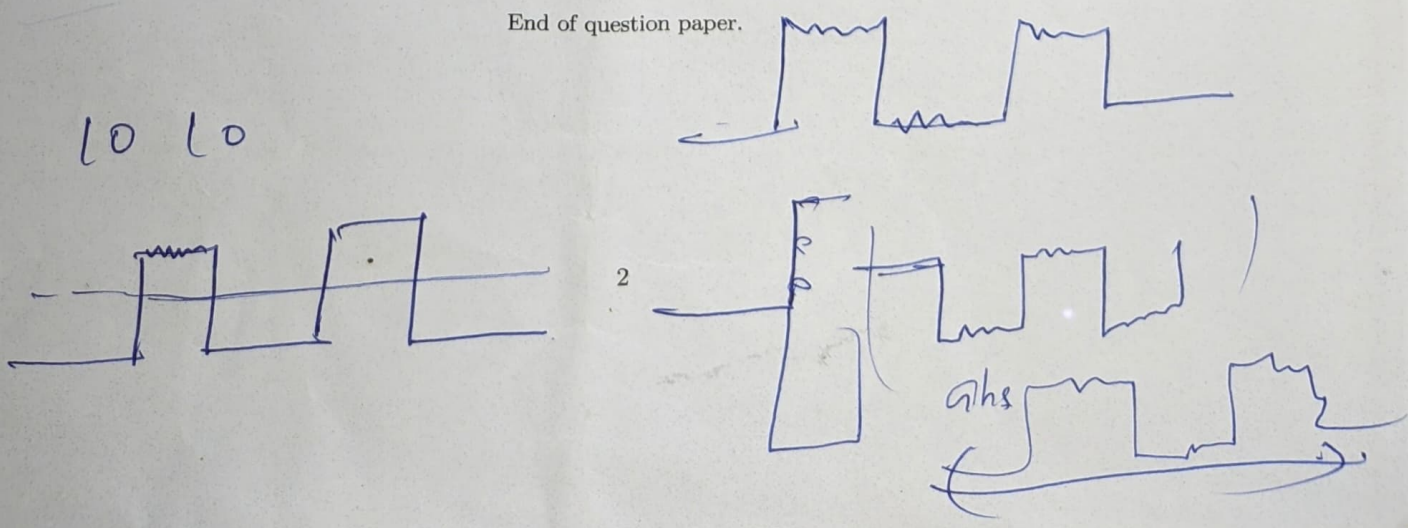


Figure 3: Baseband digital communication system for Question 5

End of question paper.



INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY, TRIVANDRUM
DEPARTMENT OF HUMANITIES
END SEMESTER EXAMINATIONS, MAY 2022
HS 321: PRINCIPLES OF MANAGEMENT SYSTEMS

SC19B077
Barath. D

Maximum Marks: 40 **Time allowed: 2 hours**

Note: 1. In case of doubt, write your answer giving the assumptions made.
2. Supplement your answers with appropriate diagrams and examples.

1. Discuss the importance of decision making in management. Discuss the contributions of a management expert to decision theory approach of management thought.

2. In a certain manufacturing firm, the production consists of a machining process which takes raw materials and converts them into (unassembled) parts. These parts are then sent to one of the two divisions for assembly into the final product- Division 1 for product A and Division 2 for product B. Product A required 40 units of raw material and 10 hours of machine processing time. Product B requires 80 units of raw material and 4 hours of machine processing time. During the period 800 units of raw material and 80 hours of machine processing time are available. The capacities of the two assembly divisions during the period are 6 and 9 units, respectively. The contribution per unit to profit and overhead is Rs.200 for each of unit of product A and Rs.120 for each unit of product B. Solve the above problem using Simplex method.

3. A cement factory manager is considering the best way to transport cement from three manufacturing centres P, Q and R to depots A, B, C, D and E. Manufacturing plants at P, Q and R have daily production of 60, 35 and 40 tonnes respectively. At depots A, B, C, D and E the daily demands are 22, 45, 20, 18 and 30 tonnes respectively. Per unit shipping costs from plants to the depots are given in the following table. If the manager was to minimize the total transportation cost, what should be his optimal distribution programme?

		A	B	C	D	E
Plant	P	4	1	3	4	4
	Q	2	3	2	2	3
	R	3	5	2	4	4

4. With a neat diagram explain the model of communication. Discuss the potential barriers of communication in an organization and in global context.

5. For the project network with eight activities, details are as follows:

Activity	Predecessor(s)	Normal time(weeks)	Crash time (weeks)	Normal cost (Rs)	Crash cost (Rs)
A	-	6	4	800	960
B	-	8	4	850	1210
C	-	5	3	1000	1060
D	A	3	3	700	700
E	A	5	3	500	580
F	B	12	8	1400	2200
G	C,D	8	5	650	800
H	E	6	6	600	600

The contract for the above project includes a penalty clause of Rs.100 per week over 17 weeks. The overhead cost per week is Rs.160. Analyse the time-cost-trade-off involved in crashing the project duration and identify the optimal crash length for the project. Depict your results in a diagram.

6. A project consists of 12 activities. The interrelationship among activities is as follows:

Activity	Predecessor	Duration (Days)
A	-	4
B	-	14
C	-	16
D	A	6
E	B	12
F	B	20
G	B	8
H	C	12
I	D, E	4
J	D, E	14
K	C, F, H	12
L	G, I	13

Draw the project network and find the critical path. Determine the total, interfering, total and independent floats of all activities and tabulate them in a table.

7. (i) Discuss the theory of motivation that aptly describes that multiple needs could be present for a person at a particular point of time.

(ii) Explain the concept of referent groups in context of the theory of motivation.

8. Discuss in detail the concept of PERT. Describe the project out of which the concept of PERT was developed. Determine the expected time and variance for an activity if the optimistic time, most likely time and pessimistic time are 8, 9, and 13 weeks respectively.

******BEST OF LUCK******

Indian Institute of Space Science and Technology

Avionics

AVM-863 RF Integrated Circuits

End Semester Examination (11.05.2022)

Time: 2 hours

Maximum marks: 30

Questions from the Research Papers:

1. Prove mathematically that the harmonic reject mixing using a 3 clock phases, each separated by 45^0 with appropriate scaling suppresses the third and fifth harmonics. [5 marks]. The fourier series expansion of the square wave is given as $S(f) = \frac{4}{\pi}\sum_{n=1,3,5\ldots}^{\infty}\frac{1}{n}\sin\left(\frac{2n\pi f}{T}\right)$.

[OR]

2. One of the key problems in wideband transmitters is the presence of spurious emission at $f_{LO} - 3f_{BB}$. Mathematically derive and show how this problem arises. [5 marks]

3. Refer to the receiver paper. In the proposed architecture, to a first order, the transconductance of which transistor(s) set(s) the input impedance of the LNA for the 1CC, 2CC and 3CC modes? According to the paper, how does the input impedance change when the circuit moves from 1CC mode to 3CC mode? Why? [3 marks]

4. In the receiver paper, for the proposed scheme, if 2CC is used and the first LNA is to be connected to C and the second LNA is connected to A, what should be the configuration of the switches – Give the gate voltages for all the cascoding transistors. [2 marks]

5. Refer to the transmitter paper (ISSCC2017). How is HRM implemented? How is the amplitude scaling achieved? What are the trade-offs involved in the choice of the capacitors? [5 marks]

6. Refer to the transceiver journal paper. What are the differences between the LNA used for LB and MHB bands and the LNA used for the NR bands? [2 marks]

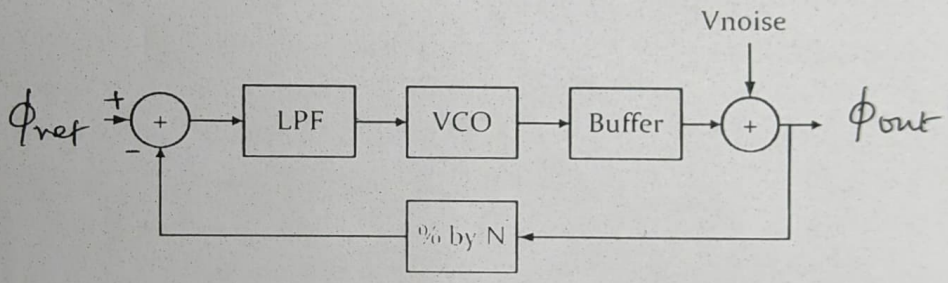
7. In the transceiver journal paper, what is the configuration in Fig. 4 to operate in mid-high bands? [1 mark]

8. Draw the schematic of the driver amplifier used in either the transceiver journal/transmitter paper (ISSCC 2017). What are the classes of biasing used? [2 marks]

General Questions:

9. Show the circuit diagram of a voltage-controlled oscillator, where a MOS cap is used for tuning. The frequency should increase as the control voltage increases. How does MOS capacitance change with applied voltage? How should the MOS caps be connected to the oscillator and where should the control voltage be applied? [3 marks]

10. In real-life PLL circuits, the VCO drives other circuitry. Hence a buffer is used. However, buffers are noisy and degrade phase noise. The noisy buffer is modelled by an ideal noiseless buffer followed by an additive noise. The designer opts to include the buffer inside the loop. How will Vnoise be shaped at the output? [5 marks]



[OR]

11. For a Class AB power amplifier, what is the range of the conduction angle? Draw the schematic of a push pull Class AB stage, including the biasing arrangements. The input voltage swing is 100 $mV_{pk\ pk}$. The threshold voltage of the transistors is 380 mV. For a conduction angle of 200^0, what is the bias voltage to be given to the input transistors? (You can assume that the transistor stops conducting below the threshold voltage.) [5 marks]

12. For a charge-pump based phase-frequency detector (PFD), derive the transfer function, if a current I_0 is used for both the up and down current sources. The switches can be taken as ideal. The charge pump is connected to a capacitor. [2 marks]

Indian Institute of Space Science and Technology (IIST)
Department of Avionics [www.iist.ac.in]

6th Semester B.Tech ECE Semester Finals
AV 321: Computer Networks, Jan-May 2022

Name:
Student ID:
Date: 09/05/2022 **Duration: 3 hours** **Max Score: 40**

Make suitable assumptions, if necessary, and clearly state them. Answers should be marked with question/branch question numbers properly. Clear and legible steps are necessary for answers.

1. **(10 points)** Consider a satellite network system with one satellite that carries one transponder with 4Mbps full duplex transmission capacity. The satellite transponder, rich in memory, accepts communication packets from four regional ground terminals and forwards the packets to the Gateway Earth Station (GES) for further packet processing. Assume the packet lengths are distributed exponentially with mean length 2500 bits where the medium access control protocol used are (i) ALOHA on the uplink (regional ground terminals to satellite) with equal probability of transmission by each ground terminal and (ii) point-to-point dedicated link between the satellite and GES. Each of the ground terminals offer a packet traffic of 120 packets per second whose inter-arrival time is exponentially distributed. The packets from the uplink channel(s) are placed in a queue at the satellite before forwarded through the downlink channel to the GES. Estimate the following:
   a. What is traffic intensity faced by the queuing system at the satellite transponder?
   b. Is the entire satellite system stable as far as the communication networking is concerned?
   c. What is the average waiting time of packets in the system?
   d. What is the mean number of packets in the system?
   e. Is there any packet loss in the network? If so, what is the percentage?
   f. Instead of ALOHA, if Slotted ALOHA is utilized for the uplink communications, what will be the results for (a), (b), (c), (d), and (e).
   g. Instead of ALOHA, if TDMA is employed where equal bandwidth per ground terminal to satellite is used, what will be the results for (a), (b), (c), (d), and (e).

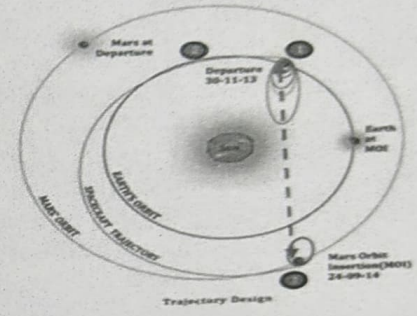
2. **(10 points)** Consider an IoT system where a camera attached to an entrance door frame uses TCP Reno for its transport layer. The entrance camera is configured in such a way that when an object (person or animals) appears at a specific location, a switch is turned ON which further turns the IoT camera ON for a duration of five minutes. The camera has a Black and White image frame of size 1024x1024 pixels at the rate of 25 frames per second when it is turned ON. Each pixel can operate at 128 Grey scale levels. The IoT server is located far away from the camera on the Internet cloud provided by a service provider. Camera is connected to the local router with a CSMA/CD network of 100Mbps capacity.
   a. What is the bandwidth requirement to transport the data to the IoT server when the camera is ON?
   b. Assume that the transport layer connectivity is carried over a network that faces a loss of 1 packet in 10000 packets. The round-trip time between the camera and the IoT server is about 100milli seconds. Default value of the segment size is 2048 bytes.
   c. Will the TCP connection provide enough throughput for carrying the data generated by the camera? Estimate the throughput and prove your answer.
   d. If your answer to (c) is No, then explain what happens to the data generated by the camera? How will the system work? Also suggest three possible ways to improve the situation.

3. **(5 points)** Answer the following:

   a. What design considerations are required to be taken when designing a packet format for a protocol? How can we design the fields in a packet format for various layers of the protocol stack? Briefly explain with examples.
   b. Draw and explain the fields of TCP header.

4. **(5 points)**
   a. What is vulnerability period? How is it affecting the performance?
   b. What is backoff process? Where is it used?
   c. What is longest prefix matching? How is it beneficial?
   d. What are the differences between distance vector routing and link state routing?
   e. What is hierarchical routing? How is it achieved?

5. **(5 points)** Assume that there exists a 10Kbps communication link between Earth and Mars as shown by the dashed line in the Mars orbiter mission trajectory shown in the figure. The minimum, farthest, and average distance from the Earth to Mars is, respectively, about 54.6, 401, and 225 million km. Assume the communication packets are of 1500Bytes and Acknowledgement packets are of negligible size. (i) What is the link utilization if we use a Stop and Wait protocol on the link? (ii) What should be the sender's transmission window size in order to maximize the link utilization?



6. **(5 points)** Explain the operation of CSMA/CD? How is collision detection achieved? Consider a Local Area Network (LAN) of 50 nodes that use CSMA/CD MAC protocol. Nodes transmit packets of fixed size 1500bytes over the physical channel of transmission rate 100Mbps. Assume that furthest two nodes are separated by 2000 meters. One of the several nodes connected to this LAN is a web cache with 40% hit rate, another node connected to this LAN is a Local DNS server, and a third node connected to this network is an HTTP server.

   a. What is the optimal transmission probability in this CSMA/CD network?
   b. What is the maximum throughput achievable in the CSMA/CD network?
   c. What do you suggest for the network to operate at higher throughput in this CSMA/CD network?

----------All the best----------