INDIAN INSTITUTE OF INFORMATION TECHNOLOGY GUWAHATI

DEPT. OF ELECTRONICS & COMMUNICATION ENGINEERING

END SEMESTER EXAMINATION, 24^{th} NOVEMBER, 2022

SUBJECT: CONTROL SYSTEMS (EC380)

TIME: 3 *Hours* FULL MARKS: 60

1) a) Write the advantages of state space model over transfer function model.
   b) Explain Lyapunov stability, asymptotic stability, and global asymptotic stability with appropriate diagram.

$(2 \times 5 = 10)$

2) Following is pendulum motion equation

$$ml\ddot{\theta} = -mgsin(\theta) - kl\dot{\theta}$$

where m, l, k, and g are different constant parameters and θ is the angular displacement.
   a) Find the equilibrium points.
   b) Determine the linearized state-space model at equilibrium points.
   c) Determine the stability at equilibrium points.

(10)

3) A unity feedback control system has the plant transfer function $G(s) = \frac{1}{s(s+10)}$. Design a PD controller of the form $G_c(s) = k_p + k_d s$ so that the system has a velocity error 2% and peak overshoot 10% to a unit step input. (5)

4) A unity feedback control system has $G(s) = \frac{1}{s(s+10)(s+100)}$ determine phase crossover frequency and gain margin of the system. (5)

5) The state space representation of a system is given below:

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ -1 & -1 & -1 \\ 0 & 0 & 1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} u, \qquad y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x$$

Determine controllability and observability of the system. (5)

6) Consider the transfer-function system: $\frac{Y(s)}{U(s)} = \frac{s^2+7s+12}{s^3+8s^2+17s+10}$ Obtain the state-space representation of this system in different canonical forms. (5)

7) Consider the system represented in state variable form

$$\dot{x} = \begin{bmatrix} 1 & 5 \\ -5 & 10 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

Design a full-state feedback controller by placing the closed-loop poles at $s_1 = -1 \pm 5i$. (5)

8) Determine the Lyapunov stability of the following system

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

(5)

9) Consider the system represented in state variable form

$$\dot{x} = \begin{bmatrix} 1 & -1 \\ 0 & -2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$

Design a full-state observer by placing the poles at $s_1 = -1$ and $s_2 = -2$. (5)

10) Bode plots of a unity feedback closed loop system with open loop transfer function $G(s)$ is shown in Fig. 1.

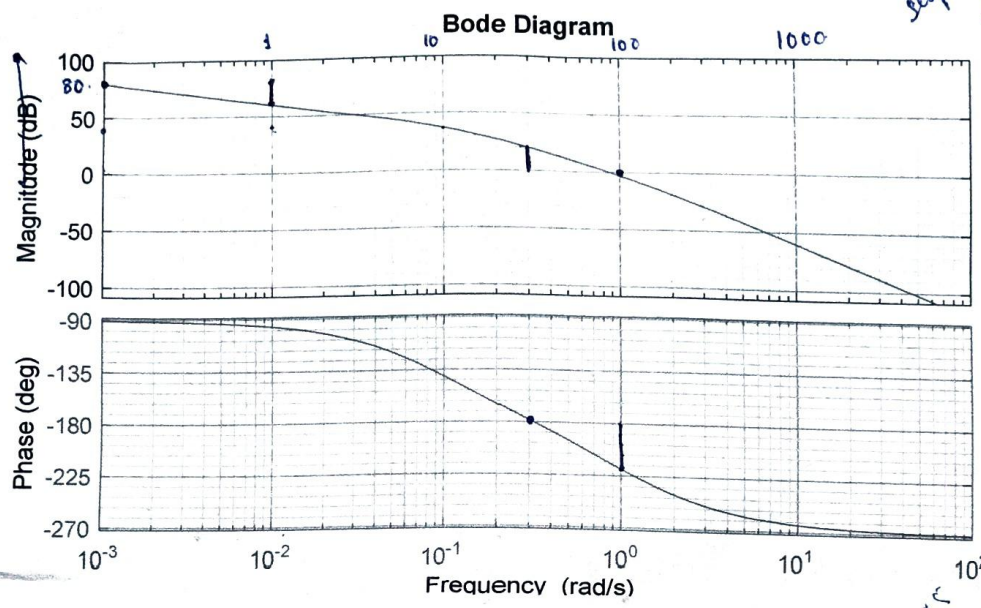

Fig. 1. Bode plots of $G(s)$

a) Determine the type and order of the system.
b) Find the gain margin and phase margin of the system.
c) Find the stability of the closed loop system.

(5)

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY GUWAHATI

END SEMESTER EXAMINATIONS (AY 2022-23)

Course: Introduction to Folklore (HS 407)

DURATION: THREE HOURS

FULL MARKS: 60

Answer any **SIX** of the following questions:

1. Discuss the economic and cultural impact of British colonial policies in Ireland with reference to "The Dream House" and "The Man Who Had No Story". (5+5 = 10)

2. Explore the recurring trope of 'travel' in folklore narratives and relevant cultural texts. Illustrate the significance of the travails undertaken by characters in the above mentioned texts. (5+5 = 10)

3. Determine the target readership of "Mr. Fox" – elucidate your response with appropriate facts and arguments. (10)

4. Examine the applications of exaggeration and the supernatural in folkloric texts. You may refer to historical and contemporary cultural texts for the response. (10)

5. Trace the thematic of majoritarianism, homogenization, and uniformity in "The New Utopia". How do these forces affect our daily lives? (5+5 = 10)

6. Highlight the tensions and conflicts between the concepts of 'absolute equality' and 'freedom' as envisioned by Jerome. K. Jerome. Relate your responses with appropriate literary and cinematic content. (10)

7. What are the impressions of contemporary economic and political climate as evident from "When The Yogurt Took Over"? Probe into the symbolic meaning and value of 'yogurt' as given in the text. (10)

8. What is meant by the term "intellectual"? Distinguish between traditional and organic intellectual. (5+5 = 10)

9. Explain the process of meaning making as per the theory of structuralism. Your response should highlight the concepts of sign, signifier, and signified. (10)

Indian Institute of Information Technology Guwahati
Department of Science and Mathematics
B. Tech Semester V
End semester examination SC 301: Biology
November 26, 2022 (Saturday)

All Questions are Compulsory

Section 1: Multiple choice questions (1 marks each)

1. The primary RNA transcript of the chicken ovalbumin gene is 7700 nucleotides long, but the mature mRNA that is translated on the ribosome is 1872 nucleotides long. This size difference occurs primarily as a result of:
   a) Capping
   b) Removal of poly A tails
   c) Reverse transcription
   d) Splicing

2. AUG is the mRNA start codon that initiates translation. A polypeptide of five amino acids is synthesized during protein synthesis in eukaryotic cells. Which of the following can be correct polypeptide?
   a) Glycine- valine-methionine-histidine–lysine
   b) Methionine-valine-glycine-histidine-lysine
   c) Histidine-lysine-glycine-valine-methionine
   d) Lysine-histidine-glycine-valine-methionine

3. A single DNA molecule (one double-helix) undergoes three rounds of replication. After the final replication is complete, how many of the DNA molecules present do not contain any part of the original template?
   a) Two
   b) Eight
   c) Four
   d) Six

5) increase the affinity of other binding spots for oxygen, leading to a left shift in the dissociation curve.

4. Where are promoters typically found in DNA?
   a) Downstream of the coding region of a gene
   b) Upstream of the coding region of a gene
   c) In the 3'UTR
   d) In the middle of the coding region of a gene

5. Which of the following statement is false?
   a) Color blindness and Haemophilia are X linked recessive traits.
   b) The genetic makeup of an organism is its phenotype while external appearance is genotype.
   c) The location of a gene on a chromosome or in a DNA molecule is called Gene locus.
   d) ABO blood group is an example of Codominance.

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6. T cell receptors (or TCR) on CD4+ T cells
   a) Recognize peptides not associated with MHC molecules
   b) Recognize peptides associated with MHC class I molecules
   c) Recognize peptides associated with MHC class II molecules
   d) Are secreted out into the environment to bind antigens

7. Which of the following is least likely to be present in the glomerular filtrate (the filtrate produced by the nephron before it enters the loop of Henle) of a healthy adult nephron?
   a) Amino acids
   b) Glucose
   c) Large molecular weight protein
   d) Electrolytes

8. Which of the following statements regarding translation is false?
   a) The genetic code is the set of three nucleotides and so also known as triplet codons.
   b) tRNA works to bring amino acid corresponding to the codons in the mRNA sequence
   c) There is only one start codon the beginning of translation and one stop codon that signals the end of translation
   d) Adjacent amino acids are joined in a sequence via peptide bond.

9._____ converts biochemical events into measurable signals.
   a) Amplifier
   b) Signal processor
   c) Rectifier
   d) Transducer

10. Rank the following blood vessels in order of their average pressure, from highest to lowest: artery, vein, arteriole, venule, aorta, capillary.
   a) Capillary > arteriole > venule > artery > vein > aorta
   b) Capillary > vein > venule > arteriole > artery > aorta
   c) Aorta > artery > arteriole > capillary > venule > vein
   d) Aorta > arteriole > venule > artery > vein > capillary

11. One molecule of haemoglobin carries how many molecules of oxygen.
   a) 4
   b) 3
   c) 2
   d) 1

12. Which of the following is the correct pathway for the propagation of the cardiac impulse
   a) AV node- SA node- Bundle of HIS- Purkinje fibres
   b) SA node- AV node- Bundle of HIS- Purkinje fibres
   c) SA node- Bundle of HIS- AV node- Purkinje fibres
   d) SA node Purkinje fibres- Bundle of HIS- AV node

13. Which of the following is the neurotransmitter
a) Acetylcholine
b) Glucose
c) Tryptophan
d) DNA

14. The correction sequence of urine formation:
a) Secretion, reabsorption, filtration
b) Reabsorption, Secretion, filtration
c) Filtration, reabsorption, secretion
d) Secretion, filtration, reabsorption

15. Which of the following does not take part in gene expression?
a) Replication
b) Transcription
c) RNA processing
d) Translation

16. Transcription is the transfer of genetic information from
(a) DNA to RNA
(b) DNA to mRNA
(c) mRNA to tRNA
(d) tRNA to mRNA

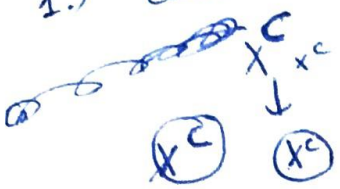
17. The anticodon of tRNA binds with
a) Nucleic bases of mRNA
b) Codons of tRNA
c) Nucleic bases of rRNA
d) Amino acids

18. Colour blindness is a recessive trait linked with
a) Z chromosome
b) Y chromosome
c) X chromosome
d) None of the above

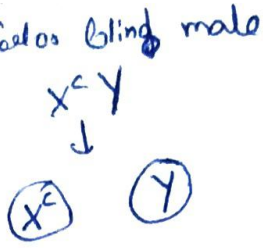
19. Vaccinations help prepare the body to fight invasions of a specific pathogen by
a) Inhibiting antigen production
b) Stimulating antibody production
c) Inhibiting white blood cell production
d) Stimulating red blood cell production

20. Which one of the following sensors is also known as mass sensitive biosensor?
a) Piezoelectric
b) Calorimetric
c) Optical
d) All of the above

1.) Colour blind carrier female



Colour blind male



Punnet Square.

	X^c	Y
X^c	X^cX^c	X^cY
X^c	X^cX^c	X^cY

P(colour blindness) = $\frac{1}{2}$

P(normal vision) = $\frac{1}{2}$

Section 2: Short questions (1 marks each)

1. What are neurotransmitters? Name two of them.
2. What are the functions of Atrioventricular (AV) valves and semilunar valves in circulatory system?
3. How many start and stop codons are present in genetic code? Provide the codes for the same.
4. Write three steps of post transcriptional processing of pre mRNA in order to become mature mRNA.
5. Classify genes on the basis of their expression.
6. Explain co-dominance by illustrating the example.
7. Why does the left ventricle possess a thicker wall than the right ventricle?

left has to pump entire body and right has to pump to lungs

8. What are the main constituents of the nephric filtrate?
9. Draw the curve for primary and secondary immune response.
10. Write the biological recognition elements used in a biosensor.

Section 3: Subjective questions (2 marks each)

1. A colour-blind carrier female marries colour blind male. Provide the punnet square depicting genotypes and possible probability of colour-blindness and normal vision in their future children's. **(2 marks)**
2. What is wobbling phenomenon during codon-anticodon interactions in translation process? Write the possible anticodons for mRNA codon 5'GGU 3' using wobbling concept. **(1+1 =2 marks)**
3. What is electrocardiogram (ECG). What does P, QRS complex, S-T interval, T and U waves indicates in ECG? **(0.5 +1.5 = 2 marks)**
4. What is resting membrane potential? Explain in brief the mechanism of nerve impulse conduction. **(0.5 +1.5 =2 marks).**

of the nerve cell is -70mV. It is a static state and both Na+ K+

5. Explain the ways how CO_2 is transported in the blood? How the partial pressure of Carbon dioxide affects oxygen-haemoglobin dissociation curve? **(1.5+0.5= 2 marks).**

2)a) Codon - 5' - A A G/C - 3' → Wobble phenomenon

anticodon - 3' - U U C/U - 5'

Ye 1st position hai

5' - G G U - 3'

2' - C C A - 5'

3' - C C I - 5'

3' - C C G - 5'

Ye 2nd position hai

3 possible codons

भारतीय सूचना प्रौद्योगिकी संस्थान गुवाहाटी
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY GUWAHATI

End Semester Examination on Electromagnetics (EC370)

26th November 2022

Total Marks: 80
Time: 9.30 am- 12.30 pm

(Please note that all the parts of a single Group have to be answered combinedly in answer sheets.)

Group A

(Marks: 30)

1. Specify the far and near field region of a 3 m long half wave dipole antenna. Also draw a diagram to distinguish between far and near field region. (5)

2. Calculate the maximum effective aperture of an antenna which is operating at wavelength of 2 m and a directivity of 100. (5)

3. The BWFN of a pencil beam antenna is 40 degrees. Calculate the HPBW. (5)

4. Calculate the radiation resistance of a $\lambda/120$ dipole in free space. (5)

5. Calculate the total radiated power and maximum directivity of an antenna whose radiation intensity is

$U(\Theta, \Phi) = \text{Cos}^2\,\Theta$ in the region $z \geq 0$ and 0 elsewhere. (10)

Group B

(Marks: 40)

6. A plane wave incident normally on an interface between two different mediums. Consider $z < 0$ is free space, a plane wave with $\mathbf{H}_i = 10\ \text{Cos}\ (10^8 t - \beta z)\ a_x$ mA/m is ***incident normally*** on a loss less medium with ($\mu_r = 2$, $\epsilon_r = 8$) in region $z > 0$. Determine reflection and transmission coefficients. Also draw a neat diagram which shows the different field components along with propagation direction. (15)

7. Write the four Maxwell's equations in phasor form for time harmonic EM field in point form. (5)

8. Find the loss tangent and depth of penetration, δ of an EM wave in copper at f= 60 Hz. For copper, $\sigma = 5.8 \times 10^7$ mho/m, $\mu_r = 1$, $\epsilon_r = 1$. (5)

9. A conducting bar can slide freely over two conducting rails as shown in Figure 1. Calculate the induced voltage in the bar (a) If the bar is stationed at y = 8 cm and $\mathbf{B} = 4 \cos 10^6 t\ \mathbf{a}_z$ mWb/m^2 (b) If the bar slides at a velocity $\mathbf{u} = 20\mathbf{a}_y$, m/s and $\mathbf{B} = 4\mathbf{a}_z$ mWb/m^2. (10)

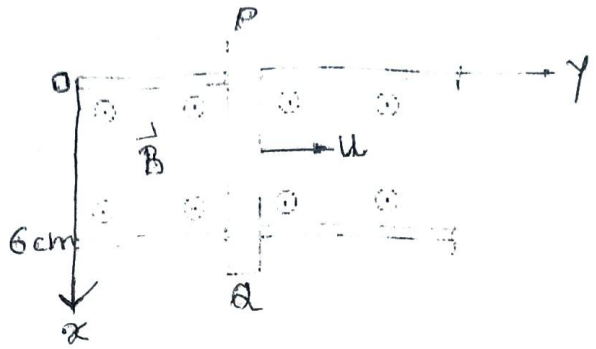


Figure 1

10. A lossy dielectric has an intrinsic impedance of 200 <30° at a particular frequency. If, at that frequency, the plane wave propagating through the dielectric has the magnetic field component as given below, find **E**. (5)

$$H = 10e^{-\alpha x}\cos\left(\omega t - \frac{1}{2}x\right) a_y \text{ A/m}$$

Group C

(Marks: 10)

11. What is the polarization of a wave propagating in the r- direction if its electric field vector at any fixed point in space is given by $\bar{E} = j*a_\theta + a_\Phi$ (5)

12. Express the global coefficient C_{44} and C_{43} in terms of element coefficients. (Figure 2) (5)

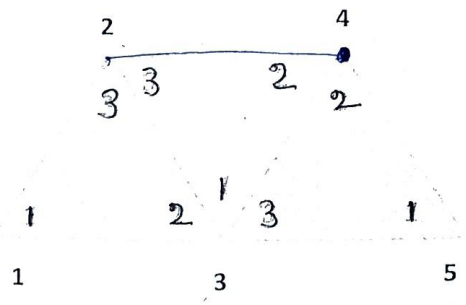


Figure 2

End Semester Examination-Monsoon Session 2022

5th Semester

Digital Communication (EC351)

20 November, 2022 | Duration: 3 Hours | **Total Marks: 60**

Note: Assume all the symbols are equiprobable, and noise spectral density as $\frac{N_o}{2}$, if specific values are not mentioned in the paper

1. Let $Y(t) = B\sin(2\pi t)$ be a random process, where probability density function of random variable B is $f_B(x) = a\,x;\ 0 \le x \le 1$, where a is constant. Can a be determined? What is $E[Y(t)]$ at $t = T$ seconds? **[2+3=5]**

2. Consider a signal detector with an input $y = \pm A + n$, where $+A$ and $-A$ occur with equal probability, and the noise variable n is a Laplacian random variable characterized by the probability density function $f_n(n) = \frac{\lambda}{2}e^{-\lambda|n|}$, where λ is called *scaling parameter*. Find the following: **[4+5+3=12]**

   (a) Evaluate the noise variance σ_n^2 in terms of λ.

   (b) Determine the probability of error as a function of the parameters A and σ_n.

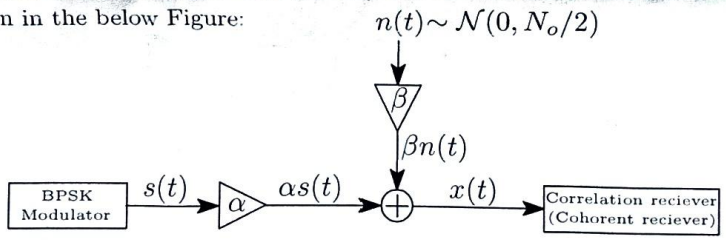
   (c) Compare the probability of error for this case with the case of AWGN noise with mean 0 and variance σ_n^2. In other words, determine the relationship between average SNR in this case with that of AWGN case. (You can use approximation of $Q(x)$, $Q(x) \approx \frac{1}{2}e^{-\frac{x^2}{2}}$)

3. Consider a BPSK signal with pilot carrier added for synchronization purposes. resulting in

$$\begin{aligned} s_1(t) &= Ac\cos 2\pi f_c t + \alpha Ac\cos 2\pi f_c t,\ \ 0 \le t \le T_b \\ s_2(t) &= -Ac\cos 2\pi f_c t + \alpha Ac\cos 2\pi f_c t,\ \ 0 \le t \le T_b \end{aligned}$$

   where T_b is the bit duration. Determine the probability of error. **[4]**

4. A BPSK signal ($s(t)$) with bit energy and bit-period are E_b are T_b respectively. This signal is transmitted into the channel as shown in the below Figure:



   $n(t)$ is the AWGN process with mean and power spectral density are 0 and $N_o/2$ respectively. Determine the following:

   (a) Determine the BER for the considered system if $\alpha = 0.5$ and $\beta = 1$. Compared this BER with standard BPSK channel (i.e. $\alpha = 1$ and $\beta = 1$). **[4]**

   (b) Determine the BER for the considered system if $\alpha = 1$ and $\beta = 0.5$. Compared this BER with standard BPSK channel ($\alpha = 1$ and $\beta = 1$). **[4]**

5. Answer the following: **[3+3+5=11]**

   (a) Specify the advantages of offset quadrature phase shift keying (OQPSK) over QPSK (point wise).

   (b) Discuss the similarities and dissimilarities of OQPSK with MSK (in tabulated form).

   (c) Determine the power spectral density (PSD) of OQPSK. Assume the symbol energy and time are E_s and T_s respectively.

6. The composite pulse $G(f)$ is used in binary data transmission with controlled ISI. $G(f)$ is given by: **[6]**

$$G(f) = \begin{cases} 2jT_b\sin 2\pi f T_b, & |f| \le \frac{1}{2T_b} \\ 0, & \text{elsewhere} \end{cases}$$

   Find the $g(t)$, and the number of received levels, and their values at sampling times nT_b, where n is any integer value.

7. A signal is represented by $s(t) = \pm\sqrt{\frac{2\,E_b}{T_b}}\cos\left(\frac{\pi t}{2\,T_b}\right)\cos(2\,\pi f_c\,t) \pm \sqrt{\frac{2\,E_b}{T_b}}\sin\left(\frac{\pi t}{2\,T_b}\right)\sin(2\,\pi f_c\,t), 0 \le t \le 2T_b$. Determine the envelope of signal $s(t)$. [4]

8. The binary data-stream 001101001 is applied to the input of a duobinary and modified duobinary partial response signaling.

   (a) Construct the duobinary coder output and corresponding receiver output, without a precoder. [5]

   (b) Construct the modified duobinary coder output and corresponding receiver output, without a precoder. [5]

Formula Sheet: Digital Communication (ECE351)

Name	P [symbol error]	P [error]
BPSK	$= \mathrm{Q}\left(\sqrt{\frac{2\mathcal{E}_b}{N_0}}\right)$	same
OOK	$= \mathrm{Q}\left(\sqrt{\frac{\mathcal{E}_b}{N_0}}\right)$	same
DPSK	$= \frac{1}{2}\exp\left(-\frac{\mathcal{E}_b}{N_0}\right)$	same
M-PAM	$= \frac{2(M-1)}{M}\mathrm{Q}\left(\sqrt{\frac{6\log_2 M}{M^2-1}\frac{\mathcal{E}_b}{N_0}}\right)$	$\approx \frac{1}{\log_2 M}P$ [symbol error]
QPSK		$= \mathrm{Q}\left(\sqrt{\frac{2\mathcal{E}_b}{N_0}}\right)$
M-PSK	$\le 2\mathrm{Q}\left(\sqrt{2(\log_2 M)\sin^2(\pi/M)\frac{\mathcal{E}_b}{N_0}}\right)$	$\approx \frac{1}{\log_2 M}P$ [symbol error]
Square M-QAM		$\approx \frac{4}{\log_2 M}\frac{(\sqrt{M}-1)}{\sqrt{M}}\mathrm{Q}\left(\sqrt{\frac{3\log_2 M}{M-1}\frac{\mathcal{E}_b}{N_0}}\right)$
2-non-co-FSK	$= \frac{1}{2}\exp\left[-\frac{\mathcal{E}_b}{2N_0}\right]$	same
M-non-co-FSK	$= \sum_{n=1}^{M-1}\binom{M-1}{n}\frac{(-1)^{n+1}}{n+1}\exp\left[-\frac{n\log_2 M}{n+1}\frac{\mathcal{E}_b}{N_0}\right]$	$= \frac{M/2}{M-1}P$ [symbol error]
2-co-FSK	$= \mathrm{Q}\left(\sqrt{\frac{\mathcal{E}_b}{N_0}}\right)$	same
M-co-FSK	$\le (M-1)\mathrm{Q}\left(\sqrt{\log_2 M\frac{\mathcal{E}_b}{N_0}}\right)$	$= \frac{M/2}{M-1}P$ [symbol error]

Figure 1: List of Formulae in terms of bit energy E_b and noise variance $N_o/2$

- Q function is defined as:

$$Q(x) = \frac{1}{\sqrt{2\pi}}\int_x^\infty e^{-t^2/2}dt \approx \frac{1}{12}e^{-\frac{x^2}{2}} + \frac{1}{4}e^{-\frac{2x^2}{3}}$$

- Probability density function ($f_X(x)$) of Gaussian random variable (X) with mean μ and variance σ^2 is defined as:

$$f_X(x) = \frac{1}{\sqrt{2\pi\sigma^2}}\exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

End of the paper!

Priyanka Jain

Indian Institute of Information Technology Guwahati

Sub : Analog Integrated Circuit (EC301)

Date : 25.11.2022

Time : 09:30 to 12:30 hrs **Full Marks : 50**

Answer All questions. No queries will be answered in the examination hall.

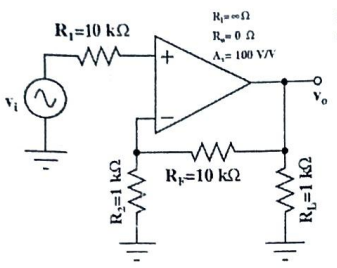


Fig. 1

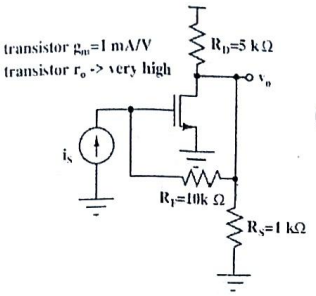


Fig. 2

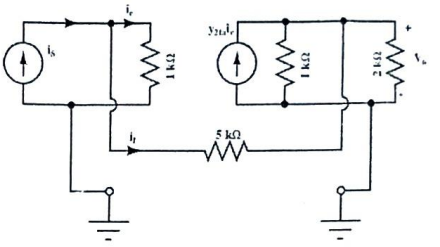


Fig. 3

1. Write down the correct alternative. (8 x 2 = 16)

i. Consider the circuit of Fig. 1. The type of feedback of the circuit is
   a. Shunt-shunt
   c. series-shunt
   b. Shunt series
   d. shunt series

ii. For the circuit of Fig. 1, magnitude of the feedback factor of the circuit is
   a. 1/11
   c. 10/11
   b. 1/10
   d. 9/11

iii. Closed loop gain v_o/v_i of the circuit shown in Fig.1 is
   a. 1200/112
   c. 1100/111
   b. 112/1100
   d. 1

iv. Consider the circuit of Fig. 2. The type of feedback of the circuit is
   a. Shunt-shunt
   c. Series-shunt
   b. Shunt-series
   d. Shunt-series

v. For the circuit of Fig. 2, magnitude of the feedback factor of the circuit is
   a. -1/1000
   c. -1/10000
   b. -1/100
   d. 1/10

vi. For the circuit of Fig. 2, the closed loop gain v_o/i_s in Ω is
   a. 4.58
   c. -4.58
   b. 4.58 k
   d. -4.58 k

vii. For the circuit of Fig. 3, magnitude of the feedback factor is
   a. -1/(5kΩ)
   c. 0
   b. 1/(5kΩ)
   d. None of the above

viii. For the circuit of Fig. 3, if y_{21a} has a very large magnitude, the closed loop gain of the circuit is
   a. – 5 kΩ
   c. 1 kΩ
   b. 5 kΩ
   d. 10 kΩ

2. For the circuit shown in Fig. 4 , prove that the output resistance w.r.t. the output node v_0 is $R_{out}= (r_{o2}||r_{o4})$ where r_{o2} and r_{o4} are output resistances of the transistors M2 and M4 respectively. (6)

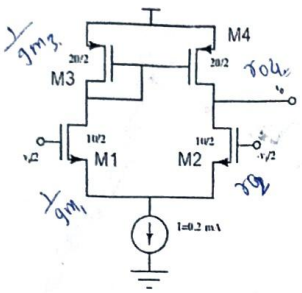


Fig. 4

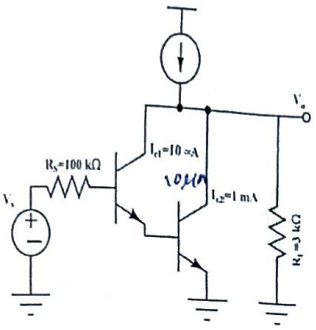


Fig. 5

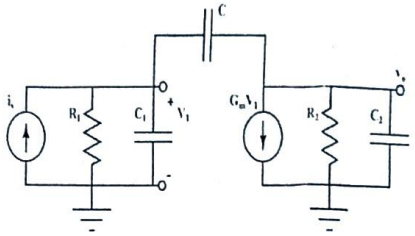


Fig. 6

3. For the Darlington pair shown in Fig. 5, for both transistors, β=100, C_μ=0.4 pF, C_π=2 pF, I_{c1}=10 μA, I_{c2}=1mA. Find the input resistance of the amplifier and the amplifier gain V_o/V_s. (V_T=25 mV) (3+3)
4. For the amplifier circuit shown in Fig. 6, if dominant and non-dominant poles are placed widely apart, prove that dominant pole $p_1=1/(G_mR_1R_2C)$ and non-dominant pole $p_2=G_mC/\{C_1+C_2+C(C_1+C_2)\}$. (3+3)
5. Draw a typical nMOS based Hartley oscillator, whose load inductances are L_1, L_2, load capacitance is C and load resistance is R. Derive the oscillation frequency of the Hartley Oscillator. (6)

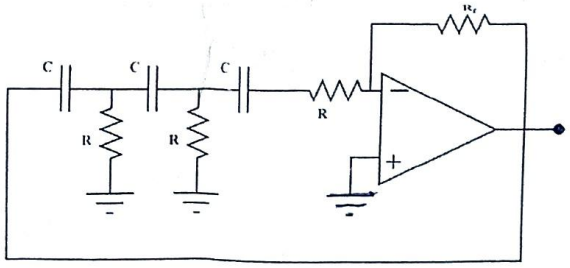


Fig. 7

6. For the phase shift oscillator shown in Fig. 7, prove that resistances R_f and R are related as R_f=29R. (6)
7. Answer the following very briefly : (1 x 4)
   i. Define the capture range of a PLL using illustration.
   ii. Why a common-emitter(CE)-common-collector (CC) configuration will have better bandwidth performance than a Darlington pair configuration?
   iii. A typical 2 stage CMOS opamp has 1st stage low frequency gain of 100 V/V and 2nd stage low frequency gain of 20 dB. Find the overall low frequency gain in dB.
   iv. Define the CMRR of a differential amplifier.