INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA [HP]

An Institute of National Importance under MoE

Saloh, Una (HP) – 177 209

Website: www.iiitu.ac.in

School of Electronics

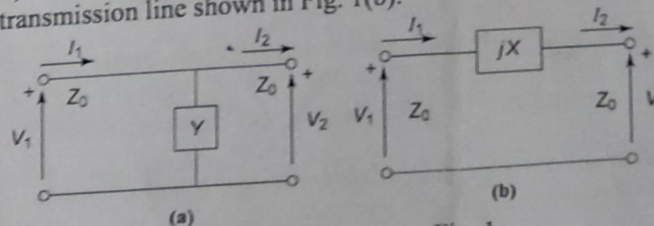
CURRICULUM: IIITUGECE22

End Semester Examination

May 01, 2023

Time: 09:00 hrs. to 12:00 hrs.

Degree	B. Tech.	**Branch**	ECE
Semester	IV		
Subject Code & Name	ECC401: Microwave Engineering		
Time: 180 Minutes	**Answer All Questions**	**Maximum: 100 Marks**	

Sl. No.	Question	Marks
1.a	Discuss how the microwave spectrum is categorized into different bands.	5
1.b	Evaluate the transverse component H_x in terms of longitudinal components when the wave is travelling in +y direction.	5
1.c	Terrestrial telecommunications systems commonly aggregate large numbers of individual communications links into a single high-bandwidth link. This is often implemented as a radio link between dish-type antennas having gain of about 27 dBi mounted on very tall towers and operating at frequencies around 6 GHz. Assuming the minimum acceptable receive power is −120 dBm (−120dB relative to 1 mW; i.e., 10^{-15} W) and the required range is 30 km, what is the minimum acceptable transmit power?	5
1.d	Derive the expressions for the field components due to TE waves in rectangular wave guide.	5
2.a	Find the equivalent voltages and currents for a TE_{10} mode in a rectangular waveguide and also calculate the relevant characteristic impedance.	5
2.b	i). If a lossless two-port network is reciprocal, show that $\|S_{21}\|^2 = 1 - \|S_{11}\|^2$. ii). If the lossless two-port network is non-reciprocal, show that it is impossible to have unidirectional transmission, where $S_{12} = 0$ and $S_{21} \neq 0$.	5 (2+3)
2.c	State and prove the symmetry and unitary property of S-matrix for a reciprocal and lossless network.	5
2.d	i). Find ABCD parameters of the shunt admittance Y in the transmission line shown in Fig. 1(a). ii). Find the S-parameters of the series reactance jX placed in the following transmission line shown in Fig. 1(b).  Fig. 1	5 (2+3)

<table>
<tr><td>3.a</td><td>An air-filled rectangular waveguide shown in Fig. 2 operates in the dominant mode.
i). Find the cut-off frequency.
ii). Determine the phase velocity of the wave in the guide at a frequency of 3 .5 GHz.

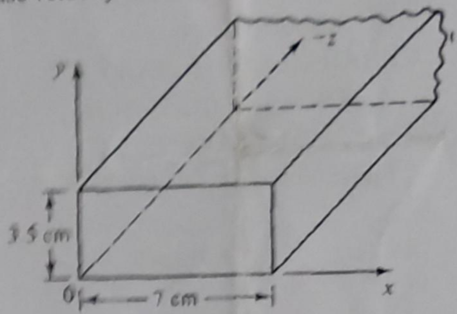



Fig. 2</td><td>5 (3+2)</td></tr>
<tr><td>3.b</td><td>Deduce the S-matrix of a E-Plane Tee microwave junction device.</td><td>5</td></tr>
<tr><td>3.c</td><td>A TE_{11} mode is propagating through a circular waveguide (CWG). The radius of the guide is 5 cm, and the guide contains an air dielectric.
i). Determine the cut-off frequency.
ii). Determine the wavelength (λ_g) in the guide for an operating frequency of 3 GHz.
Table: Values of P'_{nm} for TE modes in CWG
<table><tr><th>n</th><th>P'_{n1}</th><th>P'_{n2}</th></tr><tr><td>0</td><td>3.832</td><td>7.016</td></tr><tr><td>1</td><td>1.841</td><td>5.331</td></tr></table></td><td>5 (2+3)</td></tr>
<tr><td>3.d</td><td>For an air filled rectangular waveguide of internal dimensions $a \times b (a>b)$, the cut-off frequency for the TE_{10} mode is 6 GHz. For the same waveguide, if the cut-off frequency for the TM_{11} mode is 15 GHz, find the cut-off frequency in TE_{01} mode.</td><td>5</td></tr>
<tr><td>4.a</td><td>A Three port circulator has an insertion loss of 1 dB, isolation 30 dB and VSWR = 1.5. Find the S-matrix.</td><td>5</td></tr>
<tr><td>4.b</td><td>Explain the limitations of conventional tubes at microwave frequencies.</td><td>5</td></tr>
<tr><td>4.c</td><td>A two-cavity klystron amplifier has the following parameters:
V_0 = 1000 V f = 3 GHz
Gap spacing in either cavity: d = 1 mm
Find the gap transit angle (θ_g) and velocity modulation coefficient (β_i).</td><td>5</td></tr>
<tr><td>4.d</td><td>Explain the operation of Magnetron Oscillator and Interpret the resonant modes with equivalent circuit in the operation of magnetron.</td><td>5</td></tr>
<tr><td>5.a</td><td>Given:
Electron density: n = 1018 cm-3
Electron density at lower valley: ne = 10 10 cm-3
Electron density at upper valley: nu = 108 cm-3
Temperature: T = 300°K. Determine the conductivity of the diode.</td><td>5</td></tr>
<tr><td>5.b</td><td>i). Describe the advantages of Schottky barrier diode and draw its current-voltage characteristics in comparison with PN junction diode.
ii). What is the equivalent circuit model and symbol of Schottky barrier diode and mention the applications?</td><td>5 (3+2)</td></tr>
<tr><td>5.c</td><td>What are the criteria for negative resistance? Describe the different Gunn oscillation modes with illustrations.</td><td>5</td></tr>
<tr><td>5.d</td><td>Explain the operation of metal-semiconductor field-effect transistor (MESFET) and show how electric filed and drift velocity vary at the gate junction.</td><td>5</td></tr>
</table>

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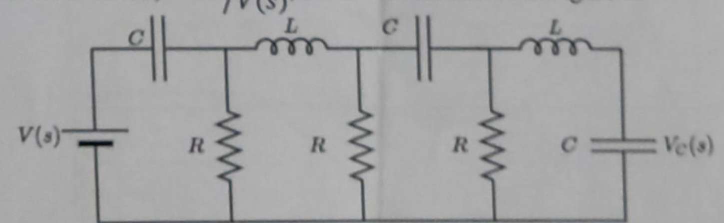
AY 2022-23
School of Electronics
CURRICULUM: IIITUGECE22
End Semester Examination
02, May.'23
09:00 – 12:00 hrs.

Degree	B. Tech.	Branch	ECE
Semester	IV		
Subject Code & Name	ECC402 / Control Systems		
Time: 180 Minutes	Answer All Questions		Maximum: 100 Marks

S. No	Question	Marks
1.a	Briefly discuss the following: i. Sensitivity of the closed loop systems. ii. Transient response of the closed loop systems. iii. Stability of the closed loop systems. iv. Tracking of the reference in the closed loop systems. v. Positive feedback in closed loop systems.	5
1.b	A temperature control system operates by sensing the difference between the thermostat setting and the actual temperature and then opening a fuel valve an amount proportional to this difference. Draw a functional closed-loop block diagram identifying the input and output transducers, the controller, and the plant. Further, identify the input and output signals of all subsystems previously described.	5
1.c	Find the transfer function, $V_C(s)/V(s)$, for the circuit shown in Figure 1.  **Figure 1:** An electrical network	5
1.d	A boost converter is a dc-to-dc switched power supply in which the voltage output is larger than the voltage input. A block diagram for a peak current mode-controlled converter is shown in Figure 2. Find the transfer function $\hat{v}_0(s)/\hat{v}_i(s)$.	5

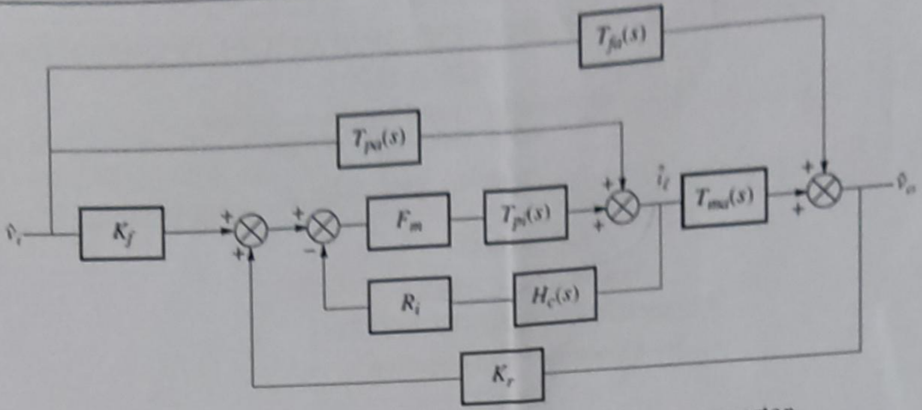


Figure 2: A block diagram representation of boost convertor.

2.a	Determine the time response of the system $y(t)$ and the steady state error $e_{ss}(t)$, when the following two systems are subjected with: (a) impulse input and (b) unit step input. $$G_1(s) = \frac{1}{\phi s + 1}$$ $$G_2(s) = \frac{\phi}{s^2 + 1.2\phi s + \phi}$$ Where, ϕ is the last two digits of your roll number.	5
2.b	For the system shown in Figure 3, find the values of K_1 and K_2 to yield a peak time of 1 second and a settling time of 2 seconds for the closed-loop system's step response.	5

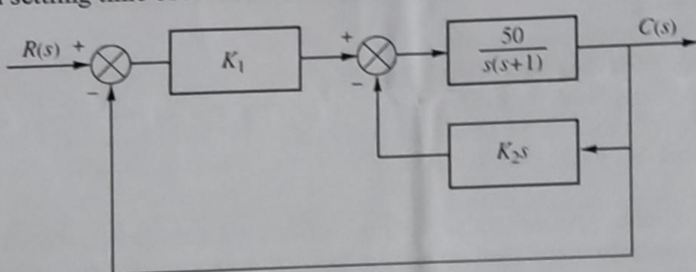


Figure 3: A block diagram representation of closed loop system.

2.c	The step response of a 2nd order system is shown in Figure 4 for an input of $4u(t)$. Determine the open and closed loop transfer function. Assume unity feedback.	5

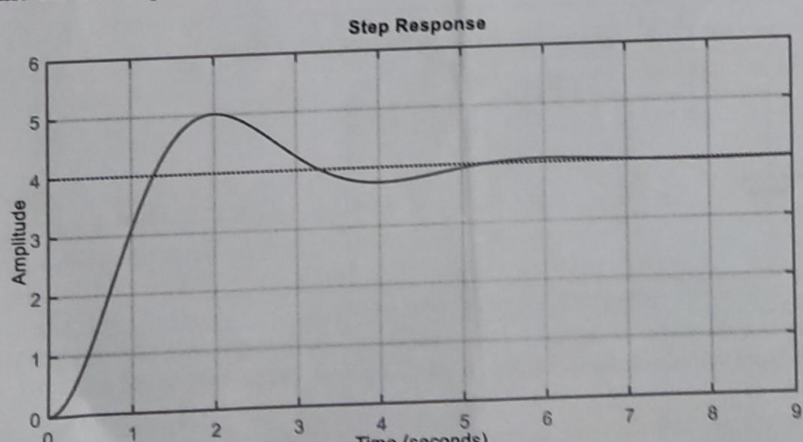


Figure 4: Step response of a 2nd order system.

$\{\xi^{\omega}/\xi$

2.d Briefly discuss the following: **[5]**

i. How can the stability of a system be estimated from the impulse response of a system?
ii. How does the type of the system impact the accuracy of the system for a given test signal?
iii. Why is it essential to determine the time response of systems?
iv. What is the physical significance of damping and natural frequency?
v. How does the location of poles and zeros impact the time response of a second order systems?

3.a Why stability is the crucial criterion in control system design? Discuss the importance of the following with respect to control systems. **[5]**

i. Exponential stability.
ii. Relative stability.
iii. Internal stability.
iv. Nyquist stability criterion.

3.b For the system shown in Figure 5, find the value of gain, K, that will make the system oscillate. **[5]**

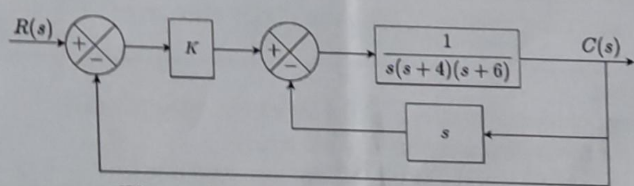


Figure 5: A feedback control system

3.c Determine the range of K for closed-loop stability of a system shown in Figure 6, when: **[5]**

$$G(s) = K\frac{s-a}{s(s-b)}$$

i. $a < 0$ & $b < 0$
ii. $a < 0$ & $b > 0$

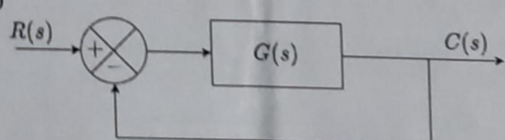


Figure 6: A feedback control system

3.d How does increasing the controller gain analytically contribute to improving accuracy, noise reduction, and disturbance rejection? **[5]**

4.a Derive the transfer function of the system based on the Bode plot depicted in the Figure 7. **[5]**

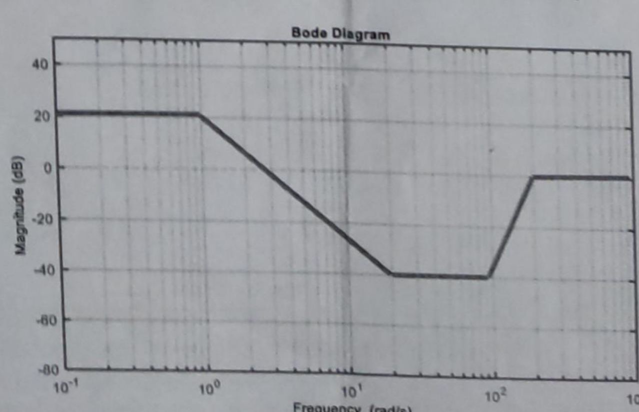


Figure 7: Bode plot of a system

4.b How can Nyquist plots be used to obtain information about stability margins and relative stability? Illustrate with the help of an example. — 5

4.c Consider the feedback system as in Figure 8. If the resonant peak and resonant frequency of this system is 1.04 and 11.55 rad/sec respectively. Determine the settling time and bandwidth. — 5

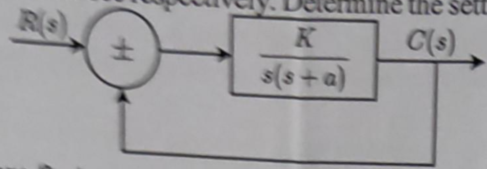


Figure 8: A second-order feedback control system

4.d Discuss the following scenarios: — 5

i. What will happen when control system has high gain at high frequency ranges?

ii. The Nyquist plot encircles the point $-1 + j0$ thrice in anti-clockwise direction. What does this indicate about the open loop and closed loop behaviour of the system?

iii. A system with 7 poles and 3 zeros would exhibit what value of slope at high frequencies in a Bode magnitude plot?

iv. How can it be inferred from the root locus if a system is unstable?

v. What effect does increasing gain have upon the steady state error?

5.a Briefly discuss the following: — 5

i. What is a convenient choice of state variables for electrical networks?

ii. Give two reasons for modelling systems in state space.

iii. What is meant by the phase-variable form of the state equation?

iv. How many state equations would a ninth order system have in its state space representation?

v. Why is it essential to determine the controllability of a system?

5.b Determine the state equations and the output equation using the phase-variable representation for the following systems: — 5

$$G_1(s) = \frac{2s + 1}{s^2 + 7s + 9}$$

$$G_2(s) = \frac{1}{s^4 + 5s^3 + s^2 + 5s + 15}$$

5.c Determine the rise time, setting time and overshoot percentage of a system whose state space model is given as: — 5

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -14 & -100 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 100 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

5.d Determine the controllability and observability of the following system: — 5

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} -1 & 1 & 2 \\ 0 & -1 & 5 \\ 0 & 3 & -4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

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7P 2Z = 7·dB/dec

4P 2Z

7×20 − 3×20

140 − 60

3×3 3×1

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AY 2021-22

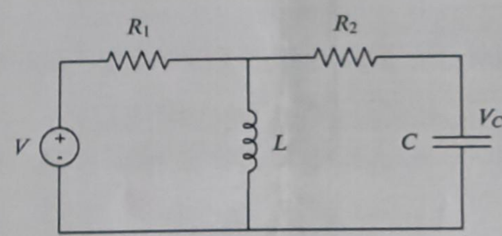
School of Electronics

CURRICULUM: IIITUGECE19

End Semester Examination

17, May.'22

Degree	B. Tech.	**Branch**	ECE
Semester	IV		
Subject Code & Name	ECC402 / Control Systems		
Time: 180 Minutes	**Answer All Questions**		**Maximum: 100 Marks**

S. No.	Question	Marks
1.a	Discuss the effect of the feedback on the following: i. Overall gain of the closed loop systems. ii. Sensitivity of the closed loop systems. iii. Transient response of the closed loop systems. iv. Stability of the closed loop systems. v. Tracking of the reference in the closed loop systems.	5
1.b	How transfer function approach and state-space approach can be used for mathematically model a system? What are the characteristics of these approaches? With the help of one example show, how the state space representation offers a better representation than transfer function approach for analysing the internal stability of the control systems?	5
1.c	Find the transfer function, $V_C(s)/V(s)$, for the circuit shown in Figure 1. Also determine the transfer function of the equivalent mechanical system using *F/V* analogy?  **Fig. 1:** Two-loop electrical network	5
1.d	The human eye has a biological control system that varies the pupil diameter to maintain constant light intensity to the retina. As the light intensity increases, the optical nerve sends a signal to the brain, which commands internal eye muscles to decrease the pupil's eye diameter. When the light intensity decreases, the pupil diameter increases. Draw a functional block diagram of the light-pupil system indicating the input, output, and intermediate signals; the sensor; the controller; and the actuator.	5

2.a Consider the state and output equations of a system. Construct the signal flow graph and by using Mason's gain formula, determine the transfer function of the system.

$$\dot{x}_1 = 2x_1 - 5x_2 + 3x_3 + 2r$$
$$\dot{x}_2 = -6x_1 - 2x_2 + 2x_3 + 5r$$
$$\dot{x}_3 = x_1 - 3x_2 - 4x_3 + 7r$$
$$y = -4x_1 + 6x_2 + 9x_3$$

5

2.b Given the block diagram of a system shown in Figure 2, find the transfer function between $\theta_{22}(s)/\theta_{11}(s)$.

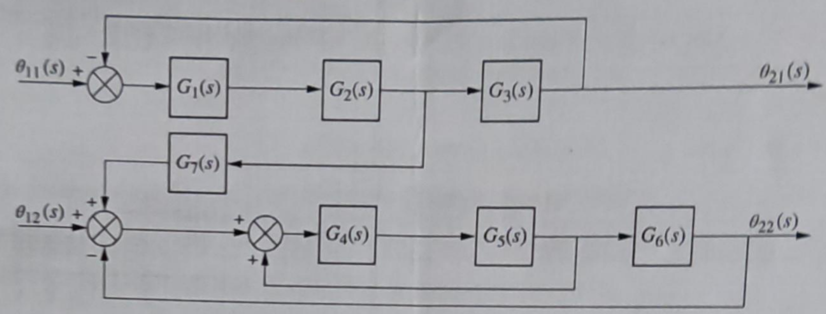


Fig. 2: A multi-input multi-output control system.

5

2.c Find the transfer functions between output voltage across C & L for an input voltage V_{IN}, for the circuits as shown in the Figure 3. Also calculate the rise time, settling time and overshoot percentage when the input voltage is increased from 5V to 8V.

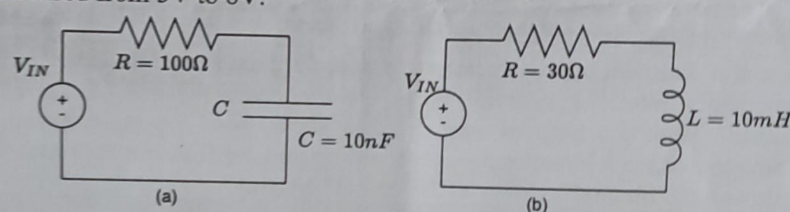


Fig. 3: A RC and RL circuit.

5

2.d For a simple 2nd order feedback control system as shown in Figure 4.

i. Describe the effect that variations of forward-path gain, K, have on the transient response.

ii. Describe the changes in damping ratio as the gain, K, is increased over the underdamped region.

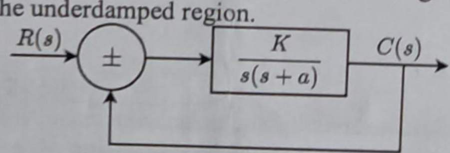


Fig. 4: Second-order feedback control system

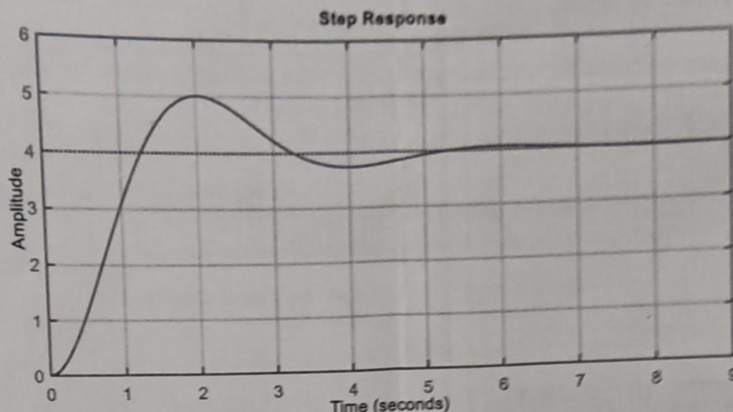
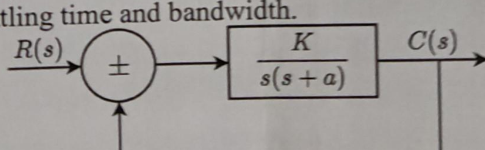
5

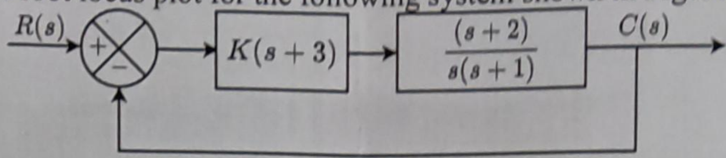
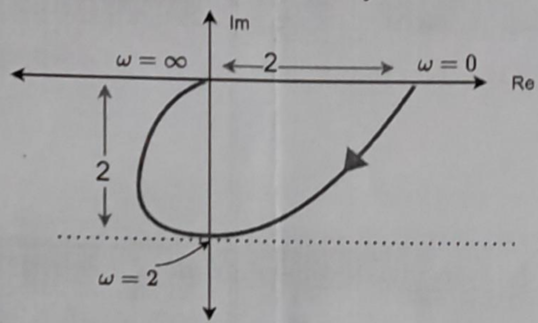
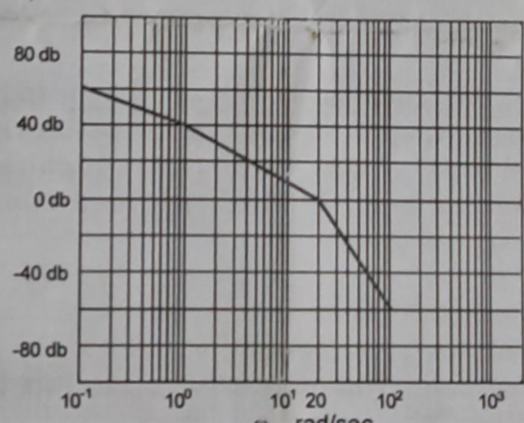
3.a Discuss the application of the following control system equipments in various control system applications? Explain with the help of an example.

i. Position control of a DC servo motor

ii. Synchro transmitter and receiver

5

3.b	A system with transfer function $G(s)$ is excited with a sinusoidal input $\sin(\omega t)$. Find the frequency of the input signal such that the steady state error is zero. $$G(s) = \frac{(s^2+9)(s+2)}{(s+1)(s+3)(s+4)}$$	5
3.c	The step response of a 2nd order system is shown in Figure 5 for an input of $4u(t)$. Determine the open and closed loop transfer function. Assume unity feedback.  **Fig. 5:** Step response of a 2nd order system.	5
3.d	Why stability is the crucial criterion in control system design? Discuss the importance of the following with respect to control systems. i. Exponential stability ii. Relative stability iii. Internal stability iv. Nyquist stability criterion.	5
4.a	A mercury thermometer was kept in ice ($0°C$) for an indefinite period. It was removed and immediately put in boiling water ($100°C$) and it showed $75°C$ after 2.5 seconds. Determine the transfer function of the thermometer.	5
4.b	Discuss the following scenarios: i. What will happen when control system has high gain at high frequency ranges? ii. The Nyquist plot encircles the point $-1 + j0$ thrice in anti-clockwise direction. What does this indicate about the open loop and closed loop behaviour of the system? iii. A system with four poles and two zeros would exhibit what value of slope at high frequencies in a Bode magnitude plot? iv. How can you tell from the root locus if a system is unstable? v. Increasing system gain has what effect upon the steady-state error?	5
4.c	Consider the feedback system as in Figure 6. If the resonant peak and resonant frequency of this system is 1.04 and 11.55 rad/sec respectively. Determine the settling time and bandwidth.  **Fig. 6:** A second-order feedback control system	5

4.d	Sketch the root locus plot for the following system shown in Figure 7.  **Fig. 7:** A feedback control system	5
5.a	Why is it necessary to analyse the frequency domain behaviour of the system in addition to the time domain behaviour of the system? How the use of Nyquist plots gives us the information about the various stability margins and relative stability? Illustrate with the help of an example.	5
5.b	The polar plot of an all-pole second order open-loop system is shown in Figure 8. Obtain the transfer function of the system.  **Fig. 8:** Polar plot of an all pole 2nd order system.	5
5.c	Obtain the transfer function of the system whose Bode plot is shown in Figure below.  **Fig. 9:** Bode plot of a system	5
5.d	Determine the controllability and observability of the following system: $\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \\ \dot{x_3} \end{bmatrix} = \begin{bmatrix} 1 & -3 & 3 \\ 3 & -5 & 3 \\ -6 & -6 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$ $y = [0 \quad 1 \quad 1] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$	5

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CURRICULUM: IIITUGECE22

END SEMESTER EXAMINATION

03, May'23

Degree	B. Tech.	Branch	ECE
Semester	IV		
Subject Code & Name	ECC403: Microprocessors and Microcontrollers		
Time: 180 Minutes	Answer All Questions		Maximum: 100 Marks

Sl. No.	Question	Marks
1.a	Explain the segment registers of 8086 microprocessor with physical address calculation using proper diagrams.	5
1.b	Discuss the user programmable flags in 8086 by showing the different contents in all the used registers.	5
1.c	What is the use of 8282 octal latch in Address latch enable (ALE) of 8086? Justify it with proper connections of 8282 latch with 8086.	5
1.d	Show the contents of all the registers of 8086 after using PUSH and POP instructions with suitable example.	5
2.a	Discuss the various addressing modes of 8086 with proper programming examples.	5
2.b	Write a program for 8086 to compute: $$Y = \sum_{i=1}^{100} x_i w_i$$ where x_i and w_i are signed 8-bit numbers by assuming there is no overflow.	5
2.c	Write a program for 8086 to find the even and odd numbers from an array of 16-bit numbers.	5
2.d	Discuss the calculation of physical address of interrupt service routine (ISR) from the interrupt table in 8086.	5
3.a	Discuss the register banks and stack in 8051 with proper address allocation.	5
3.b	Assuming that ROM space starting at 250H contains "INDIA", write a program to transfer the bytes into RAM locations starting at 40H.	5
3.c	Calculate the value to be loaded into the timer's registers for 5ms time delay generation by assuming XTAL=11.0592MHz. Show the program for Timer 0 to create a pulse width of 5ms on P2.3.	5

3.d	Assume that a 1-Hz frequency pulse is connected to input pin 3.4. Write a program to display counter 0 on an LCD. Set the initial value of TH0 to -60.	5
4.a	Discuss the format of SCON register with its proper diagram.	5
4.b	Write a program to receive the data which has been sent in serial form and send it out to port 0 in parallel form. Also save the data at RAM location 60H.	5
4.c	Discuss the calculation of value to be loaded in timer to set a particular value of baud rate for serial communication with proper programming example.	5
4.d	Write a program that displays a value of 'Y' at port 0 and 'N' at port 2 and also generates a square wave of 10KHz with Timer 0 in mode 2 at port pin P1.2. XTAL =22MHz.	5
5.a	Write a program in 8086 for designing the 8-bit binary number to grey number converter.	5
5.b	Design the connection diagram for interfacing 8086 with the 32KB of EPROM and 64KB of RAM starting at addresses of 00000H.	5
5.c	Assume that bit P2.3 is an input and represents the condition of an oven. If it goes high, it means that the oven is hot. Monitor the bit continuously. When it goes high, send a low-to-high pulse to port P1.5 to turn on buzzer using 8051 microcontroller.	5
5.d	Design the connection diagram for interfacing of seven segment with 8051 microcontroller. Write a program to display 0 to 9 on seven segment.	5

*** ALL THE BEST ***

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AY 2022-23
School of Electronics
END SEMESTER EXAMINATION
04, May'23
Time: 09:00-12:00 hrs

Degree	B. Tech.	**Branch**	ECE
Semester	IV		
Subject Code & Name	ECC404: Linear Integrated Circuits		
Time: 180 Minutes	**Answer All Questions**		**Maximum: 100 Marks**

Sl. No.	Question	Marks
1.a	Derive expression for voltage gain, input and output resistance for common emitter amplifier. Also, explain the need of emitter resistance.	5
1.b	What are the characteristics features of differential amplifier? Obtain the voltage gain, input and output resistance of differential amplifier using BJT.	5
1.c	An amplifier has an open circuit voltage gain of 1000, an output resistance of 15Ω and an input resistance of 7kΩ. It is supplied from a signal source of e.m.f. 10mV and internal resistance 3kΩ. The amplifier feeds a load of 35 Ω. Determine (i) the magnitude of output voltage and (ii) power gain.	5
1.d	For the circuit shown in Figure 1, determine the following parameters: I. The d.c. bias levels II. d.c. voltages across the capacitors. III. a.c. emitter resistance IV. Voltage gain and state of the transistor.	5

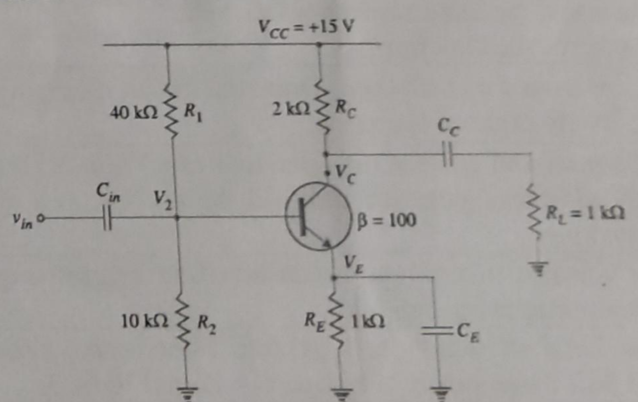
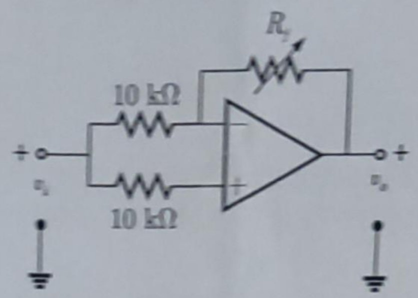
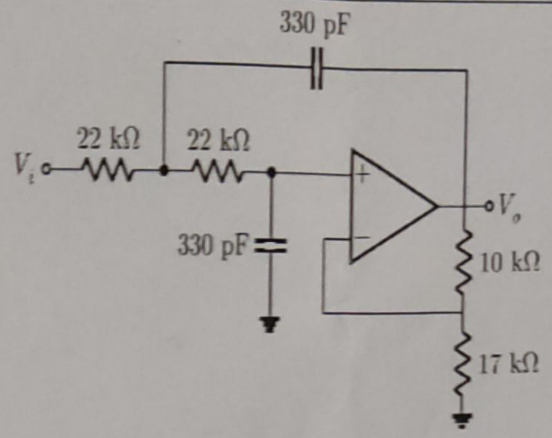
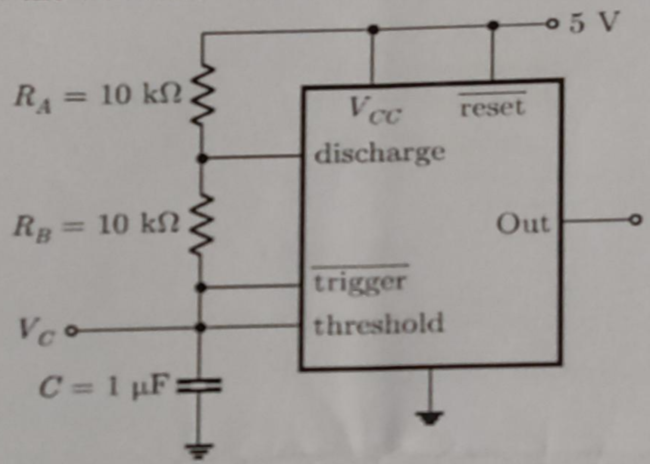


Figure 1

Sl. No.	Question	Marks
2.a	Draw and explain circuit diagram of improved instrumentation amplifier. Also, write any two applications of instrumentation amplifier.	5
2.b	Draw the circuit diagram and explain the working of a ramp generator using Op-Amp.	5

2.c	Why Op-Amp is not used in open loop for most of the applications? In the ideal Op-Amp circuit given in Figure 2, the value of R_f is varied from 1 kΩ to 100 kΩ. Determine the change in gain of Op-Amp.  Figure 2	5
2.d	The V_1 and V_2 are the input voltages of an instrumentation amplifier. The output of the instrumentation amplifier is found to be $100\,(V_1 - V_2) + 10^{-4}(V_1 + V_2)$. Determine the gain and the common mode rejection ratio (CMRR) of the instrumentation amplifier.	5
3.a	Draw and explain circuit diagram of a differentiator circuit. Also, derive an expression for the output voltage.	5
3.b	Design the following circuits using Op-Amp: I. Sample and Hold Circuit II. Logarithmic amplifier	5
3.c	Design an antilogarithmic amplifier using an Op-Amp with a feedback resistor of 10 kΩ. The input voltage is 1 V, and the desired output current is 100 μA. Morover, the diode used in the antilog amplifier has a voltage drop of 0.7 V and a reverse saturation current of 10 nA. Calculate the value of the input resistor and the Op-Amp output voltage.	5
3.d	An Op-Amp has a gain of 100,000 and an input offset voltage of 10 mV. It is being used in a circuit with a feedback loop that has a feedback resistance of 10 kΩ. The OP-AMP is being used to amplify a signal of 1 V. Determine the following: I. The output voltage of the Op-Amp. II. The voltage gain of the circuit. III. The input bias current if the input resistance is 1 MΩ. IV. The output resistance of the Op-Amp.	5
4.a	State the Barkhausen criterion for oscillation. Draw the circuit diagram of Colpitt's Oscillator and explain its principle of operation.	5
4.b	Draw the schematic diagram and analyze the operation of a Wein bridge oscillator. Also, discuss how can additional negative feedback be applied to a Wein bridge oscillator to stabilize the loop.	5
4.c	What is the difference between inverting and non-inverting Schmitt trigger? Also, design the astable multivibrator using Op-Amp.	5
4.d	Explain the difference between active and passive filter. Also, determine the frequency response and 3dB frequency of the circuit given in Figure 3.	5

	 Figure 3	
5.a	Explain the working of monostable multivibrator using 555 IC. Also, derive the expression for operating frequency.	5
5.b	Generate the square wave using 555 IC. A 555 astable multi-vibrator circuit is shown in the Figure 4. Draw the waveform and obtain the value of V_C if R_B is shorted.  Figure 4	5
5.c	Design an astable multivibrator using 555 timer circuit with $R_1 = 10\ k\Omega$, $R_2 = 22\ k\Omega$ and C= 1 μF. Obtain the following parameters of the output waveform generated by the 555 timer: 1) Frequency of the output waveform (f). 2) Duty cycle of the output waveform (D). 3) Time period of the output waveform (T). 4) High-level output voltage (V_H). 5) Low-level output voltage (V_L).	5
5.d	Explain the principle of PLL with the help of neat block diagram. Also, mention its applications.	5

**** GOOD LUCK *****