Maximum Marks: 60
Credits: 04
Duration: Two Hours

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

Values of some constants: Energy gap for Si = 1.12 eV; Thermal voltage (kT/e = 25 mV at room Temp.); Permittivity of free space ($\varepsilon_0 = 8.85\times10^{-12}$ F/m); Permittivity of silicon ($\varepsilon_{si} = 12\ \varepsilon_0$); Permittivity of oxide ($\varepsilon_{ox} = 3.9\ \varepsilon_0$); $N_c = 2.8\times10^{19} cm^{-3}$; $N_v = 1.04\times10^{19} cm^{-3}$

1. a) What is the meaning of the Fermi-Dirac probability function? Show the curves of Fermi Dirac function showing the probability of a state being occupied and the probability of a state being empty. What is the effect of temperature on it.

b) The intrinsic carrier concentration in silicon is to be no greater than $n_i = 1\times10^{12} cm^{-3}$, determine the maximum temperature allowed for silicon.

c) What is Hall Effect? Explain with sketches.

OR

1’ a) Explain qualitatively the splitting of allowed and forbidden energy bands for an electron in crystal. What is difference between compensated and degenerate semiconductors.

b) What is the product of $n_e$ and $p_o$? Derive the relationship representing this product starting from basics.

c) A 1 cm long piece of undoped silicon (shown in Figure-1) with a lifetime of 1 ms is illuminated with light, generating $G_{opt} = 2 \times 10^{10} cm/s$ (gen. rate) electron-hole pairs in the middle of the silicon.

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Figure-1
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\[\text{contd...}\]
This bar silicon has ideal Ohmic contacts on both sides. Find the excess electron density throughout the material using the simple recombination model and assuming $\mu_n = \mu_p = 1000 \text{cm}^2 / \text{V.s}$ . Also find the resulting electron current density throughout the material.

(Based on CO-2) [15]

2  What is Hyperabrupt junction? Show that $m = -\frac{3}{2}$ results desired characteristic of varactor diode. Derive the expressions for depletion and diffusion capacitances of a normal pn junction.

OR

2'  What is heterojunction? Explain the operation with energy band diagram for all four types of straddling heterojunction. What is two dimensional electron gas?

(Based on CO-3 & 4) [15]

3  For bipolar junction transistors (BJT), Define Emitter Injection Efficiency Factor, Base Transport Factor and Recombination Factor. A uniformly doped silicon $n_p n$ transistor is to be biased in the forward active mode with B – C junction reverse biased by 3 V. The metallurgical base width is 1.10 $\mu$m. The transistor dopings are $N_E = 10^{17} \text{cm}^{-3}$, $N_B = 10^{16} \text{cm}^{-3}$ and $N_C = 10^{15} \text{cm}^{-3}$ (a) For $T = 300$ K, calculate Base- Emitter voltage at which the minority carrier electron concentration at $x = 0$ is 10 percent of majority carrier hole concentration. (b) At this bias, determine the minority carrier hole concentration neutral at $x' = 0$. (c) Determine the neutral base width for this bias.

(Based on CO-3 & 4) [15]

4  Using charge sheet model and assuming gradual channel approximation, derive the current voltage characteristics of the MOSFET. Consider an n-channel MOSFET with substrate doping $N_A = 10^{16} \text{cm}^{-3}$. Assuming that $4.5 \times 10^{11} \text{cm}^{-2}$ oxide charges are present right at the Si-SiO$_2$ interface on the oxide side. Assume oxide thickness of 10 $\mu$m. Calculate the flat band voltage, if it employs (a) Aluminium gate ($e\Phi_m = 4.1 \text{ eV}$ ) and (b) $p^+$poly silicon gate. Given: electron affinity of Si = 4.05 eV and Energy Gap of Si = 1.12 eV.
2017-18
B.TECH (WINTER SEMESTER) EXAMINATION
OPEN ELECTIVE
INDUSTRIAL ELECTRONICS & INSTRUMENTATION
EL-320

Maximum Marks: 60
Credits = 4
Duration: Two Hours

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

Q.No.
1(a) Construct a MOD 2 Counter using D flip-flop
1(b) A five-bit D/A converter produces \( V_{OUT} = 0.2 \) V for a digital input of 00001. Find the value of \( V_{OUT} \) for an input of 11111
1(c) Show how a 8 Input Multiplexer (74HC151) can be used to generate the logic function \( Z = AB + BC + AC \)
1(d) With the help of a circuit diagram explain the operation of a cross coupled NAND Latch

OR

1'(a) Implement an edge triggered D flip-flop using J-K flip-flop
1'(b) Show how to use 1-of-8 decoders (74ALS138) to form a 1-of-16 decoder
1'(c) Implement a 4-line-to-2-line encoder with the help of basic gates
1'(d) With the help of a circuit diagram show that for a R-2R Ladder type DAC, the analog output is proportional to the applied digital inputs

2(a) Analyze the circuit of a Wien-bridge oscillator and obtain it's frequency of oscillation and condition of oscillation
2(b) With the help of a detailed block diagram explain the working of a continuous conversion Digital Voltmeter (DVM) using a digital-ramp ADC

\[ \text{contd...} \]
2'(b) Enlist the advantages of Digital Storage Oscilloscope (DSO) over Conventional Storage Oscilloscope (CSO). Sketch and analyse the circuit of a DSO and explain its operation.

3(a) Draw the labelled Pin Diagram of Intel 8085. Also discuss the operation of the following pins/signals:
   1. HOLD
   2. READY
   3. TRAP

3(b) With the help of a circuit diagram explain the READ & WRITE operation of a 6-T SRAM cell

OR

3'(b) Design a PROM of total capacity 8K * 8 by combining several 2K * 8 PROMs. How many PROM chips are needed? How many address bus lines are required?

4(a) Discuss the operating modes of Intel 8255. Also describe the significance of control word register and identify the individual bits of the register.

4(b) Using ADC 0804 (Analog-to-Digital converter) and a programmable peripheral interface (Intel 8255), give a microprocessor-based scheme for the temperature measurement and control.
Q.No. | Question | M.M.
---|---|---
1(a) | Sketch the root locus for a system having $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+4)}$ where, $K > 0$. | 12

OR

1(a') | A unity feedback control system has $G(s) = \frac{K}{s(s+4)(s+10)}$. Draw the Bode plot. Find $K$ when phase margin $(PM) = 30^\circ$. | 12

1(b) | What do you mean by compensator? Discuss series and parallel compensators. | 3

2(a) | Find the state space representation of the system describe by the following equations $\frac{dx_1(t)}{dt} = -3x_1(t) + x_2(t) + 2u(t)$, $\frac{dx_2(t)}{dt} = -2x_2(t) + u(t)$ and $y(t) = x_1(t)$. Where $u(t)$ is the input and $y(t)$ is the output. | 8

OR

Contd. 2.
2(a') Determine the state transition matrix and the state transition equation of the state variable system given below

\[
\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ 0 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)
\]

with initial condition

\[ x(0) = [-1 \ 3]^T \]

and the unit step input \( u(t) \) is applied. Symbol "T" in the superscript indicates transpose.

2(b) Find the controllability of the system represented by

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

OR

2(b') Derive the state equation of a system having transfer function as follows:

\[ G(s) = \frac{Y(s)}{U(s)} = \frac{8}{s(s + 2)(s + 3)} \]

Use cascade decomposition.

3(a) Describe the following common nonlinear system behaviours:
   a) Limit cycles
   b) Jump resonance

3(b) Determine the stability of the system shown in figure below

![Block diagram of a control system](image)

\[ R(s) \rightarrow \text{Defol} \rightarrow \text{Input} \rightarrow 10 \frac{10}{(1 + 0.4s)(1 + 2s)} \rightarrow C(s) \]

\[ \text{Stability analysis...} \]
4(a) Multiple Choice Questions & Answers

(i) For minimizing the transfer function the condition is:
   (A) Second differentiation of the function must be zero
   (B) Second differentiation of the function must be positive
   (C) Second differentiation of the function must be negative
   (D) Second differentiation of the function must be complex

(ii) Z-transform is used in:
   (A) Continuous optimal control problem
   (B) Discrete optimal problem
   (C) Control systems
   (D) None of the mentioned

(iii) The main step(s) for solving the optimal control problem:
   (A) Transfer function of system which is optimal with respect to the given
       performance criterion
   (B) Compute the compensators for the system
   (C) Minimizing the quadratic function
   (D) All of the above

4(b) Consider the block diagram given below,

\[ R(s) = \frac{1}{s} \]

\[ Ks \]

\[ G(s) = \frac{100}{s^2} \]

Determine the optimal value of parameter \( K \) such that

\[ S = \int_0^{+\infty} e^2(t) dt \text{ is minimum.} \]
Question 1

(a) Compute the 4-point DFT of the sequence \( x(n) = \{-2, 2, 1, -1\} \), using DIT-FFT algorithm.

(b) Consider the DFT pair

\[
x(n) \leftrightarrow X(k) = \{4, -j2, 0, j2\}
\]

with \( N = 4 \). Find the DFT of \( x((-n)_N) \).

OR

(b') In many applications, it is necessary to multiply a sequence by a window \( w(n) \). Let \( x(n) \) be an \( N \)-point sequence, and let \( w(n) \) be a Hamming window:

\[
w(n) = \frac{1}{2} + \frac{1}{2} \cos \left( \frac{2\pi n}{N} - \frac{N}{2} \right).
\]

Find the DFT of windowed sequence, \( x(n)w(n) \), in terms of the DFT of the unwindowed sequence.

Question 2

(a) Derive the relation between \( s \) and \( z \) for the Bilinear transformation method of IIR filter design.

OR

(a') Show that Bilinear transformation maps the \( j\Omega \) axis in the \( s \)-plane onto the unit circle \( |z| = 1 \) in the \( z \)-plane and maps the left half of the \( s \)-plane i.e. \( Re(s) < 0 \) inside the unit circle i.e. \( |z| < 1 \).

(b) If \( H(z) \) is a LPF, show that \( H(-z) \) is a HPF. If \( \omega_p \) and \( \omega_s \) represent the pass-band and stop-band edge frequencies of \( H(z) \), determine the location of pass-band and stop-band edge frequencies of \( H(-z) \).

OR

(b') Transform the analog filter transfer function

\[
H_a(s) = \frac{4s + 7}{s^2 + 5s + 4}
\]

into a digital filter \( H(z) \) using the impulse-invariant method at \( F_s = 2 \) Hz.
Question 3

(a) Realize the system function

\[ H(z) = \frac{1}{2} + \frac{1}{3}z^{-1} + z^{-2} + \frac{1}{4}z^{-3} + z^{-4} + \frac{1}{3}z^{-5} + \frac{1}{2}z^{-6} \]

using minimum number of multipliers.

(b) Design an FIR digital filter to approximate an ideal low-pass filter with pass-band gain of unity, cut-off frequency of 850 Hz and working at a sampling frequency of \( F_s = 5000 \text{Hz} \). The length of impulse response should be 5. Use a rectangular window.

OR

\( b' \) An FIR linear phase filter has the following impulse response

\[ h_d(n) = \begin{cases} 
1 & 0 \leq n \leq 4 \\
0 & \text{otherwise.} 
\end{cases} \]

Use Bartlett’s window and compute the impulse response of the filter.

Question 4

(a) Consider the system

\[ y(n) = \frac{1}{2}y(n-1) + x(n). \]

(i) Compute its response to the input \( x(n) = \left( \frac{1}{3} \right)^n u(n) \) for \( 0 \leq n \leq 5 \), assuming infinite precision arithmetic.

(ii) Compute the response of the system \( y(n) \), \( 0 \leq n \leq 5 \) to the same input as in (i), assuming finite precision signed magnitude fractional arithmetic with 5 bits (i.e. sign bit plus four fractional bits). The quantization is performed by truncation.

(b) What is the effects of ‘coefficient quantization’ on the stability of digital filters? Why FIR filter is always stable?

(c) A given signal \( x(n) \) whose frequency content was non-zero in the range of frequency \( \omega \in \left[ -\frac{\pi}{8}, \frac{\pi}{8} \right] \). What is the effect of the down sampling by a factor of 2 over the signal spectrum, plot the possible spectrum of the down-sampled signal.
2017-18
B.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
COMMUNICATION NETWORKS
EL-344

Maximum Marks: 60
Credits: 04
Duration: Two Hours

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

Q.No.  Question                                                                 M.M.
1(a)   In OSI layered framework, define protocol and service. Explain their difference. [CO1] [03]
1(b)   Why is it that voice and video traffic is often sent over TCP rather than UDP in today’s Internet? [CO1] [04]
1(c)   Suppose a LAN carry voice traffic. What provisions are required to handle voice traffic in a token ring and polling environment. [CO1] [04]
1(d)   Suppose transmission channels become virtually free. Is the data link layer still needed? Justify your answer.[CO1, CO2] [04]
2(a)   Explain in brief the functionality of different layers in OSI model.[CO2] [10]
2(b)   Why is CSMA/CD not used in wireless LANs?[CO3] [5]
3(a)   Assume that in a Stop and Wait ARQ system, the bandwidth of the line is 1 Mbps, and 1 bit takes 20 ms to make a round trip. What is the bandwidth-delay product? If the system data frames are 1000 bits in length, what is the utilization percentage of the link? What is the utilization percentage of the link if a protocol can send upto 15 frames before stopping for acknowledgements? [CO3], [CO4],[CO2] [8]
3(b)   Suppose that ALOHA protocol is used to share a 56kbps satellite channel. Suppose that frames are 1000 bits long. Find the maximum throughput of the system in frames/second. [CO3, CO4],[CO2] [07]
3(b’*) Suppose a message 110110 is CRC encoded using polynomial \(g(x) = x^3 + x^2 + 1\). Find the corresponding codeword. Can \(g(x)\) detect double bit error. Explain. [CO3, CO4, CO2] [07]

OR

3(b’*) Suppose a message 110110 is CRC encoded using polynomial \(g(x) = x^3 + x^2 + 1\). Find the corresponding codeword. Can \(g(x)\) detect double bit error. Explain. [CO3, CO4, CO2] [07]
4(a) Consider a subnet with prefix 128.119.40.128/26. Give an example of one IP address (of form xxx.xxx.xxx.xxx) that can be assigned to this network. Suppose an ISP owns the block of addresses of the form 128.119.40.64/26. Suppose it wants to create four subnets from this block, with each block having the same number of IP addresses. What are the prefixes (of form a.b.c.d/x) for the four subnets? [CO5]

4(b) Comment on the three-node instability problem in distance vector routing algorithm. Suggest a method to solve the above problem. [CO4, CO5]

OR

4(b') Compare and contrast link-state and distance-vector routing algorithms. [CO4, CO5]

4(c) An IPv4 packet has arrived with the first few hexadecimal digits as shown. 45000028000100000102. How many hops can this packet travel before being dropped? The data belong to what upper-layer protocol? [CO4, CO5]

OR

4(c') Consider sending a 2400-byte datagram into a link that has an MTU of 700 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation? [CO4, CO5]
2017-18
B.TECH. (WINTER SEMESTER) EXAMINATION
MECHANICAL/ ELECTRONICS ENGINEERING
ME-340: ECONOMICS AND MANAGEMENT

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all the questions. Assume suitable data if required.

Q.No. | Question | M.M.
---|---|---
1(a) | A new building to house Manufacturing Facilities is be constructed on the campus to strengthen income generation. A design utilizing a combination earth-work bowl with a steel upper deck and press box is being considered. The following cost estimates (in $) have been developed. | [08]
| First cost of complete construction | 32,000 |
| Paint steel structure every 6 years | 2,000 |
| Replace iron grouting's every 10 years | 4,000 |
| Repave machine foundations every 12 years | 3,000 |
| Annual Maintenance | 1,500 |

Assuming 25-year life and negligible salvage value, determine the minimum annual revenue that must be generated to justify the project when the interest rate is 7%.

1(b) | What are economic indicators? Explain GDP and GNP. | [04]

OR

1' | There is a continuing requirement for standby electrical power at a public utility service facility. Equipment alternative "S1" involves an initial cost of $72000, a 9 year useful life, annual expenses of $2200 the first year and increasing $300 per year thereafter, and the net market value of $8400 at the end of the useful life. Alternative "S2" has an initial cost of $90000, a 12 year useful life, annual expenses of $2100 the first year and increasing at the rate of 5% per year thereafter, and a net market value of $13000 at the end of useful life. The current interest rate is 10% per year. Which alternative is preferred using Present Worth method? | [12]

... contd...
A company is considering replacing 15 workstations which are on a STAR network. These workstations have a total salvage value of $8500. The existing system could last for another 3 years with a system update that will cost $4500 immediately. Also, after the update, the current system will have the following associated data:

<table>
<thead>
<tr>
<th>Year</th>
<th>Salvage value($)</th>
<th>Operating &amp; Maintenance Costs ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7000</td>
<td>13000</td>
</tr>
<tr>
<td>2</td>
<td>3500</td>
<td>18000</td>
</tr>
<tr>
<td>3</td>
<td>1000</td>
<td>23000</td>
</tr>
</tbody>
</table>

The new workstations will cost $8000 each ($8000 x 15 = $120,000 in total), and implementation for all the computers will cost $1500. The technological life of the new equipment is 5 years and salvage value decreases from the first cost by 28% per year. Operating costs will be $4000 for each of the first 2 years (due to warranty issues) and will be $8000, $10000, and $13000 for years 3 through 5 respectively. Should the company opt for replacement? If so, when? Use MARR of 8% per annum.

2(b) Define Inflation. Discuss some causes and consequences of Inflation.

3(a) What activities do managers perform under the four major functional areas of management?

3(b) Illustrate with an example the use of pay off matrix in decision making.

4(a) Explain various levels of planning in the context of a university as an organization.

4(b) Briefly explain the five different kinds of leaders on the leadership grid.

OR

4′(a) Discuss the relative merits and demerits of Product and Functional forms of Departmentalization.

4′(b) Differentiate between (i) Flat and Tall organizational structures (ii) Power and Authority

5(a) Why do companies hold inventory? What factors discourage them to hold inventory beyond a certain level?

5(b) Briefly explain three major decision areas of financial management.