19 Batch Level 3 Term 2 Question Bank

EEE-361 Power Electronics	2
EEE-363 Microprocessor and Interfacing	4
EEE-365 Digital Signal Processing	7
EEE-367 Electronic Communication	9
EEE-369 Semiconductor Physics and Devices	10

Question Collection Credit:

Nusrat Jahan Papri

1902008

Chittagong University of Engineering & Technology
Department of Electrical and Electronic Engineering
B.Sc. Engineering, Level 3, Term II, Examination-2021-22

Course No : EEE-361
Course Title : Power Electronics
Full Marks : 210
Time : 3 Hours

The figures in the right margin indicate full marks. Answer any three questions from each section. Use separate script for each section.

SECTION – A

1(a) Draw the symbol, two thyristor analogy of a TRIAC. Also with the cross section diagram of a TRIAC, briefly describe the operation of a TRIAC, when (i) MT2 and Gate terminal being positive with respect to MT1 terminal, (ii) MT2 is negative, but Gate terminal is positive with respect to MT1 terminal. 12

1(b) With necessary figures, briefly explain how TRIAC is used to vary the rms value of the AC output voltage. 11

1(c) With neat circuit diagram, briefly describe how DIAC can be used to trigger a TRIAC. How the trigger angle can be varied to regulate the fan speed? 12

2(a) What is the function and advantages of using free-wheeling diode in AC-DC controlled rectifier with R-L type of load? 08

2(b) Suppose you have gone outside for a short visit. During your visit, you have noticed that your mobile phone is showing very low amount of charge. Now to charge it, you are planning to use a system which provides an AC voltage of 120V (rms), 50Hz. However, your mobile phone needs to receive a DC voltage of 10V. Design a circuit to charge your mobile phone if your phone can be considered as 100Ω resistor. Also determine the power absorbed by the phone. 12

2(c) The figure for Q.2c shows a battery charging circuit using SCR. The input voltage to the circuit is 220V rms. If one of the SCR is open circuited, what is the charging current for a firing angle of 45^0? 15

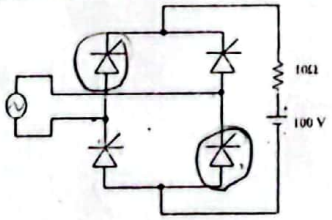

Fig Q2c

3(a) For a three phase full wave controlled rectifier with R-L-E load working on continuous conduction mode. Draw the power circuit diagram, input-phase and line-to-line voltage wave shapes, SCR trigger pulses and the output voltage wave shape for triggering angle of $\alpha = 90^0$ from the point of natural commutation. (Use graph paper to draw the wave shapes). 20

3(b) What is regenerative breaking? How can the bidirectional rotation of DC motor with regenerative breaking be obtained using power electronics converter? Describe briefly with neat diagrams. 15

4 In a DC-DC converter application a load consisting of 100Ω resistor is to be connected at the converter output with desired output voltage of +75V DC. The supply voltage to converter is 120 V DC and switching frequency is 20kHz. 35

(i). Which DC-DC converter is suitable for the above application? Why?

(ii) Draw the neat circuit diagram of the suitable DC-DC converter.

(iii) With necessary figures, derive the voltage gain relation of the DC-DC converter.

(iv) Determine the value of the inductor L, if the allowable peak-to-peak ripple current is no more than 20% of the average inductor current.

(v) Determine the value of ideal capacitor such that the output voltage ripple is no more than 2%.

(vi) Show draw the wave shapes of input voltage, gate pulses, inductor current, load and output capacitor currents, switch and diode voltages and the output voltage wave shapes.

SECTION-B

5(a) Draw the two transistor model of the SCR. Describe "Resonant-Pulse" commutation process to turn "OFF" the SCR with circuit diagrams and wave forms. 12

5(b) An AC voltage controller as shown in Fig. 5(b) has a resistive load of R=10Ω. The input rms voltage is 120 V, 50Hz. The thyristor switch is ON for n=25 cycles and is OFF for m=75 cycles. Determine: (i) RMS output voltage V_0, 12

(ii) The input power factor PF and

(iii) The average current of thyristors.

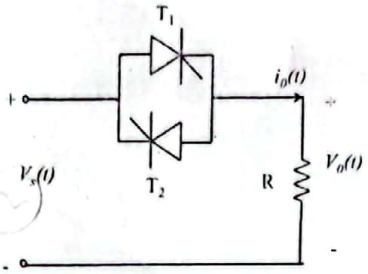

Fig. 5(b)

5(c) Explain the operation of a 1-φ full wave AC voltage controller having R-L load. Draw the necessary wave shapes and find the expressions of output voltage, currents and input power factor. 11

6(a) Draw 3- φ voltage source inverter and with the help of switching state tables, explain their operating principles considering 180^0 conduction. 17

6(b) For a full bridge inverter, the DC source is 125V, the load is a series R-L connection with R=10Ω, L=20mH, frequency is 50Hz. (i) Determine the THD of the load voltage, (ii) If displacement PF of the load is 0.9 lag, then what will be the "true" PF? 10

6(c) Draw the circuit diagram of a 1- φ cycloconverter. 08

7(a) Describe the operation of a 3- φ AC voltage controller with necessary diagrams and wave shapes. 12

7(b) For the circuit shown in figure 7(b), R=10Ω, V_{rms}=230V, f=50Hz. The delay angle of thyristors T_1, T_2 are $\alpha_1 = \alpha_2 = \pi/2$. Determine the rms output voltage V_0. 14

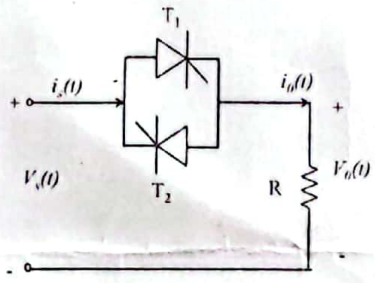

Fig. 7(b)

7(c) Write short notes on: 09

(i) Distortion factor
(ii) Harmonic factor and
(iii) Dielectric heating.

8(a) Draw the circuit diagram for a 5-level inverter. Show the output waveform and explain its operation for any level of the output voltage. 12

8(b) Draw the basic circuit for AC resistance welding and describe the operation of "Spot welding" and "Projection welding". 12

8(c) A square sheet of material 10" on a side and 0.5" thick, having a dielectric constant of 6.5 is to be heated at 5MHz. The power factor of the material is 8% and it is desired to supply 5kW to the load. What voltage must be applied to the electrode? 11

THE END

Chittagong University of Engineering and Technology
Department of Electrical & Electronic Engineering
B.Sc. Engineering, Level 3, Term II, Examination-2021-22

Course No : EEE-363/EEE-421(o)
Course Title : Microprocessor and Interfacing
Full Marks : 210
Time : 3 Hours

The figures in the right margin indicate full marks. Answer any three questions from each section. Use separate script for each section.

SECTION – A

1(a) Describe and draw the block diagram of a computer system showing the microprocessor position with address, data and control bus structure. 12

1(b) Briefly explain the evolution of microprocessor from the first to modern microprocessor. 13

1(c) Explain the function of flag bits in 8086 microprocessor with suitable example. 10

2(a) Find out which of the following instructions are correct and incorrect. Also correct the incorrect instructions showing proper causes. 10

(i) MOV AX, CALL[SI]
(ii) JUMP AX
(iii) LODS [AX],[BX]
(iv) IDIV DX-AX, BX
(v) XCHG [BX], [AX]

2(b) Discuss in details with suitable example: 10

(i) Direct address
(ii) Register relative addressing

2(c) A program and memory maps are shown in Fig. 2(c). Determine the followings: 15

(i) All the register values after the final instruction.
(ii) The final change in the relative memory maps.

```
MOV   AX, 5566H
MOV   SI, 2002H
MOV   DI, 2004H
DEC   BYTE  PTR[SI+1]
CLD
LODS  W
STOS  B
INC   DI
STD
MOVS  W
XCHG  AX, [SI+1]
XCHG  AX, [DI+2]
```

	CS		DS		ES		SS
2000	10	2000	11	2000	A1	2000	B1
2001	20	2001	12	2001	A2	2001	B2
2002	30	2002	13	2002	A3	2002	B3
2003	40	2003	14	2003	A4	2003	B4
2004	50	2004	15	2004	A5	2004	B5
2005	60	2005	16	2005	A6	2005	B6
2006	70	2006	17	2006	A7	2006	B7
2007	80	2007	18	2007	A8	2007	B8
2008	90	2008	19	2008	A9	2008	B9
2009	00	2009	1A	2009	A0	2009	AB

Fig. 2(c)

3(a) Find out the contents of the BX register after the execution of last instruction of the following program. 15

```
MOV     BX, 7788H
AND     BX, 8877H
OR      BX, 8877H
SAL     BX, 1
RCL     BX, 1
RCR     BX, 1
XOR     BX, FFEDH
```

3(b) Write an assembly language program to add three 16 bits hexa numbers. Put them in DS memory and store the final result in ES memory. Assume, DS=0000H, SI=2000H, ES=1000H, DI=3000H. 10

3(c) Using loop instruction, write an assembly language program to calculate 10

$\sum_0^{100}(x+1)$

4(a) The necessary memory maps are given in Fig. 4(a). Assume, SP before CALL is FFFFH. 13
Complete memory maps and find out following:

(i) SS before CALL
(ii) IP before CALL
(iii) SP after CALL
(iv) SS after CALL
(v) IP after CALL
(vi) CS after CALL

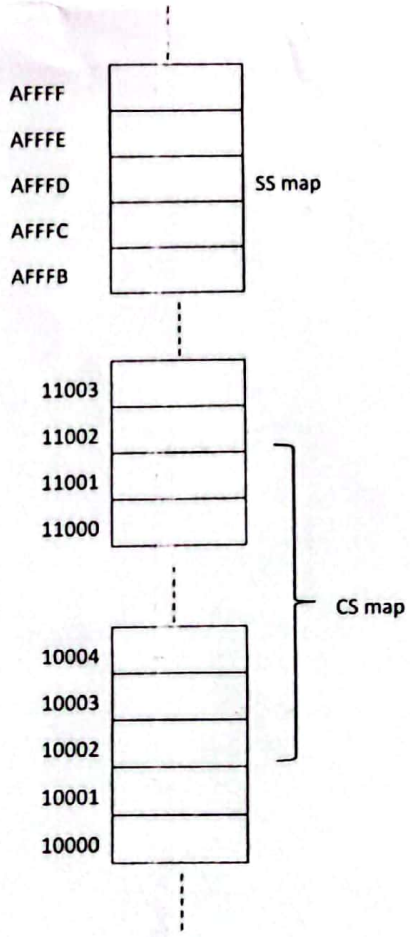

Fig. 4(a)

4(b) Write an assembly language program to add the following series using: 12

(i) REPEAT--- UNTIL loop
(ii) WHILE loop

1+4+7+.....+40

4(c) Write down the consequences of INT and IRET instructions sequentially. 10

SECTION-B

5(a) Why 8284A clock generator is used? Briefly explain the functions of 8284A clock generator. 15

5(b) Describe the bus buffering and latching in 8086 microprocessor with appropriate schematic diagram. 10

5(c) Mention the functions of the control pins of 8086 microprocessor. 10

6(a) In a memory mapped I/O, how does the microprocessor differentiate between an I/O and memory? Can an I/O have the same address as a memory register? 15

6(b) Fig. 6(b) represents the DIP switches interfacing with 8086 microprocessor. 20

(i) Why buffer is used between decoder and DIP switches?
(ii) Why 3-to-8 decoder is used?
(iii) Write an assembly language program to read data from the switches.

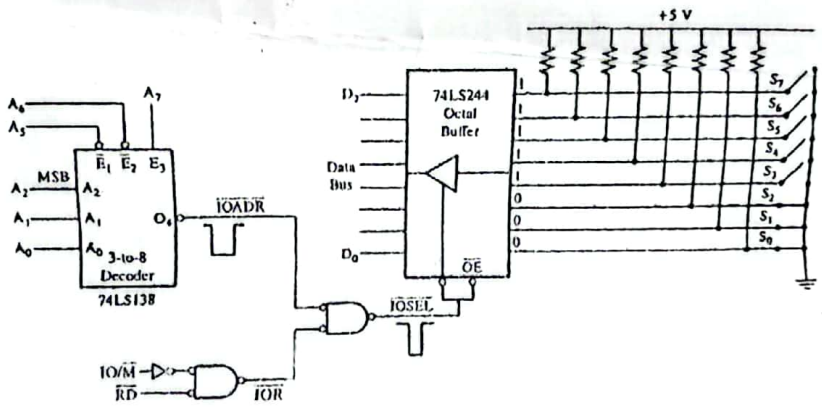

Fig. 6(b)

7(a) Describe the control word format of 8254 programmable interval timer (PIT). 15

7(b) Write instructions to generate pulses every 50μs from counter 0. (Set the port address arbitrarily). 15

7(c) Mention the ~~manes~~ names of modes of operation of counter peripheral IC. 05

8(a) How external interrupt request are handled by 8259 programmable interrupt controller? Explain. 15

8(b) With a neat sketch show how an 8×8 DOT MATRIX display can be interfaced with 8086. 10

8(c) Why the following signals are used during hand shaking operation? 05

(i) $\overline{STB}$
(ii) IBF
(iii) $\overline{OBF}$
(iv) $\overline{ACK}$

8(d) Mention the functions of IRR and ISR of 8259 PIC. 05

THE END*

Chittagong University of Engineering and Technology
Department of Electrical & Electronic Engineering
B.Sc. Engineering, Level 3, Term II, Examination-2021-22

Course No : EEE-365 / EEE 4950
Course Title : Digital Signal Processing
Full Marks : 210
Time : 3 Hours

The figures in the right margin indicate full marks. Answer any three questions from each section. Use separate script for each section.

SECTION – A

1(a) Determine the Fourier series and power density spectrum of the signal shown in Fig. 1(a).What is happened if τ is changed? Explain with graph. 13

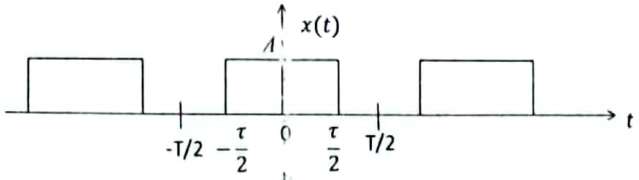

Fig. 1(a)

1(b) Compare Fourier series and Fourier transform. When they are valid? 10

1(c) What is basic difference between DTFT and DFT? If the DFT of $x(n)$ is $X(k)$. Even if $x(n)$is non-periodic signal, then show that $X(k)$ is periodic. 12

2(a) What is circular convolution? Perform the circular convolution of the sequences $x_1(n) = [2, \overset{1}{\uparrow}, 2, 1]$ and $x_2(n) = [\overset{1}{\uparrow}, 2, 3, 4]$ 12

2(b) What do you understand zero-padding? Is zero-padding changed the original value of DFT? Explain with example. What happed if zero-padding is done? Explain. 13

2(c) Write some drawbacks of DFT. How do you resolve the problems? 10

3(a) Design a digital Butterworth filter that satisfies the following constraint using bilinear transform method. Assume T=1. 13

$$0 \le |H(e^{j\omega})| \le 1 \text{ for } 0 \le \omega \le \frac{\pi}{2}$$

$$|H(e^{j\omega})| \le 2 \text{ for } 3\pi/4 \le \omega \le \pi$$

3(b) Explain time decimation process of FFT algorithm with neat sketch. Determine 8 point FFT of the signal 12

$x(n) = \{1, 2, 3, 4, 3, 2, 1, 0\}$.

3(c) Convert analog band-pass filter with the system function given below into a corresponding digital filter. 10

$$H_a(s) = \frac{1}{(s+0.1)^2 + 9}$$

4(a) Even the analog frequency range of signal may be situated from $-\infty$ *to* $+\infty$, show that corresponding digital frequency range is $-\pi$ *to* $+\pi$. 10

4(b) How do you design all types of digital filter from low-pass filter kernel? Explain with expression. 13

4(c) Design an FIR filter kernel with following parameters: $\omega_c = \pi/2$ and filter order 11 for a low-pass filter. You have to use Hamming window for reducing Gibb's effect. 12

SECTION-B

5(a) When a signal $x(n)$ is periodic? Determine the following signals either periodic or not. If the signal is periodic find the fundamental period of the signal. 12

(i) $x(n) = \cos\left(\frac{n\pi}{9}\right) + \sin\left(\frac{n\pi}{7} + \frac{\pi}{4}\right)$

(ii) $x(n) = Ae^{j\frac{5\pi n}{6}}$

5(b) Given that the input of LTI system is $x(n) = \delta(n) + \delta(n-1)$ and the output $y(n) = 2\delta(n) + 5\delta(n-1) + 3\delta(n-2)$. Determine the response of the system. 13

5(c) A causal LTI system has following system function 10

$$H(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}.$$

Show pole-zero plot of $H(z)$.

6(a) Determine the cross-correlation $x_{xy}(1)$ of the sequences 15

$x(n) = [\ldots, 0, 0, 2, -1, 3, 7, \underset{\uparrow}{1}, 2, -3, 0, 0, \ldots]$ and $y(n) = [\ldots, 0, 0, 1, -1, 2, -2, \underset{\uparrow}{4}, 1, -2, 5, 0, 0, \ldots]$

6(b) Define z-transform and ROC. Find the z-transformation of the signal in Fig. 6(b) and draw its ROC. 10

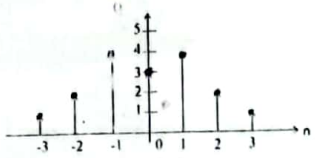

Fig. 6(b)

6(c) A discrete time system is realized by the structure shown in Fig.6(c). Determine unit sample response of the system. 10

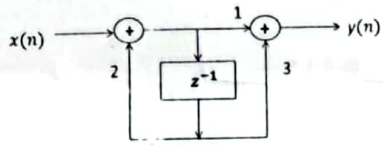

Fig. 6(c)

7(a) Determine the complete solution of $y(n)$ for $n \geq 0$ from the system equation 12

$y(n) + a_1 y(n-1) = x(n)$. Consider $x(n) = u(n)$ and $y(-1) = 0$

7(b) Determine the Fourier transform and energy density spectrum of the following signal. 13

$$x(t) = \begin{cases} A, & |t| \leq \frac{\tau}{2} \\ 0, & |t| > \frac{\tau}{2} \end{cases}$$

7(c) What is Gibb's phenomenon? How can it be reduced? 10

8(a) Consider an LTI system that is represented by $y(n) = \frac{6}{5}u(n) - \frac{1}{3}\left(\frac{1}{2}\right)^n u(n) + \frac{2}{15}\left(-\frac{1}{4}\right)^n u(n)$, where unit-step signal is input. Determine the transfer function of the system and implement the system with direct form I and direct form II. Is the system stable? 15

8(b) A system's impulse response is given by $h(n) = \{1, 2, 0, -1, 1\}$ and the input is $x(n) = \{1, 3, -1, -2\}$. Determine the output of the system $y(n) = x(n) * h(n)$ 10

8(c) Determine magnitude and phase response of $H(\omega)$ of the system given by 10

$$y(n) = 2y(n-1) + x(n) - x(n-1)$$

THE END

Chittagong University of Engineering and Technology
Department of Electrical & Electronic Engineering
B.Sc. Engineering, Level 3, Term II, Examination-2021-22

Course No : EEE 367/EEE-359(o)
Course Title : Electronic Communication
Full Marks : 210
Time : 3 Hours

The figures in the right margin indicate full marks. Answer any three questions from each section. Use separate script for each section.

SECTION – A

1(a)	Explain the functions of three main parts of electronic communication system with block diagram.	10
1(b)	With proper diagrams, explain the amplitude modulation process. Explain the usage and benefits of AM, DSBSC, SSB and VSB.	15
1(c)	What do you understand by modulation index? How can over-modulation be resolved?	10
2(a)	Explain why FM is better than AM?	05
2(b)	What are varactor diodes? Explain how FM modulation and demodulation is carried out.	15
2(c)	A frequency modulated voltage wave is $V_{fm} = 12\cos(6 \times 10^8 t + 5\sin(1250t))$. Find: (i) Carrier frequency; (ii) Signal frequency; (iii) Modulation index; (iv) Maximum frequency deviation and (v) Power dissipated by the FM wave in 10Ω resistor.	15
3(a)	Describe the operation of square law modulator circuits and diode detector circuits.	13
3(b)	Draw the basic components of both filter type and phase shift type circuits for generating SSB signals with proper equations.	14
3(c)	An SSB generator has a 9MHz carrier and is used to pass voice frequencies in the 300Hz-to-3300Hz range. The lower sideband is selected. What is the approximate center frequency of the filter needed to pass the lower side band?	08
4(a)	What do you understand by angle modulation? What are its advantages and disadvantages?	10
4(b)	Explain the process of PCM with proper diagrams. How does sampling and quantization affect the modulated signal?	15
4(c)	Describe the generation process of NBFM and WBFM.	10

SECTION-B

5(a)	Differentiate between duplexing and multiple-access.	10
5(b)	What do you understand by spread spectrum? How does it provide protection against jamming, noise and interference?	15
5(c)	How does multiple-access technique improve channel utilization? Explain with example.	10
6(a)	A ground based air surveillance RADAR operates at 1.19GHz. Its maximum range is 135 n-miles for the detection of target with a RADAR cross section of $2m^2$. Its antenna is 11m high by 5m wide and the antenna aperture efficiency is $\rho_a = 0.78$. The receiver minimum detectable signal is $S_{min} = 10^{-13}$ Watt. Determine: (i) Antenna effective aperture and gain; (ii) Peak transmitting power; (iii) Pulse repetition frequency; (iv) Duty cycle when pulse width is 1.75μs and (v) Average transmitting power	17
6(b)	What is unambiguous range of RADAR? Establish a relation between unambiguous range and inter-pulse period.	10
6(c)	What is 2nd time around echo and multiple times around echo? How to overcome them?	08
7(a)	Define and explain for a satellite: (i) Angle of inclination and (ii) Angle of elevation	10
7(b)	How does frequency selection matter in terms of uplink and downlink for satellite communication?	10
7(c)	Describe two multichannel architectures use in communication satellites.	15
8(a)	Describe the working mechanism of a TV camera with necessary diagram.	15
8(b)	Why scanning is necessary in TV transmission? Explain.	10
8(c)	How compatibility between color and monochrome TV is achieved? Explain the process.	10

THE END

Chittagong University of Engineering and Technology
Department of Electrical & Electronic Engineering
B.Sc. Engineering, Level 3 Term II, Examination-2021-22

Course No : EEE-369
Course Title : Semiconductor Physics and Devices
Full Marks : 210
Time : 3 Hours

The figures in the right margin indicate full marks. Answer any three questions from each section. Use separate script for each section.

SECTION – A

1(a). Sketch three lattice structures: i. Simple cubic, ii. Body-centered cubic, iii. Face-centered cubic. In what aspect a sphalerite structure differs from a diamond structure? 05

1(b). What is meant by substitutional impurity and an interstitial impurity in a crystal? 05

1(c). Write down the one-dimensional, non-relativistic Schrodinger's wave equation. Use the techniques of separation of variables; evaluate solutions to time-independent and time-dependent portion of it with physical interpretations. 10

1(d) For a particle in an infinite potential well, whose potential function is shown in Fig. 1(d), show that, $(x) = \sqrt{\frac{2}{a}}\sin(K_n x)$. Draw the four lowest discrete energy levels with their corresponding wave functions, and corresponding probability function. 15

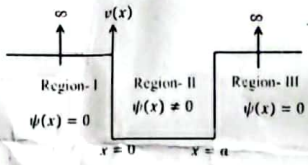

Fig. 1(d)

2(a). What is the phenomenon of quantum tunneling? 05

2(b). With the aid of neat-sketch and electronic structure explain the formation of energy bands in diamond. 10

2(c). What is the meaning of the Fermi-Dirac probability function? Consider the energy levels shown in Fig, 2(c). Let T=300^{0}K, If E_1-E_F=0.30 eV, determine the probability that an energy state at E=E_1 is occupied by an electron and the probability that an energy state at E=E_2 is empty. 10

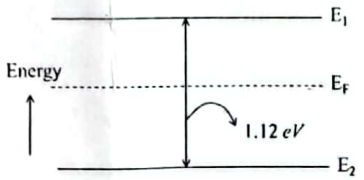

Fig. 2(c)

2(d). Discuss the concept of charge neutrality. Silicon at T=300^{0}K is doped with Boron atoms such that the concentration of holes is $\rho_0 = 5 \times 10^{15}$ cm^{-3}. (i) Find E_F-E_v, (ii) Determine E_C-E_F, (iii) Determine n_0 and (iv) Determine E_{Fi}-E_F 10

3(a). Describe the mechanism of carrier drift and induced drift current due to an applied electronic field in a semiconductor bar and end-up with microscopic representation of Ohm's law. 10

3(b). A Silicon sample is 2.5 cm long and has a cross-section area of 0.1 cm^2. The Silicon is n-type with a donor impurity concentration of N_d=2×10^{15} cm^{-3}. The resistance of the sample is measured and found to be 70Ω. What is electron mobility? 10

3(c). Why are the electron generation rate and recombination rate equal in thermal equilibrium? Explain Schokley-Read-Hall theory of recombination. 15

4(a). Starting with the ambippolar transport equation for excess minority carriers, show that the I-V characteristics of an ideal pn-junction is $J = J_s\left[e^{\frac{eV_a}{KT}} - 1\right]$; where the symbols have their usual meanings. Draw the total current profile including all the current components. 16

4(b). A Si pn-junction diode is to be designed to operate at T=300^{0}K such that the diode current is $I = 10\ mA$ at a diode voltage of V_D=0.65 V. The ratio of electron current to total current is to be 0.10 and the maximum current density is to be no more than 20 A/cm^2. Consider the following parameters in a Si junction. Determine the diode doping level. 14

D_n=25 cm^2/s; $\tau_{P_0} = \tau_{n_0} = 5 \times 10^{-7} s$; D_p=10 cm^2/s; $\epsilon_r = 11.7$

4(c). What is Poisson's equation? Why is it important for any electronic device? 05

SECTION-B

5(a). Why the switching characteristic of Schottky diode is faster than pn junction diode? Derive the equation of Schottky barrier lowering, $\Delta\varphi = \sqrt{\frac{eE}{4\pi\varepsilon_s}}$; where the symbols have their usual meanings. 17

5(b). Draw the energy band diagrams of $Al_{0.3}Ga_{0.7}As$-GaAs, hetero-junction for: 13

(i) n^+–AlGaAs, intrinsic – GaAs; (ii) p^+–AlGaAs, n^+– GaAs; (iii) n^+– AlGaAs, p– GaAs

Assume, E_g=1.85 eV for $Al_{0.3}Ga_{0.7}As$ and $\Delta E_C = \frac{2}{3}E_g$

5(c). What are the advantages of wide band gap semiconductors? 05

6(a). Sketch the cross-section of an n-channel MESFET and draw the idealized energy-band diagram of the substrate-channel-metal in the n-channel MESFET. Also sketch channel space charge region of an E-mode MESFET for (i) V_{GS}=0; (ii) V_{GS}=V_T and (iii) V_{GS}>V_T. 15

6(b). What is the basic difference between D and E mode device? Explain the effect of source resistance in trans-conductance and transistor gain of JFET. 10

6(c). Draw the band diagram of zero, negative and positive voltage biases for AlGaAs-GaAs HEMT. 10

7(a). The Schottky barrier height $\emptyset_{Bn}$ of a metal-n-GaAs MESFET is 0.90 V. The channel doping is N_d=1.5×10^{16} cm^{-3} and the channel thickness is a=0.6μm, T=300^{0}K. (i) Calculate the internal pinch-off voltage V_{p0} and the threshold voltage V_T. (ii) Determine whether the MESFET is depletion-type or enhancement-type. 15

7(b). How 2DEG is formed in n-N GaAs-AlGaAs. Explain using band diagram. Why the efficiency of a Schottky junction solar cell is less than pn-junction solar cell? 12

7(c). Explain the operating principle of HBT by the help of band diagram under forward active mode and equilibrium. 08

8(a). Draw the layer by layer structure of GaAs/AlGaAs based resonant tunneling diode and draw a schematic energy-band diagram of that structure in thermal equilibrium and when bias is applied. Show and discuss the I-V characteristics of different bias conditions (focus on negative differential resistance). 20

8(b). Explain the method of carrier injection in a semiconductor LED. 06

8(c). Discuss the design limitations of BJT and explain how these limitations can be minimized in HBT. 09

THE END