Question Paper

ESA JAN - FEB 2023 - UE22EC141A (set- 1)

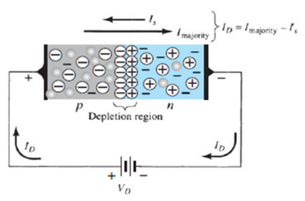
1.a : Marks (8.0)

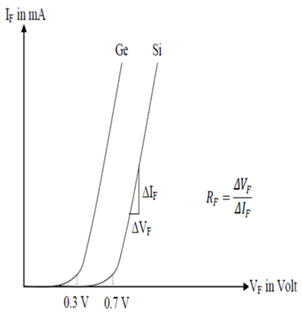
Answer the following:

(i) Explain Forward V-I Characteristics of semiconductor Diode with a neat diagram.
(ii) Realize Logical AND Operation and Logical OR using Diodes.
(ii) Mention the difference between Ideal and practical diode Characteristics.

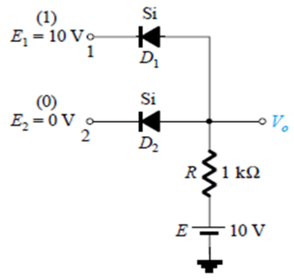
Excepted Answer

(i) In Forward Bias the material type of Diode connected to the same polarity terminal of the voltage source i.e. P type to Positive and N type to negative.

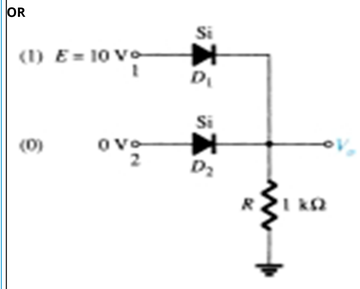




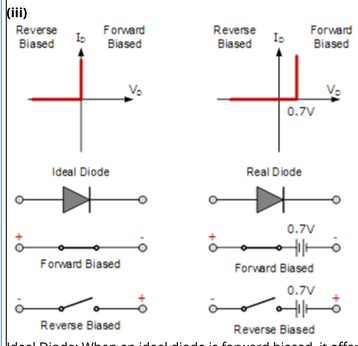
(ii) AND



OR



(iii)



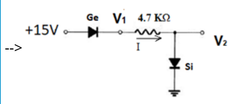
Ideal Diode: When an ideal diode is forward biased, it offers no resistance & acts like a closed switch. Likewise the ideal under reverse bias offers infinite resistance hence, it acts like open switch.
Practical Diode: A diode which is said to be forward biased it starts conducting at knee voltage & under reverse bias no current due to majority charges hence a practical diode is considered to be open switch (minority charges current ignored).

3M+3M+2M

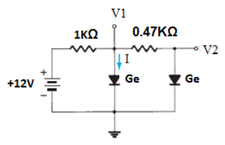
1.b : Marks (6.0)

Solve the following using second approximation for a diode.

(i) Determine I,V_1 and V_2



(ii) Determine I, V1 and V2, for the circuit shown below



Excepted Answer

(i)
15-0.3-I x4.7K-0.7=0
I=15-1/4.7K= 2.97mA ,-----2M
V1=15-0.3=14.7 V,---1M
V2=0.7V---1M

(ii)
12-1KxI -0.3=0
I=12-0.3/I=11.7mA---1M
V1=V2=0.3V ----------1M

1.c : Marks (6.0)

Using Shockley's equation, Find the diode current I_d for a silicon Diode, if the applied voltage V_D=0.72V and Reverse Saturation Current is 7×10^{-12} A at a temp of 32^0 C. Consider (?=1). Find the new Saturation current I_s if the Temperature is increased to 53^0 C.

Excepted Answer

$$I_D = I_S\left(e^{\frac{qV_D}{nkT}} - 1\right)$$ -----1M

$I_D = I_S \times e^{VD/VT}$ T= 273+32=305K
V_T= T/11600= 305/11600=0.0262------2M
$I_D = 7 \times 10^{-12} \times e^{0.72/0.0262}$ =6.02A------2M

New Temp T=326K
$I_S = 30 \times 10^{-12}$ A ----------1M

2.a : Marks (6.0)

Considering an Ideal diode for a Half wave rectifier, derive the expressions for V_{rms} and $V_{dc.}$ Also find the Efficiency (?) and Ripple factor of the Half wave rectifier.

Excepted Answer

$$V_{rms} = \left[\frac{1}{2\pi}\int_0^{2\pi}(V_m sin\omega t)^2\, d\omega t\right]^{1/2}$$
$$= \left[\frac{V_m{}^2}{2\pi}\int_0^{\pi}(sin^2\,\omega t)\;\; d\omega t\right]^{1/2}$$
$$= \left[\frac{V_m{}^2}{2\pi}\int_0^{\pi}\left(\frac{1-Cos2\,\omega t}{2}\right)\; d\omega t\right]^{1/2}$$
$$V_{rms} = \left[\frac{V_m{}^2}{2\pi}\left(\frac{\omega t}{2}-\frac{sin2\omega t}{2}\right)_0^{\pi}\right]^{1/2} = \frac{V_m}{2}$$

$$V_{dc} = \frac{1}{2\pi}\int_0^{2\pi} V_m\; sin\omega t\, d\omega t$$
$$= \frac{1}{2\pi}\int_0^{\pi} V_m\; sin\omega t\, d\omega t$$
$$= \frac{V_m}{2\pi}\;[-Cos\;\omega t]_0^{\pi} = \frac{V_m}{\pi}$$

$$\eta = \frac{P_{dc}}{P_{ac}} = \frac{DC\ power\ delevered\ to\ the\ load}{AC\ input\ power\ from\ the\ secondary\ of\ transformer\ to\ rectifier}$$

$$\eta = \frac{I_{dc}{}^2\, R_L}{I_{rms}{}^2\; R_L}$$

$\eta = 40.6\ \%$

$I'_{rms} = \sqrt{I^2_{rms} - I^2_{dc}}$ where I'_{rms} = rms value of AC Component

$$r = \frac{I'_{rms}}{I_{dc}} = \sqrt{\frac{(I^2_{rms} - I^2_{dc})}{I_{dc}{}^2}}$$

$r = 1.21$

$$= \sqrt{\left(\frac{I_{rms}}{I_{dc}}\right)^2 - 1}$$

2.b : Marks (8.0)

For the following Circuits, Draw the output waveform and calculate the Average DC Voltage and the required PIV of each diode. Consider Ideal Diodes.
(i)

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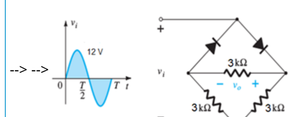

(ii)

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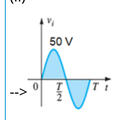
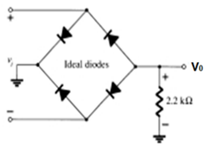
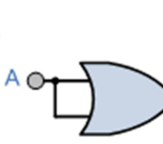




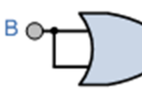
Excepted Answer

-->(i)

--> 

DC Voltage =3.81 PIV=6V Marks ---------- 2+1+1=4M

(ii)

--> 

DC Voltage= -31.83V, PIV=50V Marks ---------- 2+1+1=4M

2.c : Marks (6.0)

For the given Circuit determine the range of values of Vi that will maintain the Zener diode in the ?on? state.

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Excepted Answer

--> $V_{i_{min}} = \frac{(R_L + R)V_Z}{R_L}$

$I_L = \frac{V_L}{R_L} = \frac{V_Z}{R_L} =$

$I_{R_{max}} = I_{ZM} + I_L$

$V_{i_{max}} = I_{R_{max}}R + V_Z$

V_{imin} =21.46V----------2M
I_L=13.33 mA----------1M
IR_{max}=73.33mA----------1M
Vi_{max}=28.0663----------2M

3.a : Marks (5.0)

Answer the Following
(i) Realize NAND gate using NOR Gates
(ii) State and Prove Consensus Theorem.
(iii) Write the Dual expression for the function F(x, y, z) = (x +y+z). (x?+y?+z). (x?+y+z?)

Excepted Answer

(i)

----------2M

(ii)

❖ **Consensus Theorem:**

AB + ĀC+BC = AB+ĀC

LHS = AB+ĀC+BC
= AB + ĀC + BC.1
= AB + ĀC + BC (A + Ā) → since A + Ā = 1
= AB + ĀC + ABC + ĀBC
= AB (1 + C) + ĀC (1 + B)
1 + B = 1 + C = 1
= AB + ĀC = RHS

❖ **BC is redundant term**

----------2M

(iii) Dual of the expression
F(x, y, z) = (x +y+z). (x?+y?+z). (x?+y+z?) is **xyz + x?y?z+ x?yz? ----------1M**

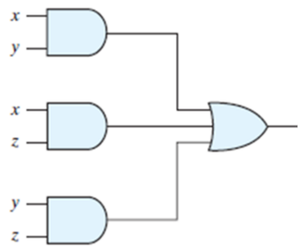
3.b : Marks (5.0)

Answer the Following
(i) Simplify the Boolean Expression f(x,y,z) = x?yz + xyz? + xyz+ xy?z implement the simplified expression using Basic gates.
(ii) Find the SOP and hence find the Minterms for the function f(x, y, z) = xy +yz.

Excepted Answer

(i)

= x'yz + xy'z + xyz' + xyz
= x'yz + xy'z + xy (z'+z)
= x'yz + xy'z + xy
= x'yz + x(y'z + y) Absorption Law
= x'yz + x(z + y)
= x'yz + xz + xy
= z(x'y + x) + xy
= z(y + x) + xy
= yz + xz + xy



2M+1M

(ii)

xy(z+z?)+yz(x+x?) --------> xyz+xyz?+xyz+x?yz ----------> xyz+ xyz?+x?yz ------------> Minterms(m3+m6+m7) 1M+1M

3.c : Marks (5.0)

For a 2:1 Multiplexer write the Function Table and get the Boolean expression for the output and Realize 2:1 Multiplexer Using NAND gates.

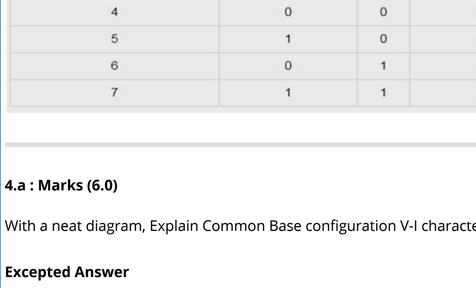
Excepted Answer

S	Y
0	I_0
1	I_1

----------1M

Boolean Expression:

$Y = S'.\ I_0 + S.\ I_1$ ----------1M



----------3M

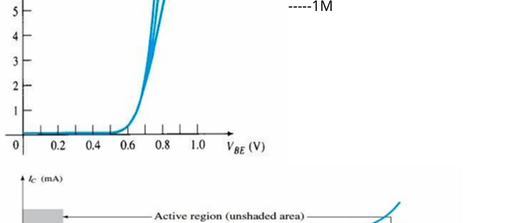
3.d : Marks (5.0)

Write the Characteristic Table for T Flip flop and using the same realize 3 bit Asynchronous UP -counter

Excepted Answer

	Previous		Next	
T	Q_{Prev}	Q'_{Prev}	Q_{Next}	Q'_{Next}
0	0	1	0	1
0	1	0	1	0
1	0	1	1	0
1	1	0	0	1

----------2M



----------2M

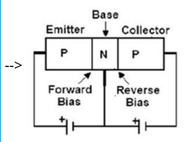
No of negative edge of Clock	Q_0 LSB	Q_1	Q_2 MSB
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1

----------1M

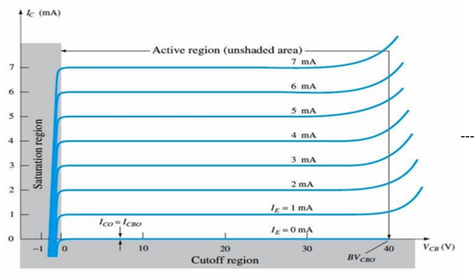
4.a : Marks (6.0)

With a neat diagram, Explain Common Base configuration V-I characteristics of PNP Bipolar Junction Transistor. Find the value of I_B, ? and ? if I_E = 1.25mA and I_c =0.97mA.

Excepted Answer

--> 

-----1M



----------2M

I_B=1.25mA- 0.97mA= 0.28mA ,----------3M
? = 0.776 and
?=3.46

4.b : Marks (6.0)

Discuss the following in a typical Cellular Communication.
(i) Frequency Reuse
(ii) Hand Off
(iii) Guard Channels

Excepted Answer

1. Each cellular base station is allocated a group of radio channels within a small geographic area called a *cell.* Neighbouring cells are assigned different channel groups. These Frequencies are allotted to different geographic area.----------2M
2. Handoff: when a mobile unit moves from one cell to another while a call is in progress, the MSC (Mobile switching Centre) must transfer (handoff) the call to a new channel belonging to a new base station.----------2M
3. Guard Channels are percentage of total available cell channels exclusively set aside for handoff requests. It makes fewer channels available for new call requests. ----------2M

4.c : Marks (8.0)

Answer the Following
i) What is the role of channel in a Typical electronic Communication system? Mention the different types of channels.
ii) Mention the Difference between MOSFET and BJT
iii) Discuss different types of Digital Modulation Techniques.Draw the waveforms for binary input 1010

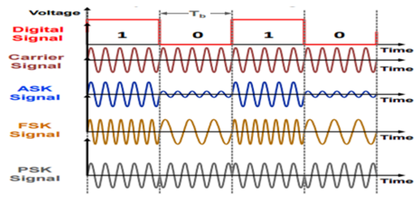
Excepted Answer

i) Channel is the physical medium on which the signal is carried. Channel can be Wired and Wireless . Example: Air, wires, coaxial cable, radio wave, laser beam, fiber optic cable.----------2M

ii). (i) MOSFETs are voltage controlled devices. ----------3M
BJTs are current controlled devices.
(ii) MOSFETs have higher input impedance.
BJTs have higher gains.
(iii) MOSFETs are less sensitive to temperature variations and are more

easily integrated on ICs.

3. In Digital Modulation the information will be in binary form i.e. 1s and 0s where as carrier will be continuous. The amplitude or phase or frequency of the carrier will be varied according to binary data.ASK,PSK and FSK are the different types----3M



5.a : Marks (5.0)

State whether the following statements are **TRUE** or **FALSE**. Correct the **FALSE** statement:

(i) Embedded Systems highly tailored to take advantage of the power saving modes supported by the hardware and the OS.
(ii) Embedded systems are a combination of generic Hardware and general purpose operating systems for executing variety of application.
(iii) In Second Generation embedded systems 32 bit Microprocessor was used
(iv) Digital Signal Processors can be pre-fabricated for a special application or it can be custom fabricated by using the components from a re-usable building block library of components.
(v) CPLD's offer smaller amount of logic up to about 10,000 gates.

Excepted Answer

i) Embedded Systems highly tailored to take advantage of the power saving modes supported by the hardware and the OS.**(True)**
(ii) Embedded systems are a combination of generic Hardware and general purpose operating systems for executing variety of application.**(False)**
Correct Statement:-
General Purpose systems are a combination of generic Hardware and general purpose operating systems for executing variety of application

(iii) In Second Generation embedded systems 32 bit Microprocessors are used.**(False)**
Correct Statement:-
In Third Generation embedded systems 32 bit Microprocessors was used **or** In Second Generation embedded systems 16 bit Microprocessor are used

(iv) Digital Signal Processors are pre-fabricated for a special application or it can be custom fabricated by using the components from a re-usable building block library of components.**(False)**

Correct Statement:-
Application Specific Integrated Circuits are pre-fabricated for a special application or it can be custom fabricated by using the components from a re-usable building block library of components.

(v) CPLD's offer smaller amount of logic up to about 10,000 gates.**(True) ----------1X 5=5M**

5.b : Marks (8.0)

Answer the Following.
(i) Differentiate between EPROM and EEPROM
(ii) List the Characteristics of Microcontroller
(iii) Mention different Modes of Operation in ARM 7 Processor.

Excepted Answer

Erasable Programmable Read Only Memory (EPROM)----------3M

- **EPROM gives flexibility to re-program the same chip.**
- **It stores the bit information by charging the floating gate of an FET to a high voltage.**
- **It contains a quartz crystal window , which is exposed to UV rays rays for 20 to 30 minutes, the entire memory will be erased.**
- **Limitation is Erasing the memory using UV rays is tedious and time consuming process.**

Electrically Erasable Programmable Read Only Memory (EEPROM)

- **The information contained in this memory can be erased and re-programmed in-circuit using electrical signals at register/Byte level.**
- **It provides greater flexibility for system design.**
- **Limitation is its capacity (only a few kilobytes).**

List the Characteristics of Microcontroller----------2M

1. **A highly integrated chip that contains Scratch pad RAM, special and general purpose register arrays, on chip ROM/FLASH memory for program storage, timer and interrupt controller units and dedicated I/O ports.**
2. **Contains multiple built in I/O ports.**
3. **Includes lot of power saving features.**

Modes of Operation----------3M

Mode	Description	
Supervisor (SVC)	Entered on reset and when a Software Interrupt instruction (SWI) is executed	Privileged modes
FIQ	Entered when a high priority (fast) interrupt is raised	
IRQ	Entered when a low priority (normal) interrupt is raised	
Abort	Used to handle memory access violations	
Undef	Used to handle undefined instructions	
System	Privileged mode using the same registers as User mode	
User	Mode under which most Applications / OS tasks run	Unprivileged mode

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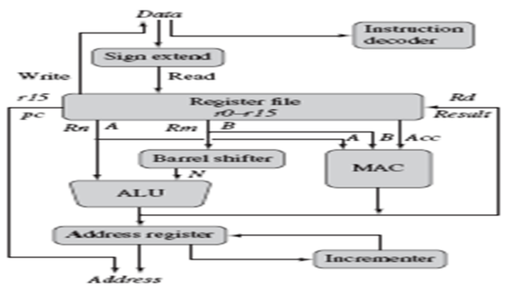
5.c : Marks (7.0)

With a neat diagram explain the Data Flow Model of ARM 7 Processor.

Excepted Answer



1. ALU takes the register values Rn and Rm and computes the result
2. Barrel shifter computes the result for any number of shifts within a clock cycle .
3. This is achieved as it is combinational logic (not sequential)

ex: ADD R3,R2,LSL#4

1. Multiply-Accumulate Circuit is used to perform both multiply and add

Ex : Matrix addition and multiplication

1. Load and store instructions use the ALU to generate an address to be held in the address register and broadcast on the Address bus

i. Instruction decoder translates instructions before they are executed.
ii. Data items are placed in register file-storage bank made of 32- bit registers. Since the ARM core is a 32-bit processor, most instructions treat the registers as holding signed or unsigned 32-bit values.
iii. Sign extend hardware converts signed 8-bit and 16-bit numbers to 32 bit values as they are read from memory and placed in a register