WINTER – 19EXAMINATION

Subject Name: Microcontroller **Model Answer** Subject Code: 17534

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in themodel answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may tryto assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given moreImportance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in thefigure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constantvalues may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
Q. 1	**a)**	**Attempt any THREE of the following:**	**12- Marks**
	i)	**Compare between microprocessor and microcontroller(any four)**	**4M**

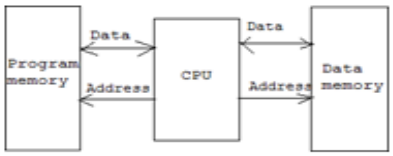
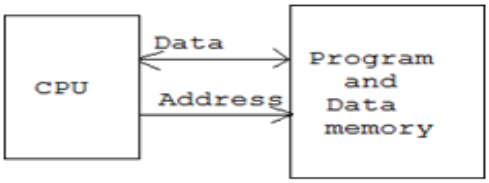
Ans:

Sr. No	Parameter	Microprocessor	Microcontroller
1.	No. of instructions used	Many instructions to read/ write data to/ from external memory.	Few instruction to read/ write data to/ from external memory
2.	Memory	Do not have inbuilt RAM or ROM.	Inbuilt RAM /or ROM
3.	Registers	Microprocessor contains general purpose registers, Stack pointer register, Program counter register	Microcontroller contains general purpose registers, Stack pointer register, Program counter register additional to that it contains Special Function Registers (SFRs) for Timer , Interrupt and serial communication etc.
4.	Timer	Do not have inbuilt Timer.	Inbuilt Timer
5.	I/O ports	I/O ports are not available requires extra device like 8155 or 8255.	I/O ports are available
6.	Serial port	Do not have inbuilt serial port, requires extra devices like 8250 or 8251.	Inbuilt serial port
7.	Multifunction pins	Less Multifunction pins on IC.	Many multifunction pins on the IC
8.	Boolean Operation	Boolean operation is not possible directly.	Boolean Operation i.e. operation on individual bit is possible directly
9.	Applications	General purpose, Computers and Personal Uses.	Single purpose(dedicated application), Automobile companies, embedded systems, remote control devices.

1M each (Any four)

ii) **State the difference between Harvard and Von-Neumann architecture with suitable diagram.** **4M**

Ans:

Sr. No.	Harvard architecture	Von-Neumann architecture
1		
2	Harvard architecture uses physically separate memories for their instructions and data.	Von –Neumann architecture uses single memory for their instructions and data.
3	Requires separate and dedicated buses for instructions and data.	It requires single bus for instruction and data
4	Design is complicated.	Its design is simpler.
5	Instructions and data can be fetched simultaneously which increases the operation speed.	Instructions and data have to be fetched in sequential order which limits the operation speed.

4M (Any four)1M each

(iii) **Draw the format of PSW register of 8051 microcontroller and describe it.** **4M**

Ans:

PSW : Program Status Word (Bit Addressable)

CY	AC	F0	RS1	RS0	OV	F1	P

CY	PSW.7	Carry Flag.
AC	PSW.6	Auxiliary Carry Flag.
F0	PSW.5	Flag 0 available to the user for general purpose.
RS1	PSW.4	Register Bank selector bit 1
RS0	PSW.3	Register Bank selector bit 0
OV	PSW.2	Overflow Flag.
F1	PSW.1	Flag F1 available to the user for general purpose.
P	PSW.0	Parity flag. Set/cleared by hardware each instruction cycle to indicate an odd/even number of "1" bits in the accumulator.

CY: the carry flag.

1. This flag is set whenever there is a carry out from the D7 bit.
2. The flag bit is affected after an 8 bit addition or subtraction.
3. It can also be set to 1 or 0 directly by an instruction such as —SETB C and CLR C where SETB C stands for - set bit carry and CLR C for - clear carry.

AC: the auxiliary carry flag

- If there is a carry from D3 and D4 during an ADD or SUB operation, this bit is set; it is cleared. This flag is used by instructions that perform BCD (binary coded decimal) arithmetic.

1. **F0**: Available to the user for general purposes.
2. **RS0, RS1**: register bank selects bits
   1. These two bits are used to select one of the four register banks from internal RAM as given in the table.
   2. By writing zeroes and ones to these bits, a group of registers R0- R7 can be used out of four registers banks in

Format:2M

Description: 2M

Internal RAM.

RS1	RS0	Space in RAM
0	0	Bank 0 (00H- 07H)
0	1	Bank 1 (08H-0FH)
1	0	Bank2 (10H-17H)
1	1	Bank3 (18H-1FH)

3. **OV: the overflow flag**
   This flag is set whenever the result of a signed number operation is too large, causing the high-order bit to overflow into the sign bit. In general, the carry flag is used to detect errors in unsigned arithmetic operations. The overflow flag is only used to detect errors in signed arithmetic operations.
4. **P: Parity flag:** The parity flag reflects the number of 1s in the A (accumulator) register only. If the A register contains an odd number of 1's, then P=1, P=0 if A has an even number of 1'

(iv) **Explain the function of following directives** — **4M**

(1)DB

(2)EQU

(3)ORG

(4)END

Ans: — **1M each**

(1)DB

DB:- (Define Byte)

Syntax: Label: DB Byte

Where byte is an 8-bit number represented in either binary, Hex, decimal or ASCII form. There should be at least one space between label & DB. The colon (:) must be present after label. This directive can be used at the beginning of program. The label will be used in program instead of actual byte. There should be at least one space between DB & a byte. E.g. LOOKUP: DB 30h,31h,32h,33h,34h,35h.

(2)EQU

EQU: Equate

It is used to define constant without occupying a memory location.

Syntax: Label EQU Numeric value

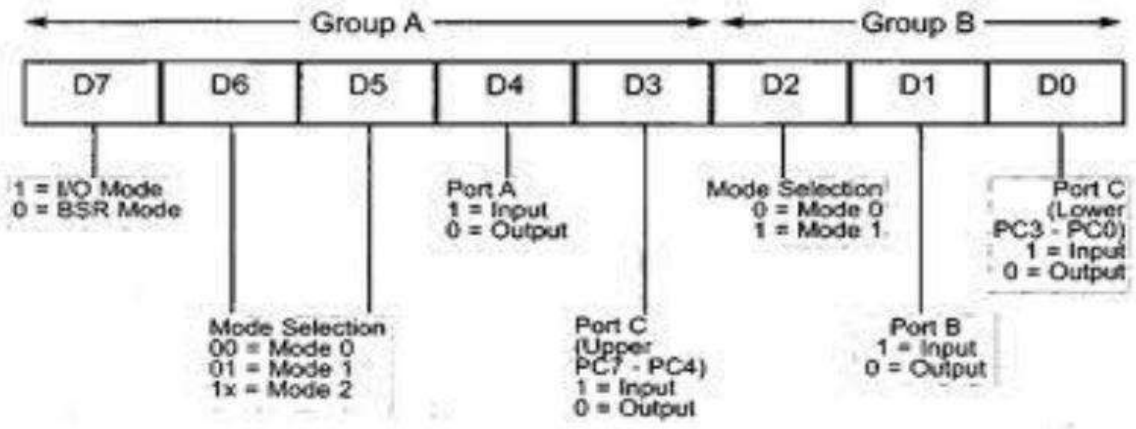
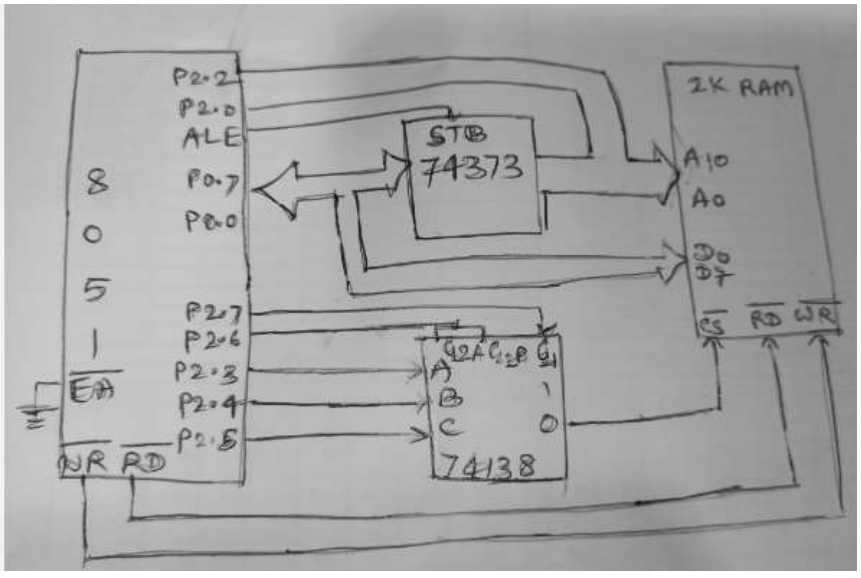
By means of this directive, a numeric value is replaced by a symbol. For e.g. MAXIMUM EQU 99 After this directive every appearance of the label ―MAXIMUM in the program, the assembler will interpret as number 99 (MAXIMUM=99).

(3)ORG

ORG:-ORG stands for Origin

Syntax: ORG Address

The ORG directive is used to indicate the beginning of the address. The number that comes after ORG can be either in hex or in decimal. If the number is not followed by H, it is

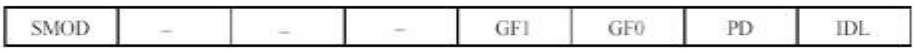
		decimal and the assembler will convert it to hex. Some assemblers use —.ORG (notice the dot) instead of —ORG for the origin directive **(4)END** This directive must be at the end of every program meaning that in the source code anything after the END directive is ignored by the assembler. This indicates to the assembler the end of the source file. Once it encounters this directive, the assembler will stop interpreting program into machine code. e.g. END ; End of the program.	
	(v)	**Draw the control word format of 8255 for I/O mode**	**4M**
	Ans:	**Diagram: -**  	**4M**
b)		**Attempt any ONE of the following:**	**6M**
	(i)	**Draw the diagram to interface 2KB,external RAM with 8051 microcontroller,mention the pins during interfacing and describe in brief.**	**6M**
	Ans:	**Diagram:-**  **Pins used in interfacing are** **1.P0.0-P0.7-** Lower order multiplexed address/data bus. It is used to carry lower order address in the first part of operation and data in the later part. **2.P2.0-P2.7**-PORT 2: These are another set of bidirectional input port, they are used when	**Diagram:3 M** **Pins:1/2M each**

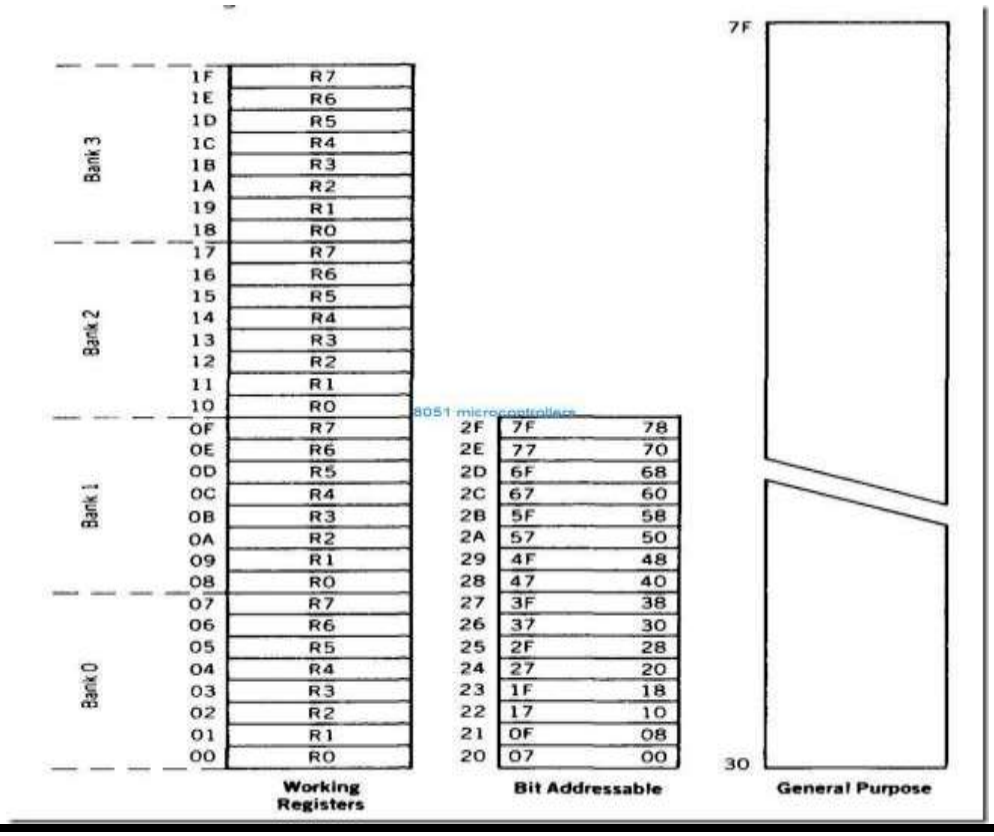
		processing external memory to carry higher order address . **3.ALE-**Named as Address Latch Enable (ALE). It is used when working with external memory. When ALE=1, AD0-AD7 contains address and ALE=0, AD0-AD7 contains data. **4.RD-Read data from memory** **5.WR- Write data to memory** **6.EA-**Named as External Access (EA). In order to execute code from internal memory this pin is connected to Vcc. To execute code from external memory the pin must be grounded.	
	(ii)	**Write a program to multiply two 8 bit numbers stored in internal memory location. Multiplication is stored in location 40H and multiplier is stored in memory location 41H store LSB of result in R_2 and MSNB of result in R_3.**	**6M**

	Ans:	**(Note:4 marks for correct program, stepwise marks can be given for partially correct program, Any suitable address or data can be assumed)**
		Program:
		MOV 40H, # 23H ; store first 8-bit no. in 40H
		MOV 41H, #15H ; store second 8-bit no. in 41H
		MOV A, 40H ; move first number to A
		MOV B, 41H ; move second number to B
		MUL AB ; multiply the numbers
		MOV R2, A ; move LSB to Reg.R2
		MOV R3, B ; move LSB to Reg.R3
		HERE: SJMP HERE
			6M

Q.2		**Attempt any FOUR of the following:**	**16-Total Marks**
	a)	**Which are different types of Buses? State their features.**	**4M**
	Ans:	**Types of Buses are** 1.Address Bus 2.Data Bus 3.Control Bus **Features:** 1.Address Bus Address bus is unidirectional i.e. bits flow in only one direction from the microcontroller to the peripherals. The microcontroller with its 16 address lines is capable of addressing2 ^16=65536(64K) memory locations. 2. Data Bus	**Types-1M** **Features-1M each**
	b)	**Draw the format of TCON SFR and explain each bit.**	**4M**

	Ans:	**TCON SFR** (MSB) (LSB) TF1 TR1 TF0 TR0 IE1 IT1 IE0 IT0 **Symbol / Position / Name and Significance** TF1 / TCON.7 / Timer 1 Overflow Flag. Set by hardware on timer/counter overflow. Cleared when interrupt processed. TR1 / TCON.6 / Timer 1 Run control bit. Set/cleared by software to turn timer/counter on/off. TF0 / TCON.5 / Timer 0 Overflow Flag. Set by hardware on timer/counter overflow. Cleared when interrupt processed. TR0 / TCON.4 / Timer 0 Run control bit. Set/cleared by software to turn timer/counter on/off. IE1 / TCON.3 / Interrupt 1 Edge Flag. Set by hardware when external interrupt edge detected. Cleared when interrupt processed. IT1 / TCON.2 / Interrupt 1 Type control bit. Set/cleared by software to specify falling edge/low level triggered external interrupts. IE0 / TCON.1 / Interrupt 0 Edge Flag. Set by hardware when external interrupt edge detected. Cleared when interrupt processed.	**Format:2 M Explanation:2M**
c)		**Describe the function of following pins of 8051 microcontroller.** **(i)PSEN** **(ii)EA** **(iii)ALE** **(iv)RESET**	**4M**
	Ans:	**(i)PSEN** **1.**PSEN (program store enable). PSEN is the read strobe for external Program Memory. In an 8031-based system in which an external ROM holds the program code, this pin is connected to the OE pin of the ROM. PSEN is not activated for internal fetches. **(ii)EA** **1.** EA (external access).EA is pin number 31 in the DIP packages. It is an input pin and must be connected to either Vcc or GND. It cannot be left unconnected. 2. The lowest 4K bytes of Program Memory can be either in the on-chip ROM or in an external ROM. This selection is made by connecting EA pin. 1. If the pin is connected to Vcc, then addresses 0000H through 0FFFH are directed to the internal ROM and addresses 1000H through FFFFH are directed to external ROM. 2. If the pin is connected to Vss, then all address are directed to external ROM. **(iii)ALE** ALE (Address latch enable). It is an output pin and is active high for latching the low byte of address during accesses to external memory. The ALE pin is used for de-multiplexing the address and data by connecting to the STB pin of the 74LS373 chip. **(iv)RESET** Pin 9 is the Reset Input Pin. This is used for resetting the microcontroller to its initial values. If	**1M each**

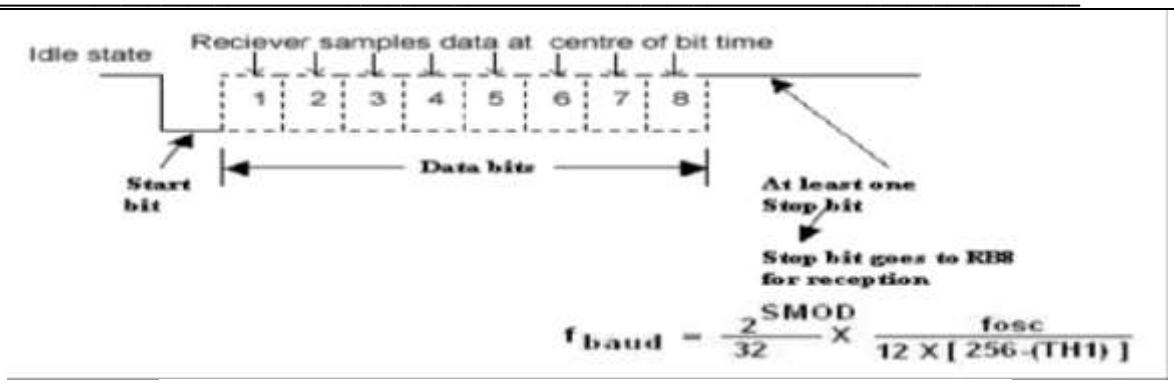
		the pin is set at logic 0, the chip runs normally. When the oscillator is running, setting the pin at logic 1 for more than two machine cycles will reset the microcontroller.	
	d)	**State four features of 8051 microcontroller.**	**4M**
	Ans:	Features of 8051 micro controller are as follows:- 1) 8- bit data bus and 8- bit ALU. 2) 16- bit address bus – can access maximum 64KB of RAM and ROM. 3) On- chip RAM -128 bytes (Data Memory) 4) On- chip ROM – 4 KB (Program Memory) 5) Four 8-bit bi- directional input/output ports Four 8-bit bi- directional input/ output ports. 6) Programmable serial ports i.e. One UART (serial port) 7) Two 16- bit timers- Timer 0& Timer 1 8) Works on crystal frequency of 11.0592 MHz / 12 MHz 9) Has power saving and idle mode in microcontroller when no operation is performed. 10) Six interrupts are available: Reset, Two interrupts Timers i.e. Timer 0 and Timer 1, two external hardware interrupts- INT0 and INT1, Serial communication interrupt for both receive and transmit	**Any Four:1M each**
	e)	**Draw the format of PCON register and explain function of each bit.**	**4M**
	Ans:	**PCON : Power Control Register (Not Bit Addressable)**  SMOD | – | – | – | GF1 | GF0 | PD | IDL SMOD PCON.7 Double baud rate bit. If SMOD = 1, the baud rate is doubled when the serial part is used in mode 1, 2 and 3. - PCON.6 Not implemented, reserved for futur used* - PCON.5 Not implemented, reserved for futur used* - PCON.4 Not implemented, reserved for futur used* GF1 PCON.3 General purpose bit. GF0 PCON.2 General purpose bit. PD PCON.1 Power Down bit. If set, the oscillator is stopped. A reset or an interrupt (83C154 and 83C154D only) can cancel this mode (Note 1). IDL PCON.0 IDLE bit. If set the activity CPU is stopped. A reset or an interrupt can cancel this mode (See Note 1).	**Format:** **2 M** **Explanation:** **2M**
	f)	**Draw internal RAM structure of 8051.**	**4M**

	Ans:		**4M**
Q.3		**Attempt any THREE of the following:**	**12-Total Marks**
	a)	**Describe the function of following instruction of 8051 microcontroller.** **(i)MOV A,@Ri** **(ii)MOVX A,@DPTR** **(iii)SWAP A** **(iv)INC@ Ri**	**4M**
	Ans:	**(i) MOVA, @R0** This instruction moves the contents of memory location pointed by R0 to the Accumulator No of bytes : 1 Addressing mode: register indirect No flags affected Example: MOV R0, #40H ; R0=40H(internal RAM address) MOV A,@R0 ; 40H= 25H(Value present in internal memory pointed by R0) ; A = 25H **(ii) MOVX A, @DPTR** This instruction transfers data from external memory to Accumulator.The 16 bit external memory address is held by the DPTR register. This instruction moves the contents of the external RAM memory pointed by (or stored in) DPTR to the Accumulator. No of bytes : 1 Addressing mode: register indirect	**1 M each description**

		Example: MOV DPTR, # 2000H ; DPTR = 2000H(external RAM address) MOV A, @DPTR ; 2000H=0BH ; A=0BH **(iii) SWAP A** This instruction interchanges bits 0-3 i.e. lower nibble (D0-D3) of the Accumulator with bits 4-7 i.e. upper nibble (D4-D7) of the Accumulator. This instruction is identical to executing "RR A" or "RL A" four times. **No of bytes**: 1 byte **Addressing mode**: register specific **Example:** MOV A, #59H ;A= 59H (0101 1001 in binary) SWAP A ; A= 95H (1001 0101 in binary) **(iv) INC @Ri** These instruction increments indirect RAM by 1. It increments the contents of memory location pointed by Ri by 1. Example: MOV R0, # 40H ; R0 =40H(Sets the memory pointer) ;40H = 05H; INC @R0 ; Increments contents pointed by R0 by 1 ;40H =06H (After execution)	
	b)	**List any two instructions of following addressing modes.** **(i)Immediate addressing** **(ii)Register addressing** **(iii)Direct addressing and** **(iv)Index addressing mode**	**4M**
	Ans:	**(i) Immediate addressing mode:** 1)MOV A, #25H ; Load 25H into A 2)MOV R2,#05H ;Load 05H into R2 **(ii) Register Addressing mode:** 1)ADD A, R5 ; Add the contents of register R5 to contents of A (accumulator) 2)MOV R2, A ; Move contents of Accumulator to R2 **(iii) Direct Addressing mode:** 1) MOV R0, 40H ; Save contents of RAM location 40H in R0. 2) ADD A,50H ; Add contents of memory location 50H &accumulator &store result in Accumulator. **(iv) Indexed Addressing mode:** 1) MOVC A, @A+DPTR MOVC is a move instruction, which moves data from the external code memory space. The address operand in this example is formed by adding the content of the DPTR register to the Accumulator value. Here the DPTR value is referred to as the base address and the accumulator value us referred to as the index address. 2) MOVC A,@A+PC	**1 M each addressing (½ Mark for one example)**
	c)	**Write assembly language program to find sum of 5 numbers stored in internal RAM from memory location 50H.Store result in memory location 70H**	**4M**
	Ans:	**Program for addition of five 8 bit nos.** ORG 0000H	**4 M correct**

		CLR PSW.3 ; Select register Bank 0
		CLR PSW.4 ;
		MOV R0, #05H ; Initialize byte counter
		MOV R1, #50H ; Initialize memory pointer
		MOV A, # 00H ; Clear Accumulator
		UP: ADD A @R1 ; Add accumulator with number from array
		INC R1 ; Increment memory pointer
		DJNZ R0, UP ; Decrement byte counter,
		; if byte counter ≠ 0
		; Then go to UP if counter is zero then no jump
		MOV 70H, A ; Store result in internal memory
		HERE: SJMP HERE ; Stop
		(Note: Appropriate Marks to be given for any other correct logic used by students.)
			program

	d)	**State function of editor, assembler, linker and complier.**	**4M**
	Ans:	**1) Editor:** An editor is a program which helps you to construct your assembly language program in right format so that the assembler will translate it correctly to machine language. So, you can type your program using editor. This form of your program is called as source program and extension of program must be .asm or .src depending on which assembler is used. The DOS based editor such as EDIT, Wordstar, and Norton Editor etc. can be used to type your program. **2) Assembler:** An assembler is programs that translate assembly language program to the correct binary code for each instruction i.e. machine code and generate the file called as Object file with extension .obj and list file with extension .lst extension. Some examples of assembler are ASEM-51, Keil"s A51, AX 51 and C51, Intel PL/M-51 etc. **3) Linker:** A linker is a program, which combines, if requested, more than one separately assembled object files into one executable program, such as two or more programs and also generate .abs file and initializes it with special instructions to facilitate its subsequent loading the execution. Some examples of linker are ASEM-51 BL51, Keil u Vision Debugger, LX 51 Enhanced Linker etc. **4) Compiler:** Instructions in assembly language are represented in the form of meaningful abbreviations, and the process of their compiling into executable code is left over to a special program on a PC called compiler.	**1M function of each**
	e)	**Explain the operating mode 1 of serial port of 8051 microcontroller.**	**4M**
	Ans:	**Serial Data Mode-1 (standard UART mode)(baud rate is variable)** In mode-1, the serial port functions as a standard Universal Asynchronous Receiver Transmitter (UART) mode. 10 bits are transmitted through TXD or received through RXD. The 10 bits consist of one start bit (which is usually '0'), 8 data bits (LSB is sent first/received first), and a stop bit (which is usually '1'). Once received, the stop bit goes into RB8 in the special function register SCON. The **baud rate is variable.**	**3 M description**

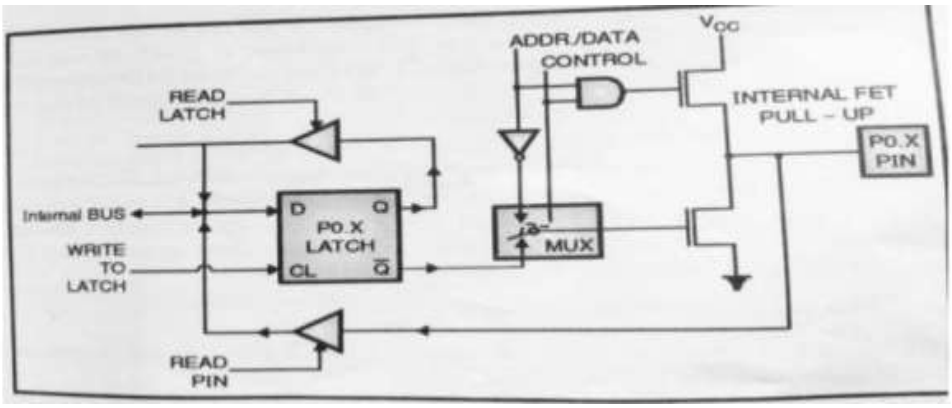


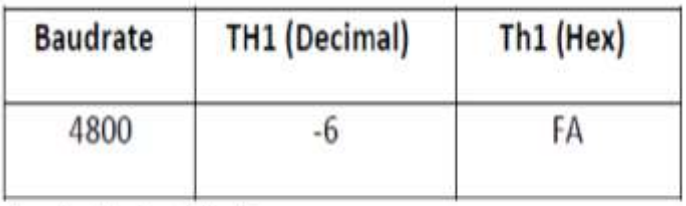
$$\text{Baud Rate} = \frac{2^{SMOD}}{32} \times \frac{\text{Oscillator Frequency}}{12 \times [256 - (TH1)]}$$

1 Mark for formula

Q.4	**a)**	**Attempt any THREE of the following :**	**12-Total Marks**
	(i)	**Write a program to add two BCD numbers stored in Register R2 and R3 of bank 1.Store result in Register R_0 of Bank.**	**4M**

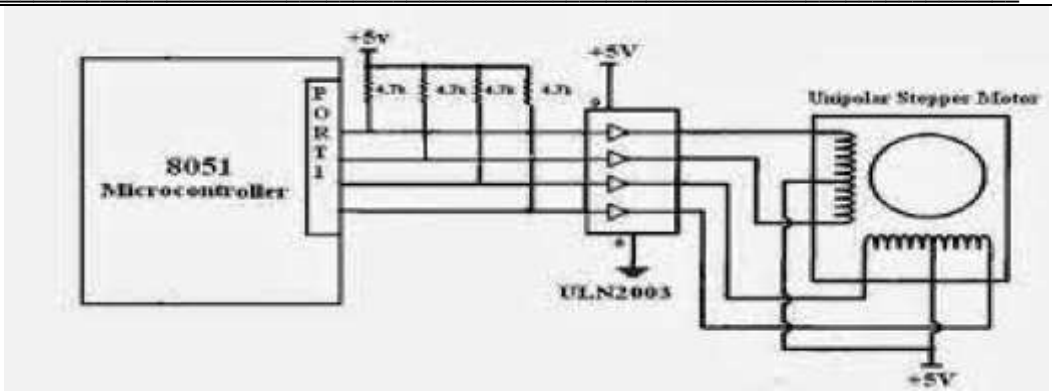
	Ans:	ORG 0000H
		SETB PSW.3 ; Set the bit 3 RS0=1 of PSW
		CLR PSW.4 ; Clear bit 4 RS1=0 of PSW to select bank 1
		MOV A, R2 ; Load the data from R2 to A
		ADD A, R3 ; Add the data present in R3 with Accumulator
		DA A ;Adjust the BCD result after addition
		MOV R0, A ; Store the result in R0
		END ; Stop
		(Note: Appropriate Marks to be given for any other correct logic used by students.)
			4 Marks for correct program

	(ii)	**Draw the port structure of port O and describe its function.**	**4M**
	Ans:	**Diagram: -**  	**2 M Diagram**

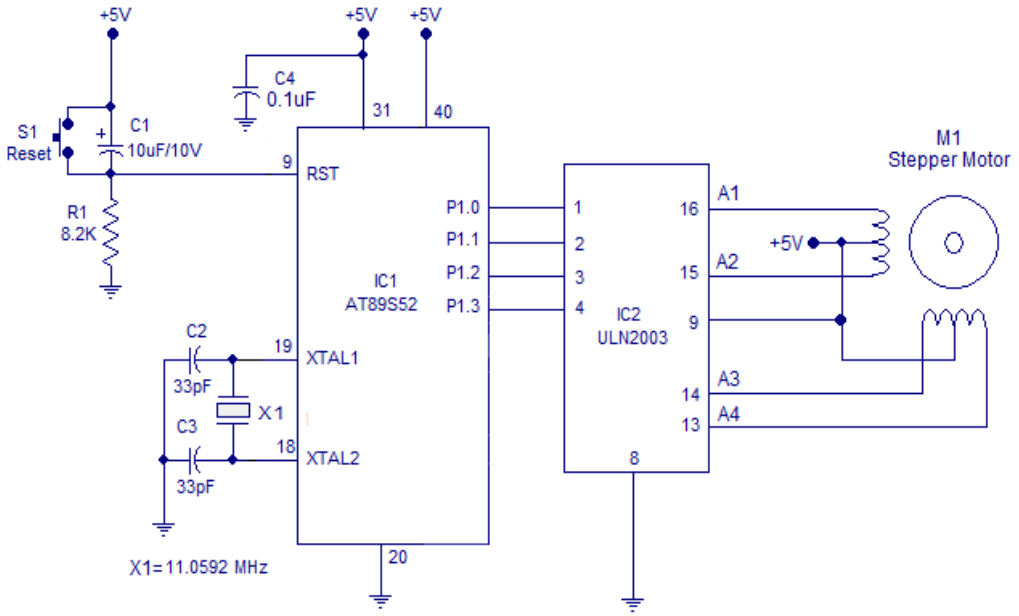
		Port '0' Port 0 is multi functioned **port** of microcontroller **8051**.Its SFR address is 80H.It is bit addressable **port**. **Port 0:** It can be used as a) Simple input/output b) Bidirectional low order address / data bus (AD0 - AD7) for external memory. When connecting an **8051** to an external memory, **port 0** provides both address and data. The **8051** multiplexes address and data through **port 0** to save pins. ALE indicates if P0 has address or data. When ALE = **0**, it provides data D0-D7, but when ALE =1 it has address and data with the help of a 74LS373 latch Port 0: ● It is used as input/output or bidirectional low order address and data bus for external memory. ● It does not have internal pull up resistors. ● When port 0 is used as address/data bus internal control logic switches to address lines to the gate of FET. ● A logic 1 will turn off lower FET to provide high output at that pin. A logic 0 will turn on lower FET to provide low output at that pin. ● After the address has been formed ALE signal is used to latch the address and then bus is turns around to become data bus. Port 0 now reads data from external memory; hence it must be configured as input. The internal control logic writes logic 1 to all the latches of port 0.	**2M description**
(iii)		**What is baud rate in UART of 8051. What value should be loaded into TH_1 to have 4800 baud rate. Give its decimal and hex value for crystal frequency 11.0592 MH**	**4M**
Ans:		**Baud rate** is a measure of the logic level shifts in a signal per second . It is a measure of the **speed** of data transfer, expressed in bits per second (bps). The **baud rate is** the **rate** at which information **is** transferred in a communication channel. In the serial port context, "4800 **baud**" **means** that the serial port **is** capable of transferring a maximum of 4800 bits per second The machine cycle frequency of 8051 = 11.0592 / 12 = 921.6 kHz, and 921.6 kHz / 32 = 28,800 Hz is frequency by UART to timer 1 to set baud rate. 28800/4800=6 where -6 in decimal=FAH in hex is loaded into TH1.  For 4800 baud rate value in decimal is -6 For 4800 baud rate value in hex is FA **OR** The count to be loaded in TH1 to have a baud rate of 4800 can be calculated as follows **TH1=256d- [(K*oscillator frequency)/(384d*baud rate)]** Where,	**1Mark for definition** **1 Mark for calculation** **1Mark each for decimal and**

Baudrate	TH1 (Decimal)	Th1 (Hex)
4800	-6	FA

		SMOD = 0 then K=1 and SMOD = 1 then K=2 Therefore, TH1=256-[(1*11.0592*10^6)/(384*4800)] **TH1=250d** **TH1=0FAH**	**hex value(2 M)**
	(iv)	**Write the format of SCON register and explain it.**	**4M**
	Ans:	**Diagram: -**  SM0 SM1 SM2 REN TB8 RB8 TI RI **SM0** Serial Port Mode Bit 0, **SM1** Serial Port Mode Bit 1 **SM0 SM1 Mode Description Baud Rate** 0 0 0 shift register $f_{osc}/12$ 0 1 1 8-bit UART variable 1 0 2 9-bit UART $f_{osc}/64$ or $f_{osc}/32$ 1 1 3 9-bit UART variable **SM0 SM1** 0 0 Serial Mode 0 0 1 Serial Mode 1, 8-bit data, 1 stop bit, 1 start bit 1 0 Serial Mode 2 1 1 Serial Mode 3 **SM2:** enables the multiprocessor communication feature in Modes 2 and 3. In Modes 2 or 3, if SM2 is set to 1 than RI will not be activated if the received 9th date bit(RB8) is 0. In Mode 1, if SM2 = 1 then RI will not be activated if a valid stop bit was not Received. In Mode 0 SM2 should be 0. **REN**: Receive enable bit. When the REN =1, reception is enabled & REN=0, the Reception is disabled. **TB8**: Transfer bit 8 The 9th data bit that will be transmitted in modes 2 and 3. **RB8**: Receive bit 8. The 9th data bit that was received in modes 2 and 3.In mode 1, this bit is the stop bit that was received. **TI**: Transmit interrupt flag. set by hardware at end of 8th bit in mode 0 and at the beginning of the stop bit in other modes, in serial transmission. Must be cleared by software. **RI**: Receive interrupt flag. set by hardware at end of 8th bit in mode 0 and half way through The stop bit time in other modes in serial reception. Must be cleared by software. **(Note: Make SM2, TB8 and RB8 = 0.)**	**2 Marks for Format** **2Marks for function of each bit**
	b)	**Attempt any ONE of the following :**	**6M**
	(i)	**Draw the interfacing diagram of stepper motor with 8051 and write and ALP to rotate stepper motor continuously in clock wise direction.**	
	Ans:	**Interfacing diagram**	**3 Marks for interfacing diagram**



OR



Step no	Winding A	Winding B	Winding C	Winding D	Clockwise
1	1	0	0	1	↓
2	1	1	0	0	
3	0	1	1	0	
4	0	0	1	1	

3 Marks for program

Program:

```
        ORG 0000H
        MOV A,#66H          ;load step sequence
BACK:   MOV P1,A            ;issue sequence to motor
        RRA                 ;rotate right clockwise
        ACALL DELAY          ;wait
        SJMP BACK            ;keep going
DELAY: MOV R2,#100           ;Delay subroutine
```

```
H1:     MOV R3,#255
H2:     DJNZ R3,H2
        DJNZ R2,H1
        RET
        END
```

OR

```
ORG 0000H
MOV P1, #00H                ; port as output port
MOV R2, #25                 ;counter for 180^0 rotation(optional as not mentioned in
                                question for rotation)
 UP1: MOV R3, #4            ; counter for full step sequence
MOV DPTR, #TABLE            ;load address of program memory into data pointer
UP: CLR A                   ; clear accumulator
MOVC A, @A+DPTR             ; read code from memory into accumulator
MOV P1, A                   ; send step code to port
ACALL DELAY                 ;add delay
INC DPTR                    ; increment memory pointer for next step sequence
DJNZ R3,UP                  ;decrement counter and repeat from UP till becomes zero
DJNZ R2, UP1                ;decrement counter and repeat from UP1 till becomes zero
SJMP $                      ;wait
DELAY: MOV R4,#25           ; delay subroutine
L3: MOV R5,#100
L2: MOV R6,#100
L1: DJNZ R6, L1
DJNZ R5,L2
DJNZ R4,L3
RET
ORG 0050H
TABLE : DB  09H,0CH,06H,03H
END
```

(Note: Appropriate Marks to be given for any other correct logic used by students.)

(ii) Write a program to move a block of ten bytes stored in internal memory 50H onwards to external memory location 2000H onwards.

Ans:

```
ORG 0000H
MOV R0,#50H          ; Initialize source pointer R0 to 50H
MOV DPTR, #2000H     ; Initialize destination pointer DPTR to 2000H
MOV R7,#0AH          ;Initialize byte counter
UP:   MOV A,@R0      ;Move the contents of first source location to Accumulator
MOVX @DPTR, A        ;Move the contents of  Accumulator to the first destination
INC R0               ; Increment the content of R0
INC DPTR             ; Increment the contents of DPTR
DJNZ R7, UP          ; Decrement counter by one and repeat the procedure from UP label ,
                         If counter becomes zero then no jump to UP
END
```

6 Marks for correct program

(**Note: Appropriate Marks to be given for any other correct logic used by students.)**

Q.5 Attempt any FOUR of the following — **12 M**

(a) Draw the format of TMOD register of 8051 and state function of each bit. — **4M**

	Ans:	**TMOD: TIMER/COUNTER MODE CONTROL REGISTER. NOT BIT ADDRESSABLE.** GATE | C/$\overline{T}$ | M1 | M0 | GATE | C/$\overline{T}$ | M1 | M0 TIMER 1 TIMER 0 GATE When TRx (in TCON) is set and GATE = 1, TIMER/COUNTERx will run only while INTx pin is high (hardware control). When GATE = 0, TIMER/COUNTERx will run only while TRx = 1 (software control). C/$\overline{T}$ Timer or Counter selector. Cleared for Timer operation (input from internal system clock). Set for Counter operation (input from Tx input pin). M1 Mode selector bit. (NOTE 1) M0 Mode selector bit. (NOTE 1) **NOTE 1:** M1 M0 Operating Mode 0 0 0 13-bit Timer (MCS-48 compatible) 0 1 1 16-bit Timer/Counter 1 0 2 8-bit Auto-Reload Timer/Counter 1 1 3 (Timer 0) TL0 is an 8-bit Timer/Counter controlled by the standard Timer 0 control bits, TH0 is an 8-bit Timer and is controlled by Timer 1 control bits. 1 1 3 (Timer 1) Timer/Counter 1 stopped.	**2M-Format, 2M-Function**
	(b)	**Write a program to generate square wave of 1 KH_z at P1.5 pin of 8051. Using mode 1 and timer 0. Assume 12 MHz crystal frequency.**	**4M**
	Ans:	**Calculation:** Timer clock Frequency is = XTAL / 12 = 12 MHz / 12 = 1 MHz Timer clock period is (Tin)= 1/ Timer Frequency = 1 / 1 MHz = 1 μ sec For 1 kHz square wave Fout = 1 KHz Tout = 1/ (1X 10^3) Tout =1ms= 1000μ sec Consider half of it , Tout = 500μ sec N = Tout / Tin = 500/1 = 500 65536-500= $(65036)_{10}$ = $(FE0C)_H$ **Program:** MOV TMOD, # 01H ; Set timer 0 in Mode 1, i.e., 16 bit timer L2: MOV TL0, # 0CH ; Load TL register with LSB of count MOV TH0, # FEH ; load TH register with MSB of count SETB TR0 ; start timer 0 L1: JNB TF0, L1 ; poll till timer roll over CLR TR0 ; stop timer 0 CPL P1.5 ; complement port 1.5 line to get high or low CLR TF0 ; clear timer flag 0 SJMP L2 ; re-load timer with count as mode 1 is not auto reload	**1M-Calculation, 1M-Delay, 2M-Program**
	(c)	**Draw IE register format and explain it.**	**4M**

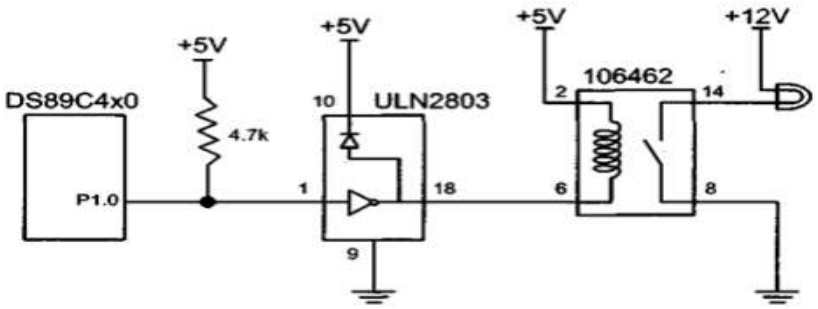
	Ans:	**IE: INTERRUPT ENABLE REGISTER. BIT ADDRESSABLE.** If the bit is 0, the corresponding interrupt is disabled. If the bit is 1, the corresponding interrupt is enabled. EA | — | ET2 | ES | ET1 | EX1 | ET0 | EX0 EA IE.7 Disables all interrupts. If EA = 0, no interrupt will be acknowledged. If EA = 1, each interrupt source is individually enabled or disabled by setting or clearing its enable bit. — IE.6 Not implemented, reserved for future use.* ET2 IE.5 Enable or disable the Timer 2 overflow or capture interrupt (8052 only). ES IE.4 Enable or disable the serial port interrupt. ET1 IE.3 Enable or disable the Timer 1 overflow interrupt. EX1 IE.2 Enable or disable External Interrupt 1. ET0 IE.1 Enable or disable the Timer 0 overflow interrupt. EX0 IE.0 Enable or disable External Interrupt 0. *User software should not write 1s to reserved bits. These bits may be used in future MCS-51 products to invoke new features. In that case, the reset or inactive value of the new bit will be 0, and its active value will be 1.	**2M-Format,** **2M-Explain**
	(d)	**Write an assembly language program to check bit P1.7, if it is high send 55H to P_0 otherwise send AAh to P2.**	**4M**

	Ans:	MOV A, #55H ;Load the Accumulator with data 55H
		JNB P1.7, HERE ;if P1.7 is not set then go to specified address else go to next address
		MOV P0, A ;send 55H to Port 0
		SJMP $
		HERE: MOV A, #0AAh
		MOV P2, A ;send AAH to Port 2
		SJMP $
			3M Program , 1M-Comments

	(e)	**Write an assembly language program to send 'Hello' on serial port of 8051 at 9600 baudrate. Assume fose= 11.0592MHz.**	**4M**

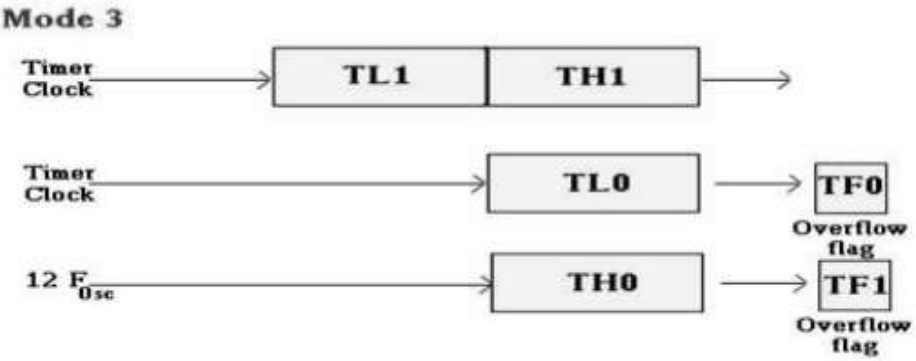
	Ans:	MOV TMOD, #20H ; timer 1, mode2
		MOV TH1,#-3 ; 9600 baud rate
		MOV SCON, #50H ; 8-bit data,1 stop bit, REN enabled
		SETB TR1 ; Start timer 1
		AGAIN: MOV A, #"H" ; transfer "H"
		ACALL MESSAGE ; Some delay
		MOV A, #"e" ; transfer "e"
		ACALL MESSAGE
		MOV A, #"l" ; transfer "l"
		ACALL MESSAGE
		MOV A, #"l" ; transfer "l"
		ACALL MESSAGE
		MOV A, #"o" ; transfer "o"
		ACALL MESSAGE
		SJMP AGAIN
		MESSAGE: MOV SBUF, A
		JNB TI, HERE
		CLR TI
		RET
			3M Logically Correct Program , 1M-Comments

Q.6		**Attempt any FOUR of the following:**	**16M**
	(a)	**Draw the interface diagram of relay with 8051 and write ALP to turn ON and OFF relay.**	**4M**

	Ans:	**Diagram: -**  **Program** AGAIN: SETB P1.0 ACALL DELAY ;Call delay CLR P1.0 ACALL DELAY ; Call Delay SJMP AGAIN SJMP $ DELAY: MOV R2, #0FFH L1: DJNZ R2, L1 RET END	**2M-Diagram** **2M-Program**
	(b)	**Describe selection factors of microcontroller.**	**4M**
	Ans:	The selection of microcontroller depends upon the type of application. The following factors must be considered while selecting the microcontroller. **1. Word length:** The word length of microcontroller is either 8, 16 or 32 bit. As the word length increases, the cost, power dissipation and speed of the microcontroller increases. **2. Power dissipation:** It depends upon various factors like clock frequency, speed, supply voltage, VLSI technology etc. For battery operated embedded systems, we must use low power microcontrollers. **3. Clock frequency:** The speed of an embedded system depends upon the clock frequency. The clock frequency depends upon the application. **4. Instruction Set:** On the basis of instructions microcontrollers are classified into two categories 1. CISC 2. RISC. CISC system improves software flexibility. Hence it is used in general purpose systems. RISC improves speed of the system for the particular applications. **5. Internal resources:** The internal resources are ROM, RAM, EEPROM, FLASH ROM, UART, TIMER, watch dog timer, PWM, ADC, DAC, network interface, wireless interface etc. It depends upon the application for which microcontroller is going to be used. **6. I/O capabilities:** The number of I/O ports, size and characteristics of each I/O port, speed of operation of the I/O port, serial port or parallel ports. These are the considerations needed to ascertain correct selection of microcontroller.	**1M-Each Any 4 Points**
	(c)	**Draw and describe IP register format of 8051.**	**4M**
	Ans:	**<u>FORMAT OF IP:</u>**	

		D7 D0 -- -- PT2 PS PT1 PX1 PT0 PX0 Priority bit = 1 assigns high priority. Priority bit = 0 assigns low priority. -- IP.7 Reserved -- IP.6 Reserved **PT2** IP.5 Timer 2 interrupt priority bit (8052 only) **PS** IP.4 Serial port interrupt priority bit **PT1** IP.3 Timer 1 interrupt priority bit **PX1** IP.2 External interrupt 1 priority bit **PT0** IP.1 Timer 0 interrupt priority bit **PX0** IP.0 External interrupt 0 priority bit	**2M- Format,** **2M- describe**
	(d)	**List the interrupts in 8051. Give their priorities and vector addresses.**	**4M**
	Ans:		**2M- List,** **1M- Priority,** **1M- vector address**

Interrupt Source	Vector address	Interrupt priority
External Interrupt 0 – INT0	0003H	1
Timer 0 Interrupt	000BH	2
External Interrupt 1 – INT1	0013H	3
Timer 1 Interrupt	001BH	4
Serial Interrupt	0023H	5

	(e)	**Explain mode 3 of timer of 8051 with its internal logic diagram.**	**4M**
	Ans:	**Diagram: -**  **Explain: -** In this mode, timer 0 becomes two completed separate 8-bit timers. TL0 is controlled by gate arrangement of timer 0 and sets timer 0 flag when it overflows. TH0 receives the timer clock under the control of TR1 bit and sets TF1 flag when it overflows. Timer 1 may be used in mode 0, 1 and 2 with one important exception that no interrupt will be generated by the timer when the timer 0 is using TF1 overflow flag.	**2M- Diagram,** **2M- Explain**