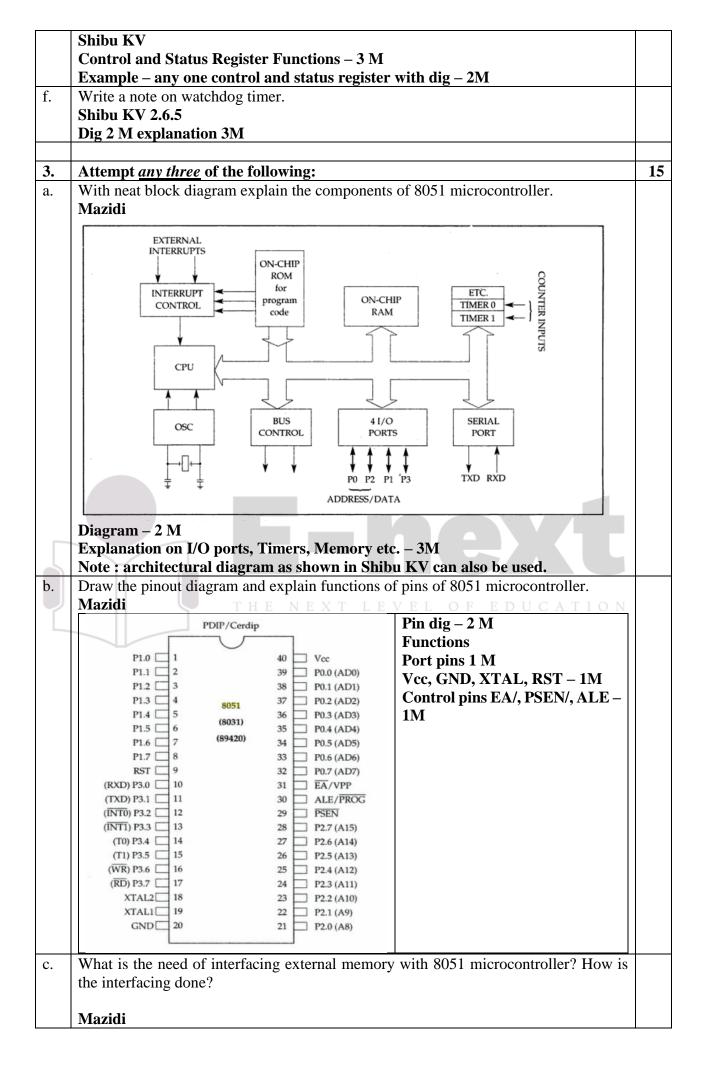N. B.: (1) **All** questions are **compulsory**.
    (2) Make **suitable assumptions** wherever necessary and **state the assumptions** made.
    (3) Answers to the **same question** must be **written together**.
    (4) Numbers to the **right** indicate **marks**.
    (5) Draw **neat labeled diagrams** wherever **necessary**.
    (6) Use of **Non-programmable** calculators is **allowed**.

1.	**Attempt _any three_ of the following:**	15
a.	Distinguish between general purpose system and embedded systems **Shibu KV 1.2** **5 points of distinction – 1 M each. Examples can be included.**	
b.	List three applications of embedded systems. Discuss any one in detail. **Shibu KV 1.5** **Five applications 1 M each**	

c.	Briefly explain function of the following. Also give on example each
	    i) PLD
	    ii) COTS
	
	Shibu K V 2.1.3 and 2.1.4 – 2 M each for PLD and COTS and 1 M for examples	

d.	What is use of a stepper motor in an embedded system? Explain different types of stepper motors **Shibu KV 2.3.3.4** **3 M – use of stepper motor; 2 M for types of stepper motor**	
e.	Discuss characteristics of embedded systems. **Shibu KV 3.1** **1 M each characteristic**	
f.	What are operational quality attributes of embedded system? **Shibu KV 3.2.1** **5 attributes are expected 1 M each**	
2.	**Attempt _any three_ of the following:**	15
a.	Explain the difference between domain specific and application specific embedded system. Give two examples of each. **Shibu KV chapter 4 – introduction – difference – 3M** **Examples – 2M**	
b.	What is role of display panel in a washing machine? What inputs can be accepted from user in a washing machine display interface? **Shibu KV 4.1 Fig 4.2** **Role – 2 M** **Inputs – 3 M (inputs like – water level, wash cycle, water temperature etc)**	
c.	What is memory map? Explain the interrupt map for embedded system **Mazidi** **Memory map explanation 2 M Dig – 1 M** **Interrupt map – 2 M**	
d.	What are different types of memory? Explain each in brief. **Shibu KV / Mazidi** **Types of memory – 2 M RAM – DRAM SRAM NVRAM ; ROM – PROM EPROM E2PROM** **Explanation 3M**	
e.	Explain the function of control and status register? Give example.	

	Shibu KV **Control and Status Register Functions – 3 M** **Example – any one control and status register with dig – 2M**	
f.	Write a note on watchdog timer. **Shibu KV 2.6.5** **Dig 2 M explanation 3M**	
3.	**Attempt _any three_ of the following:**	**15**
a.	With neat block diagram explain the components of 8051 microcontroller. **Mazidi** **Diagram – 2 M** **Explanation on I/O ports, Timers, Memory etc. – 3M** **Note : architectural diagram as shown in Shibu KV can also be used.**	
b.	Draw the pinout diagram and explain functions of pins of 8051 microcontroller. **Mazidi** 	**Pin dig – 2 M** **Functions** **Port pins 1 M** **Vcc, GND, XTAL, RST – 1M** **Control pins EA/, PSEN/, ALE – 1M**
c.	What is the need of interfacing external memory with 8051 microcontroller? How is the interfacing done? **Mazidi**	

	Some members of 8051 family are ROM less. They thus need external memory to store and access programs. Also, on chip ROM of all 8051 versions is limited and many times a higher capacity ROM is needed to accommodate a complex program. **(1M)** **Interface dig – 2 M** **Explanation with mention of EA/ and PSEN/ - 2M**	
d.	Write a note on data types in embedded C. **Mazidi** **Unsigned char, signed char (default), - 1M** **unsigned int, signed int (default), -1M** **Sbit, -1M** **Bit -1M** **and SFR – 1M**	
e.	Explain how time delay is calculated using 8051 microcontroller? Write code segment to support your explanation. **Mazidi** *The delay depends upon –* • *Number of clock cycles per machine cycle* • *Crystal frequency* • *Compiler.* *(1M)* *Consider an analog clock, there are 12 divisions on the clock. The clock can count 12 hours, thus each division will represent one hour (12 / 12).* *8051 microcontroller has frequency of approximately 11.0596 MHz, hence we can say that each pulse needs time 12 / 11.0596 = 1.085µs* *Now, if a delay of 1ms is required, 1000 / 1.085 = 921.658* *Total count is 65536. Hence for 1 ms we will need to count 65536 – 921.658 = 64614.34 pulses. This number when converted to hex is FC65 H.* *If we use the timer registers, to count to this number, they will take the time of 1ms. Following code will generate the time delay of 1 ms.* *(2M)* ```\nvoid T0Delay()\n{\n TMOD=0x01;\n TL0=0xFC;\n TH0=0x65;\n TR0=1;\n while(TF0==0);\n TR0=0;\n TF0=0;\n}\n``` *Note that timer 0 is used in mode 1 (TMOD = 0X01). Here, timer 0 is 16 bit counter. It cab store values from 0000 H to FFFF H using both TH and TL registers. When the counter starts, (TR = 1), the count begins from the preset value and when it reaches FFFF H, it rolls to 0000 H. when this is done, TF is set to 1. This explains our T0Delay() function. The timer 0 is set to mode 1, then the base value FC65 H as per the calculation shown above, for 1 ms delay, is loaded into TH0 and TR0 = 1. The counting will continue till all numbers from FC65 to FFFF are counted. Then our delay is generated. However flag TF should be reset again to 0 so that next time when the function is called, same operation can be repeated. (2M)*	
f.	Demonstrate the use of bitwise operator in embedded C. **Mazidi** **AND, OR and NOT operators – 2M**	

	Bitwise shift operators -3 M		
4.	**Attempt *any three* of the following:**		**15**
a.	What are the factors to be considered in selecting a microcontroller for embedded system? Discuss any one in detail. **Shibu KV** **List the factors with description – 2 M** **Explanation – 3M**		
b.	Explain the steps in designing a embedded system using 8051 microcontroller. **Shibu KV** **Problem analysis** **Design the circuit** **Create software** **Code dumping** **Testing** **1 M each.**		

c.	List and explain in brief the features of 8051 microcontroller.
	Mazidi / Shibu
	
	- *4 KB on chip program memory.*
	- *128 bytes on chip data memory(RAM)*
	  - *32 bytes devoted to register banks*
	  - *16 bytes of bit-addressable memory*
	  - *80 bytes of general-purpose memory*
	- *4 register banks.*
	- *128 user defined software flags.*
	- *8-bit data bus*
	- *16-bit address bus*
	- *16 bit timers (usually 2, but may have more, or less).*
	- *3 internal and 2 external interrupts.*
	- *Bit as well as byte addressable RAM area of 16 bytes.*
	- *Four 8-bit ports, (short models have two 8-bit ports).*
	- *16-bit program counter and data pointer.*
	- *1 Microsecond instruction cycle with 12 MHz Crystal.*
	
	Memory – 1M
	System bus, Timers and interrupts – 1M
	Ports – 1 M
	Crystal oscillator with frequency -1M
	Program counter and data pointer - 1M		

d.	With required example explain structure of embedded system program **Mazidi** **Major constituents of embedded C program are -** - *Comments* - *Pre-processor directives* - *Global variables and functions* - *Main function* **1 M each** **1 M for Example**		
e.	**Explain what is meant by the superloop based approach.**		

	Shibu KV 9.1.1 **What is superloop / infinite loop – 1M** **Role of superloop in embedded system – 2M** **Example – 2 M**	
f.	What are different types of files created in the process of burning a program onto the IC? *Shibu KV 9.2* *Fig 9.1* *Types of files generated –* *.asm or .src files – Object files – Library files used with object file are used by linker or locator to build absolute object file and then converted to hex file.*	
5.	**Attempt _any three_ of the following:**	**15**
a.	Define operating system kernel. What are services provided by kernel? **Shibu KV 10.1** **Definition – 1 M** **Process Management** **Memory Management** **File System Management** **Device Management** **1 M each**	

b.	Distinguish between Real Time operating system and general purpose operating system.
	Shibu KV
	General Purpose OS –
	  Used in general purpose systems
	  Systems designed to perform multiple different tasks
	  Kernel offers all types of services
	  Non deterministic in behavior
	  Examples – Windows
	
	  Used in dedicated embedded systems
	  Systems are designed to perform real time tasks, limited in number
	  Kernel offers limited services
	  Deterministic in behavior
	  Examples – QNX, VxWorks
	
	1M each difference
	Any other valid point of difference can be considered.	

c.	List and explain the functional requirements to be considered in order to select the correct RTOS. **Shibu KV** **10.10.2** **Any five functional requirements can be discussed – 1 m each**	
d.	What are the components of IDE of embedded system development environment? **Shibu KV** **13.1.1** **Project window** **Text editor** **Output window** **Menu bars** **Diagram** **1 M each**	
e.	Explain following terms –	

	Shibu KV chapter 13 – 13.3, 13.4 **Compiler** **Debugger** **Disassembler** **Emulator** **Simulator** **1 M each**	
f.	Write a note on current trends in embedded industry. **Shibu KV 16.1, 16.2, 16.3** **Processor trends – 1M** **Embedded OS trends – 2M** **Development Language Trends-2 M**	