GUJARAT TECHNOLOGICAL UNIVERSITY

BE 5 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Advance Microcontroller - 3151107

Chapter 1: ARM Introduction

Repeated Questions:

1. RISC, CISC and ARM Design Philosophy:

- **Q.** Compare RISC and CISC philosophy. List the features rejected from RISC Design for improved ARM Design. / Explain difference between RISC and CISC architecture. Which RISC features are selected in ARM processor and which features are rejected in ARM processor? **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2023, 3 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 7 Marks OR; SUMMER 2025, 7 Marks)**
- **Q.** Describe the ARM design philosophy in detail. Explain why ARM became popular in embedded systems. / Which are the different features of ARM instruction set that make it suitable for embedded applications? **(WINTER 2024, 7 Marks; WINTER 2025, 7 Marks)**
- **Q.** What is the RISC design philosophy? What is the Reduced Instruction Set Computer (RISC) design philosophy? List down features of its. **(WINTER 2024, 3 Marks; WINTER 2025, 4 Marks)**

Other Important Questions:

1. ARM Applications and Features (Theory):

- **Q.** For what type of applications ARM is preferred over AVR microcontroller? What is advantage of 32-bit processor over 8-bit processor? **(SUMMER 2024, 4 Marks)**
- **Q.** Give different applications of ARM processors. **(WINTER 2024, 4 Marks)**
- **Q.** Write three features of the ARM processor family. **(WINTER 2025, 3 Marks)**

2. Architectures (Theory):

- **Q.** State the difference between Von Neumann and Harvard architecture. **(SUMMER 2026, 3 Marks)**

Chapter 2: ARM Architecture and pipeline structure

Repeated Questions:

1. ARM Core and Programmer's Model:

- **Q.** Draw and explain ARM Core data flow model. **(SUMMER 2023, 7 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Explain the ARM7TDMI programmer's model. / Explain ARM7TDMI architecture and its programming model. / Explain the key features and components of the ARM7TDMI architecture. Discuss the ARM7TDMI processor modes. **(SUMMER 2022, 7 Marks; WINTER 2022, 7 Marks; SUMMER 2023, 4 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Explain ARM Architecture and Programming model. What are the special purpose registers? Explain importance of barrel shifter with example. / What is the advantage of barrel shifter in ARM? **(SUMMER 2022, 3 Marks; SUMMER 2024, 7 Marks; WINTER 2024, 3 Marks)**
- **Q.** What is the special purpose of R13, R14 and R15 registers in ARM? / What are the special functions of R13, R14 and R15 registers? **(SUMMER 2022, 3 Marks; WINTER 2022, 3 Marks)**

2. CPSR and SPSR:

- **Q.** Explain flags in ARM. What is the purpose of CPSR and SPSR? / Describe each field of CPSR Register. / Explain CPSR and SPSR Register of ARM microcontroller. / Explain the role of the ARM7TDMI Status Register (CPSR) in managing processor state and controlling program execution. Discuss the flags contained in the CPSR and their significance in instruction execution. **(SUMMER 2022, 4 Marks; WINTER 2023, 3 Marks; SUMMER 2024, 3 Marks; SUMMER 2025, 4 Marks; SUMMER 2026, 4 Marks)**

3. Pipeline:

- **Q.** Explain the 5-stage Pipeline architecture used in ARM controller with necessary figures. / Explain 3 stage and 5 stage pipeline used in ARM Microcontroller / Describe 3-stage pipelined architecture of ARM7 / Describe the ARM7TDMI pipeline architecture and the stages involved in the execution of instructions. Discuss the role of pipeline hazards and techniques such as forwarding and stalling in optimizing pipeline performance. / Explain ARM pipeline with 3,5,6 stages. / Explain 5-stage pipelines used in ARM processor. **(SUMMER 2022, 7 Marks OR; WINTER 2022, 7 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks; SUMMER 2024, 4 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks OR; SUMMER 2026, 7 Marks)**

4. Interrupt Latency and FIQ:

- **Q.** Why interrupt latency of FIQ is less than IRQ in ARM Microcontroller? / Why FIQ response is fast than IRQ response in ARM processor? Explain necessity of FIQ with one example. / What is interrupt latency? How FIQ interrupt latency is reduced in ARM Microcontroller? **(SUMMER 2022, 4 Marks; WINTER 2022, 3 Marks; SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 4 Marks)**

5. Endianness:

- **Q.** Explain difference between Little endian & Big Endian with example. / Explain difference between Harvard & Von-Neumann Architecture. / What is endianness? Differentiate between little-endian and big-endian. / Explain the concept of little-endian byte ordering in ARM7TDMI processors. How does byte ordering affect memory access and data representation? **(SUMMER 2022, 3 Marks; SUMMER 2022, 3 Marks OR; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks)**

Other Important Questions:

1. Processor Features (Theory):

- **Q.** What is the importance of condition codes with instructions in ARM Microcontroller? **(WINTER 2022, 4 Marks)**

- **Q.** What problem will occur with pipeline during branch instruction? How this problem is resolved in ARM? **(SUMMER 2024, 4 Marks)**
- **Q.** What is Cortex? Compare features of ARM Cortex series with ARM7 core. **(WINTER 2023, 7 Marks OR)**
- **Q.** Write a short note on ARM7TDMI interface signals. **(WINTER 2025, 4 Marks)**

2. Registers (Theory):

- **Q.** With a neat diagram explain the different general purpose registers of ARM processors. **(WINTER 2024, 4 Marks)**
- **Q.** What are banked registers? Show how the banked registers are utilized when the user mode changes to IRQ mode. **(WINTER 2024, 7 Marks)**

3. Memory Organization (Theory):

- **Q.** Explain Non-protected memory, MPU & MMU. **(WINTER 2024, 3 Marks)**
- **Q.** Describe the ARM memory map and load-store architecture with an example. **(WINTER 2025, 7 Marks OR)**

Chapter 3: ARM7TDMI assembly language instructions and programming

Repeated Questions:

1. Instruction Explanations and Results:

- **Q.** Explain following ARM instruction with example: 1) UMULL 2) SBCS 3) BL 4) BIC 5) RSC 6) EORS 7) MOVEQ **(SUMMER 2023, 7 Marks)**
- **Q.** Explain following ARM assembly language instructions: (1) LDR R1,[R2,#8] (2) LDRB R1,[R0],#1 (3) TST R1,R2 (4) LDMIA R0!, {R1-R3} (5) CMN R1,R2 (6) ASR (7) BX **(SUMMER 2024, 7 Marks)**
- **Q.** Explain following assembly language instructions: [a] LDMIA R0!,{R2-R6} [b] MVN R1,R4 [c] MOV R5,R6,LSL #2 [d] LDR R1,[R3] [e] RSC R0,R1,R2 [f] ADDEQ R0,R1,R2 [g] TST R1,R2 / Explain following assembly language instructions: [a] LDMIA R0!, {R1-R7} [b] MVN R1,R3 [c] MOV R1,R2,LSL #2 [d] LDR R1,[R2] [e] RSC R0,R1,R2 [f] ADDEQ R0,R1,R2 [g] TST R1,R2 **(SUMMER 2022, 7 Marks; SUMMER 2025, 7 Marks)**
- **Q.** Describe following instructions with suitable example. (1) LDMIA R1, {R2-R10} (2) LDMDB R1!, {R2-R10} **(WINTER 2023, 4 Marks OR; WINTER 2025, 4 Marks OR)**
- **Q.** What will be content of register R1 after executing following instruction. (Assume initial content of R1=0xFAFAFAFA and R2=0x55555555) BIC R1,R1,R2 / What will be content in register R3 after executing following instructions in ARM Microcontroller? LDR R1,=0xFFFFFFF LDR R2,=055555555 BIC R3,R1,R2 / What will be content in register R3 after executing following instructions in ARM Microcontroller? LDR R1,=0xFFFFFFF LDR R2,=0x11118888 BIC R3,R1,R2 **(WINTER 2022, 3 Marks; SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks OR)**

2. Branch Instructions:

- **Q.** What is the difference between branch instruction “B” and “BL”? Explain branch instructions of ARM Microcontroller with suitable examples. / Explain branch instructions B and BL. What is the difference between B and BL? / What is difference between branch instructions “B” and “BL”? / Explain ARM program control flow instructions (B, BL, BX) with examples. **(WINTER 2022, 7 Marks; SUMMER 2024, 4 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 7 Marks)**

3. Exceptions, Interrupts and SWI:

- **Q.** What are the exceptions and interrupts in ARM? How exception handling done? / What is exception? List types of exceptions occur in ARM processor. Explain registers available to programmers during exceptions. / What are the exceptions in ARM processor? Explain mode of operation for different exceptions. / How are interrupts or exceptions handled in ARM processors? / Describe the ARM7TDMI interrupt handling mechanism and the process of prioritizing and servicing interrupts in ARM7TDMI-based systems. / Discuss ARM exception handling mechanism with reset example. / Write a short note on exceptions in ARM processor. Discuss the types of exceptions, the exception handling mechanism. **(SUMMER 2022, 7 Marks OR; WINTER 2022, 7 Marks; SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 7 Marks OR)**
- **Q.** Describe software interrupt instruction SWI with its importance. / Describe Software Interrupt instruction with example. **(SUMMER 2023, 3 Marks; SUMMER 2026, 3 Marks)**

4. Thumb Mode:

- **Q.** Describe Thumb mode in ARM processor. Differentiate ARM mode and Thumb Mode. How to switch from/to Thumb mode to/from ARM mode? / Discuss the advantages of using the ARM7TDMI Thumb state in low-power and code size-constrained applications. How does Thumb state reduce memory bandwidth and energy consumption compared to the ARM state? / What is a Thumb mode in ARM? Explain in brief. / List the properties of the Thumb Instruction Set in ARM processors. **(WINTER 2023, 7 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 4 Marks; SUMMER 2026, 3 Marks OR)**

5. Stack and Assembler Directives:

- **Q.** Write a short note on stack implementation in ARM. **(SUMMER 2023, 7 Marks OR; WINTER 2024, 7 Marks OR)**
- **Q.** Describe following assembler directives: AREA, DCD, ADR, ENTRY / Explain following directives of ARM assembler 1. EQU 2. RN 3. ALIGN / Describe following assembler directives: ENTRY, ADR, DCD **(WINTER 2023, 4 Marks; WINTER 2024, 3 Marks OR; WINTER 2025, 3 Marks OR)**

6. Conditional Statements in Assembly:

- **Q.** Write assembly language instruction for following operations: if(R0 < (R5+R7)) { R1 = R1 + R2*8 R3 = R3 - R1*16 } / Write equivalent assembly language instruction for following "C" statement: if (z==1) R1=R2+(R3*4) { z is Zero flag and R1,R2, R3 are registers } / Write equivalent assembly language instruction for following "C" statement: if (z==1) { R1=R2+(R3*4); } Where z is Zero flag and R1,R2, R3 are registers **(WINTER 2023, 4 Marks OR; SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks OR)**

Other Important Questions:

1. Instructions (Theory):

- **Q.** Explain barrel shifter instructions with example. **(SUMMER 2023, 4 Marks)**
- **Q.** Explain the BX instruction with suitable example. **(SUMMER 2023, 3 Marks OR)**
- **Q.** Explain how register allocated by ARM C compiler. **(SUMMER 2023, 4 Marks OR)**
- **Q.** Explain control flow instructions for ARM controller with suitable examples. **(SUMMER 2023, 3 Marks OR)**
- **Q.** Describe following instruction with its addressing mode, with example. (1) LDR R1, [R2], 16 (2) LDR R1, [R2, 16] (3) LDR R1, [R2, 16]! (4) LDR R1, [R2, R3]! **(WINTER 2023, 4 Marks)**
- **Q.** Explain working of various multiply instructions in ARM with proper example. **(WINTER 2025, 3 Marks OR)**
- **Q.** What is conditional execution? What are the mnemonic extension codes used for conditional execution? Explain with example. **(SUMMER 2026, 4 Marks OR)**

2. Assembly Language Programs:

- **Q.** Write a program to count a number of 1's in R0. Assume that R0 contains any 32-bit data. **(SUMMER 2023, 7 Marks OR)**
- **Q.** Write assembly language subroutine to find value of Y in following equation: Y = 16X + 4 (Assume register R1 holds Y and register R2 holds X) **(WINTER 2022, 4 Marks)**
- **Q.** Write assembly language program to multiply given number (in R2 register) by 35 without using multiply instructions. Move result to R10 register after operation. **(WINTER 2023, 3 Marks)**
- **Q.** Write assembly language program to (1) shift left R1 by 32 and (2) logical shift right R2 by 8 (3) Add both result in R3. Assume R1=0x34, R2 = 0x53A0, What will be content of R1, R2 and R3 after executing the code. **(WINTER 2023, 3 Marks OR)**
- **Q.** Write an assembly language program to count no of 0's in R2 register. **(SUMMER 2026, 4 Marks)**
- **Q.** Write ARM assembly language program for HEX number to ASCII conversion. Assume HEX number is stored in register R1. **(WINTER 2024, 4 Marks)**

Chapter 4: Embedded C Programming for ARM

Repeated Questions:

1. Embedded C Concepts and Optimization:

- **Q.** What are the advantages and disadvantages of C programming over assembly programming for embedded systems? Explain any two optimization techniques of C program with help of example. **(WINTER 2022, 7 Marks; SUMMER 2024, 7 Marks)**
- **Q.** List optimization techniques of Embedded C Programming. Explain any three techniques in detail with examples. **(SUMMER 2022, 7 Marks OR; WINTER 2025, 7 Marks OR)**
- **Q.** Discuss techniques for optimization of memory needs while writing C program for ARM based microcontroller. / Explain techniques used for memory optimization in embedded systems. **(WINTER 2024, 7 Marks OR; SUMMER 2026, 7 Marks)**
- **Q.** Discuss variable storage class: Automatic, Register and static. **(SUMMER 2022, 3 Marks; WINTER 2024, 3 Marks)**
- **Q.** List ARM development tools and advantages of Embedded C Programming. **(SUMMER 2022, 4 Marks; WINTER 2024, 4 Marks)**
- **Q.** How will you perform bit-wise operation in C using ARM compiler? / Describe how bit-wise operations can be performed in C using the ARM compiler. **(WINTER 2024, 4 Marks; SUMMER 2026, 4 Marks)**

2. GPIO Programming:

- **Q.** Write C language program to set port pins P0.0 to P0.7 and P1.0 to P1.7 in ARM processor. **(WINTER 2022, 3 Marks OR; WINTER 2024, 3 Marks OR)**

3. Timer, ADC and PWM Programming:

- **Q.** Describe how to configure a timer on an ARM microcontroller. Explain how to set the key parameters such as pre-scaler, clock source and mode of operation. / Explain the process of configuring and programming timers in ARM7TDMI to perform tasks such as generating precise delays with help of examples. **(SUMMER 2024, 7 Marks OR; SUMMER 2025, 4 Marks)**
- **Q.** Explain the steps involved in configuring and initializing the ADC module in an ARM microcontroller. / Describe the basic steps involved in configuring the ADC module of an ARM7TDMI microcontroller for analog input signal conversion. **(SUMMER 2024, 3 Marks; SUMMER 2025, 3 Marks)**
- **Q.** Explain ADxCR (Analog to Digital Conversion Control Register) for channel selection, resolution and start of conversion. / Explain the role of the various registers in the ADC of an ARM processor. **(SUMMER 2024, 3 Marks OR; SUMMER 2026, 4 Marks OR)**
- **Q.** Explain the concept of PWM using timers. How can you generate PWM signals for controlling devices such as motors or LEDs using ARM Microcontroller? What are the registers useful for PWM programming? / Describe the principles of Pulse Width Modulation (PWM) and its applications in embedded systems. Discuss how PWM signals are generated using timers. Provide an example of using PWM to control the brightness of an LED with interfacing diagram. **(SUMMER 2024, 7 Marks OR; SUMMER 2025, 7 Marks OR)**
- **Q.** Design ARM system to generate two PWM signals to control devices. Write C program to generate PWM on any two PWM pins with duty cycle of 20% and 40% respectively. / Write a C program to generate PWM signals with 60% duty cycle in LPC2148. Also, explain the significance of using PWM in embedded systems. **(SUMMER 2022, 7 Marks OR; SUMMER 2026, 7 Marks OR)**

Other Important Questions:

1. Embedded C Concepts (Theory):

- **Q.** List the portability issues encounter when porting C code to the ARM. **(SUMMER 2023, 3 Marks)**

- **Q.** Explain ARM addressing modes with suitable examples. **(SUMMER 2023, 7 Marks OR)**
- **Q.** Describe code optimization techniques of embedded C-programming. **(WINTER 2023, 3 Marks)**
- **Q.** Describe concept of inline assembly code in ARM C-program. **(WINTER 2023, 3 Marks OR)**
- **Q.** Define pointer aliasing in Embedded C. Why is it a concern? **(WINTER 2025, 3 Marks)**
- **Q.** Explain how inline functions differ from normal functions in ARM C. Give an example. **(WINTER 2025, 4 Marks)**

2. GPIO Programs:

- **Q.** Write a C program to blink LED connected to pin P0.3 at the interval of 1 second in LPC2148. Generate a delay using Timer. **(SUMMER 2023, 7 Marks)**
- **Q.** Discuss how to toggle the state of GPIO port pin P1.0. Explain the use of bitwise XOR (exclusive OR) to change the state of the pin. Write C program for toggling the P1.0 pin's state to generate square wave with highest frequency. **(SUMMER 2024, 4 Marks)**
- **Q.** 8 LEDs are connected to port pin P1.16 to P1.23. Write C program to blink (Flash) LED with any amount of delay. **(SUMMER 2024, 4 Marks OR)**
- **Q.** Digital sensor is connected to port pin P0.0 and Buzzer is connected to port pin P1.0. Write C Program to sound buzzer when digital sensor provides logic 1 and mute buzzer when digital sensor provides logic 0. **(SUMMER 2024, 3 Marks)**
- **Q.** Write subroutines to set port pins IOSET() and clear port pins IOCLR() where pin number can be specified in argument in these subroutines. Write main program to set port pin P1.6 and clear port pin P1.4 using these subroutines. **(SUMMER 2024, 7 Marks)**
- **Q.** Write initialization instruction in Embedded C language for ARM if we want to connect 4 push-button SW with P0.0 to P0.3, 8 LEDs with P0.4 to P0.11, Digital sensors with P0.12 to P0.15 and Actuators with P0.16 to P0.19 pins of ARM Chip. **(SUMMER 2022, 3 Marks)**
- **Q.** Design ARM based system to control solenoids S1, S2, S3 and S4. Write Embedded C program to operate solenoid in such a way that solenoid S1 and S3 should be ON for 5 second and then after solenoid S2 and S4 should be ON for 3 second and then after repeat the sequence continuously. **(SUMMER 2022, 7 Marks)**
- **Q.** Write C Program to turn ON and OFF electrical device controlled by port pin P1.7 ON and OFF should be done at the interval of 10 second. Assuming relay driver circuit is available and connected with port pin P1.7 to control electrical device and devices turns ON when logic 1 is available on the port pin. **(SUMMER 2025, 3 Marks)**
- **Q.** Write C language program to set port pins P0.16 to P0.20 and P1.8 to P1.15 in ARM processor. **(SUMMER 2025, 4 Marks OR)**
- **Q.** Write a program to toggle LEDs connected to port pin P0.2 using in ARM7 microcontroller. **(SUMMER 2026, 4 Marks)**

3. Peripheral Interfacing (LCD, UART, SPI, I2C, Display, Relay):

- **Q.** Explain interfacing of 16x2 LCD with ARM Microcontroller. Draw interfacing diagram and write C language program to display message "Atma Nirbhar Bharat" on LCD. **(WINTER 2022, 7 Marks OR)**
- **Q.** Sketch circuit diagram of LCD interfacing with LPC2148. Write C-program to display "MICROCONTROLLER" on first line of LCD. [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks)**
- **Q.** Sketch circuit diagram to interface following devices with LPC2148. (1) Eight LEDs at P1.0 to P1.7 (2) single switch (SW1) at P1.16 (3) Single relay (R1) at P1.20. Write C-program to turn on LEDs as per binary counter if switch is pressed. When counter pattern reach at 0xFF, turn-on relay for 1 second. [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks OR)**

- **Q.** Draw interfacing diagram to interface LCD with ARM processor. Write Assembly or C program to display message “DIGITAL INDIA” on the LCD. [Diagram required – refer to the original question paper] **(WINTER 2024, 7 Marks)**
- **Q.** Draw interfacing diagram of Common Cathode seven segment display connected to port P0.0 to P0.7. Write C language program to display 0 to F continuously with delay. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks)**
- **Q.** Draw the interfacing diagram of a relay with LPC2148 and explain its working. [Diagram required – refer to the original question paper] **(SUMMER 2026, 4 Marks OR)**
- **Q.** Discuss UART Programming in ARM Microcontroller. Explain important registers used for UART programming. **(WINTER 2022, 7 Marks)**
- **Q.** Write a C program that send and receive data from UART device interfaced with ARM. **(WINTER 2024, 7 Marks)**
- **Q.** Write a C program to interface a UART device with an ARM microcontroller. **(SUMMER 2026, 7 Marks)**
- **Q.** Explain programming steps for SPI programming. **(WINTER 2022, 4 Marks OR)**
- **Q.** List I2C and SPI interface signals. Is it possible to connect multiple devices with I2C interface? **(SUMMER 2022, 3 Marks OR)**
- **Q.** Compare SPI and I2C in terms of protocol, speed, and usage in ARM Embedded C. **(WINTER 2025, 7 Marks)**

4. ADC and Timer (Theory):

- **Q.** Explain the process of reading analog input values from the ADC data registers in ARM7TDMI programming. How are the converted digital values accessed and processed for further use in the application? **(SUMMER 2025, 3 Marks OR)**
- **Q.** Draw and explain Timer block diagram in LPC2148. [Diagram required – refer to the original question paper] **(SUMMER 2026, 7 Marks OR)**

Chapter 5: Cache and Memory Management and Protection

Repeated Questions:

1. Virtual Memory, TLB and MMU:

- **Q.** Explain the function of Translation look aside buffers in virtual memory system. / Write a short note on translation look aside buffer. **(WINTER 2022, 4 Marks; WINTER 2023, 4 Marks OR; SUMMER 2026, 7 Marks OR)**
- **Q.** Justify the statement "Virtual memory is illusion of large main memory". **(SUMMER 2022, 3 Marks OR; WINTER 2024, 3 Marks OR)**
- **Q.** What is the difference between physical and virtual memory? / What is virtual memory, and why is it essential in computer systems? Describe the primary purpose it serves in managing system memory. **(WINTER 2022, 3 Marks; SUMMER 2024, 4 Marks)**
- **Q.** What is MMU? Enlist merits and demerits of MMU. / Write down the MMU Advantages for ARM processor. **(SUMMER 2023, 3 Marks; WINTER 2023, 3 Marks)**

2. Cache Memory:

- **Q.** Explain flush and clean operation performed on a cache memory in ARM. **(WINTER 2022, 4 Marks OR; WINTER 2024, 4 Marks OR; SUMMER 2026, 3 Marks OR)**
- **Q.** What is cache memory? What is advantage of using cache memory? Explain concept of cache memory / Explain the concept of cache memory in ARM7TDMI processors and the benefits of using cache memory for improving memory access performance. **(SUMMER 2022, 4 Marks OR; SUMMER 2025, 7 Marks)**
- **Q.** Compare unified cache and split cache. / Explain the unified split cache memory. **(SUMMER 2023, 4 Marks OR; WINTER 2025, 4 Marks)**

Other Important Questions:

1. Memory Hierarchy and Cache (Theory):

- **Q.** Draw and explain the memory hierarchy used in a computer system. **(SUMMER 2023, 4 Marks)**
- **Q.** Describe the cache hierarchy commonly used in ARM processors, including L1, L2, and L3 caches. How do these levels of cache differ in terms of capacity, proximity to the CPU? **(SUMMER 2024, 4 Marks OR)**
- **Q.** Describe basic architecture of cache memory. [Diagram required – refer to the original question paper] **(WINTER 2023, 4 Marks)**
- **Q.** Explain hierarchical memory organization in ARM systems and the role of each level. **(WINTER 2025, 7 Marks)**

2. Virtual Memory and Paging (Theory):

- **Q.** Explain mapping a task in virtual memory to physical memory using a relocation register. **(SUMMER 2023, 4 Marks)**
- **Q.** Explain the role of page tables in virtual memory management. **(SUMMER 2025, 4 Marks)**
- **Q.** Describe the concept of address translation in virtual memory systems. **(SUMMER 2025, 4 Marks OR)**
- **Q.** What is the use of paging mechanism? Show how paging is done in any of ARM families of processors. **(WINTER 2024, 7 Marks OR)**
- **Q.** Differentiate between paging and segmentation. **(WINTER 2025, 3 Marks OR)**

3. MMU, MPU and TCM (Theory):

- **Q.** Discuss Tightly coupled Memory (TCM). **(SUMMER 2023, 7 Marks OR)**
- **Q.** Enlist main control components of ARM MMU. **(WINTER 2023, 3 Marks OR)**
- **Q.** Explain ARM MPU (Memory Protection Unit) with an example. **(WINTER 2025, 3 Marks)**

- **Q.** Explain the importance of Memory Protection Unit. **(SUMMER 2026, 3 Marks)**

Chapter 6: ARM Peripherals and versions

Repeated Questions:

1. AMBA Bus System:

- **Q.** Discuss the APB bus transfers. Explain the need of APB bridge. / Describe the different types of AMBA buses, such as AHB (Advanced High-Performance Bus) and APB (Advanced Peripheral Bus). How do these buses differ in terms of functionality and performance? / Compare AHB, APB and ASB of AMBA bus system of ARM Architecture. / Compare AHB and APB of AMBA bus system of ARM Architecture. / Differentiate AHB and APB bus transfers. / Compare ARM System Bus (ASB) and ARM Peripheral Bus (APB) by listing their differences. **(SUMMER 2023, 7 Marks; WINTER 2023, 7 Marks OR; SUMMER 2024, 7 Marks OR; WINTER 2024, 4 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 3 Marks)**
- **Q.** Sketch and Describe AMBA bus arbitration with help of diagram. / Describe AMBA Arbitration with the help of a diagram for AMBA based system. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR; WINTER 2023, 7 Marks)**
- **Q.** What advantages does the AMBA architecture bring to ARM-based SoC designs? How does it improve system scalability, modularity, and performance? / Describe the Advanced Microprocessor Bus Architecture (AMBA) in detail, highlighting its key components and their roles in ARM7TDMI-based systems. Discuss how AMBA facilitates high-performance and scalable interconnectivity between different system components. / Explain Advanced Microprocessor Bus Architecture (AMBA) and discuss its special features. **(SUMMER 2024, 4 Marks; SUMMER 2025, 7 Marks OR; SUMMER 2026, 3 Marks OR)**

2. ARM Cortex Versions:

- **Q.** What is difference between Cortex A, Cortex M and Cortex R series of ARM? / Compare Cortex-M, Cortex-R, and Cortex-A in the context of AMBA interconnect usage. **(SUMMER 2022, 4 Marks; WINTER 2025, 7 Marks OR)**

Other Important Questions:

1. AMBA and AHB (Theory):

- **Q.** Briefly discuss the AHB bus features. **(SUMMER 2023, 3 Marks OR)**
- **Q.** What is the name of signal used by AMBA's ASB bus master "x" to the bus arbiter to request bus and what is the name of bus grant signal communicated by bus arbiter? **(WINTER 2022, 3 Marks)**
- **Q.** Explain AHB basic data transfer with help of diagram. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks)**
- **Q.** What is the purpose of HLOCK signal produced by AHB Master? **(WINTER 2022, 3 Marks OR)**
- **Q.** What is AMBA? Why AMBA is popular in modern embedded system design? **(SUMMER 2022, 4 Marks OR)**

2. Pipeline (Theory):

- **Q.** Explain concept of delayed branch. **(SUMMER 2026, 4 Marks)**

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