B.E. Seventh Semester

(Electronics & Telecommunication / Electronics & Communication Engineering) (C.B.S.)

Elective - I : VLSI Signal Processing

P. Pages : 3 **NKT/KS/17/7458**

Time : Three Hours * 0 1 0 4 * Max. Marks : 80

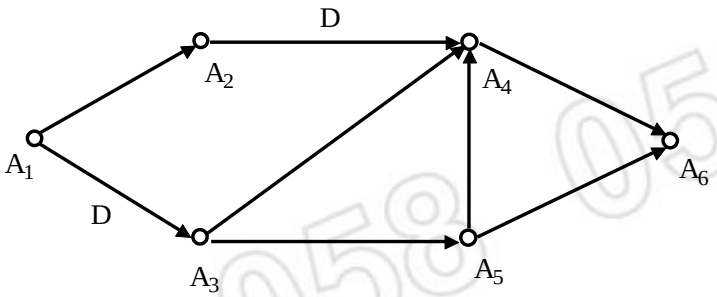
Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Diagrams and chemical equations should be given whenever necessary.
11. Illustrate your answers whenever necessary with the help of neat sketches.
12. Use of non programmable calculator is permitted.

1. a) Derive the expression for reduced power consumption for a pipelined filter. **7**

b) Explain the terms: **7**
i) Data Broadcast structure.
ii) Fine grain pipelining.

OR

2. a) In the SFG shown, the computation time of each node is assumed to be 1 u.t. **4**
i) Calculate the critical path computation time.
ii) Obtain an appropriate pipelined circuit with critical path of 2 u.t.



b) Consider a direct form implementation of FIR filter. **10**
$y(n)=ax(n)+bx(n-2)+cx(n-3)$
Assume that the time required for 1 multiply- add operation is T.
i) Pipeline the filter such that the clock period is approximately T.
ii) Future pipeline the above pipelined filter such that clock period is T/2.

3. a) What is retiming. prove that: The weight of retimed path **7**
$p \approx v_0 \xrightarrow{e_0} v_1 \xrightarrow{e_1} \xrightarrow{e_{k-1}} v_k$ is given by $w_r(p)=w(p)+r(v_k)-r(v_0)$.

b) Explain cut set retiming in detail. **6**

OR

4. Draw a constraint graph & use it to determine if the following system of inequalities has a solution & find a solution if one exists using Bellman Ford algorithm. **13**

$r_1 - r_2 \leq 0$

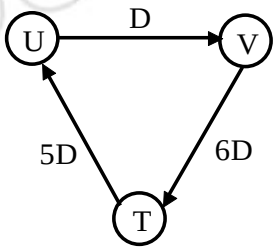
$r_3 - r_1 \leq 5$

$r_4 - r_1 \leq 4$

$r_4 - r_3 \leq -1$

$r_3 - r_2 \leq 2$

5. a) Unfold the DFG with unfolding factor 3. **8**



b) Explain in short unfolding transformation. **5**

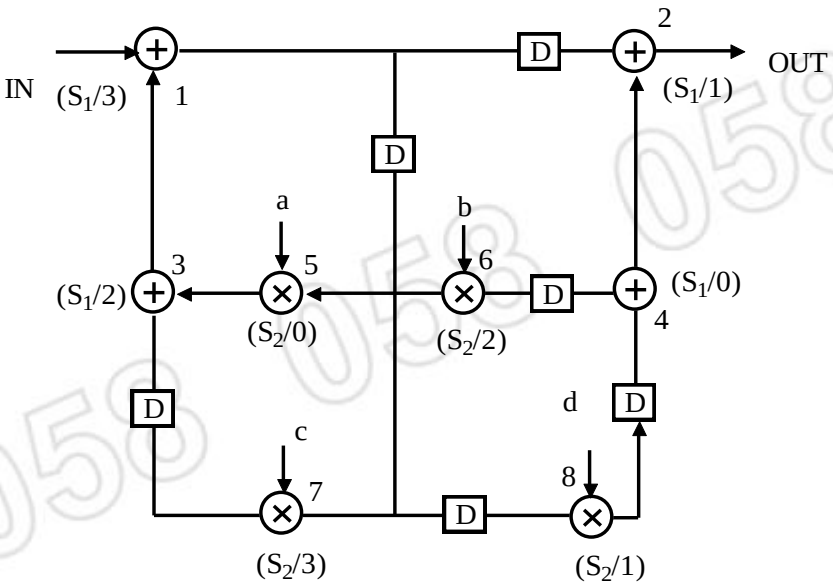
OR

6. a) Give the properties of unfolding. **5**

b) Explain how, the unfolded DFG can have a sample period equal to iteration bound of original DFG. **8**

7. a) Explain life-time analysis for register minimization in folding. **6**

b) Design folded biquad filter by systematic folding technique for the fig. shown below. **7**



OR

8. a) Explain folding algorithm. **6**

b) Consider a DSP program that performs the transpose operation of 3x3 matrix. Find minimum number of registers required to implement the DSP program & give its folded architectures. **7**

$$\text{Matrix} = \begin{bmatrix} a & b & c \\ d & e & e \\ g & h & i \end{bmatrix}$$

9. Construct a 2x3 linear convolution $s_{(p)} = h_{(p)} \cdot x_{(p)}$. **14**

Where $h_{(p)} = h_0 + h_1 p$, $x_{(p)} = x_0 + x_1 p + x_2 p^2$ use cook-Toom algorithm to construct efficient implementation for the same.

OR

10. a) Construct a 2×2 convolution using winograd algorithm with $m(p) = p(p-1)(p+1)$. **10**

b) Explain the steps of modified cook-Toom algorithm. **4**

11. a) Explain the steps of iterated convolution algorithm. **3**

b) Construct a 3x3 fast convolution algorithm by inspection. **10**

OR

12. a) Construct a 4x4 cyclic convolution algorithm using CRT with $m(p) = (p^4 - 1) = (p-1)(p+1)(p^2+1)$. **13**

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