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MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL
(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH. (COMPUTER SCIENCE AND ENGINEERING)

MAKEUP EXAMINATIONS, JUNE 2019

PARALLEL COMPUTER ARCHITECTURE AND PROGRAMMING [CSE 3202]

REVISED CREDIT SYSTEM (12/06/2019)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ❖ Answer **ALL** the questions.
- ❖ Missing data may be suitably assumed.

- 1A.** With neat diagram explain the CPU and GPU design philosophies. **3M**
- 1B.** By listing the functionalities of Shader stage in fixed-function graphics pipeline, discuss how world map texture is mapped onto a sphere object. **2M**
- 1C.** Discuss the principle involved, advantages and disadvantage if any, in the following:
- i) Superscalar execution
 - ii) very long instruction word execution **5M**
- 2A.** Write a MPI program to read a string S in the root process. Read an integer array Count consisting of elements equivalent to string length of S in the root process. Using m processes including the root (where string length is evenly divisible by m), produce the resultant string RS which repeats every character of S , n times (where n is the integer value in input array Count which is having the same index as of the character taken in S) as shown below. Display the resultant string in the root process.
Eg : $m = 3$ Input String S : string Input array Count : 1 2 1 3 4 2 **5M**
Output String RS : sttriiinnnngg
- 2B.** With the syntax, explain the following collective communication routines by giving example.
- i) MPI_Scatter
 - ii) MPI_Reduce
 - iii) MPI_Alltoall **3M**
- 2C.** User wants to allocate some memory space which must be used during point to point communication in MPI. With the help of a code snippet explain how the user can achieve this. **2M**
- 3A.** Write an OpenCL kernel for generating the following triangle. Accept the number of rows from the user. Each row has to be calculated by one thread.
e.g. $N = 5$
- ```

O
 O
O*O*O
*O*O*O*
O*O*O*O*O

```

**5M**

- 3B.** Write the following APIs involved in OpenCL programming with the help of syntax:  
     i. Creating command queue                      ii. Creating device buffer                      **3M**  
     iii. Setting the kernel argument
- 3C.** Explain the different type of memory available in OpenCL's abstract memory model with diagram in detail. **2M**
- 4A.** There are 3D grids of size (3, 4, 2) and each block has 2D structure of size (2, 4). Draw this structure. Give a generalized formula for calculating global thread id. **3M**
- 4B.** List the CUDA device memory types. Draw a memory pyramid showing the device memory times in decreasing order of speed (fastest at top) and increasing order of memory size (largest at bottom). **2M**
- 4C.** A matrix  $A$  has  $M \times N$  elements and there is a matrix  $B$  of size  $N \times P$ . Write a CUDA program to find the matrix  $C$  of size  $M \times P$  such that each row of  $A$  is added with each column of  $B$  to produce  $C$ . **5M**
- 5A.** Write a CUDA kernel to compute the square of each element of an input matrix  $A$  of size  $M \times N$  and put in a matrix  $B$  of size  $M \times N$ . **3M**
- 5B.** Explain the use of dim3 data type in CUDA with examples. **2M**
- 5C.** Before a data element can be sent, it must be packed and after it is received, it must be unpacked. Name all the routines involved to do this for various data types. Discuss any one of the packed and unpacked routine's association with the `pvm_send()`, `pvm_recv()` and `pvm_initsend()`. **5M**