

**Shahjalal University of Science and Technology**  
**Institute of Information and Communication Technology (IICT)**  
**Software Engineering**

**2<sup>nd</sup> Year 1<sup>st</sup> Semester Final Examination (Session: 2019-20)**  
**Course Code: SWE 223      Credits: 3      Course Title: Object Oriented Programming**  
**Time: 3 hrs      Total Marks: 100**

**Group A**  
*[Answer all the questions]*

<b>1.</b>	<b>Answer any FIVE</b>	<b>5x2=10</b>
a)	Exemplify how would you pause a Java program?	
b)	In String object, what is the difference between equals() vs '=='	
c)	Show two ways to concatenate the following two strings together to get the string "Hi, mom."; String hi = "Hi, "; String mom = "mom.;"	
d)	What happens when the main() isn't declared as static?	
e)	Differentiate between instance and local variables.	
f)	Explain 'super' keyword in Java	
g)	Why JAVA is called platform independent? Explain.	
h)	If you print a variable which is not initiated, what would you see as output?	
<b>2.</b>	<b>Answer any FOUR</b>	<b>4x5=20</b>
a)	Explain final variable, method and class.	5
b)	Check the program for any possibility of exception. If there is a possibility are possibilities of exception, <u>handle each individual possibility separately</u> . Otherwise don't. Don't use generic exception handling. <pre>1. public class Main { 2.     public static void main(String[] args){ 3.         int[] myIntArray = new int[]{1, 2, 3}; 4.         System.out.println(myIntArray[3]); 5. 6.         ArrayList&lt;Integer&gt; arr; 7.         arr.add(myIntArray[1]); 8. 9.         System.out.println("Done"); 10.    } 11. }</pre>	5
c)	Explain the expected output of the following code segment? <pre>1. public class AddExperiment 2. { 3.     public static void main (String args[]) 4.     { 5.         System.out.println(10 + 20 + "Experiment-1"); 6.         System.out.println("Experiment-2" + 100 + 100); 7.     } 8. }</pre>	5
d)	Explain pass by value and pass by reference.	5
e)	What is buffer? Explain, and show use of buffer in code.	5
f)	Differentiate and explain with example-nested class and inner class.	5
<b>3.</b>	<b>Answer any TWO</b>	<b>2x10=20</b>
a)	Write down the output for the following java code: Input: Object Oriented Programming <pre>1. public class GradeBook { 2.     public void displayMessage() { 3.         System.out.printf("Welcome to the grade book for\n%s!\n", courseName); 4.     } 5. }  6. public class GradeBookTest { 7.     public static void main( String[] args ) { 8.         Scanner input = new Scanner( system.in ); 9.         GradeBook myGradeBook = new GradeBook(); 10.        System.out.println( "Please enter the course name:" ); 11.        String nameOfCourse = input.nextLine(); 12.        System.out.println(); 13.        myGradeBook.displayMessage( nameOfCourse ); 14.    } 15. }</pre>	10
b)	I. Differentiate throw, throws and try-catch with example. II. Why do we use "finally" in exception handling?	8+2

c)	III. Write a Java program to read a number of integers from a text file (ended by a string "end") using the Scanner class. Calculate and display the sum of the numbers. IV. Write a simple program to replace all the occurrences of a given word str1 in a string of several lines by another word str2	7+3
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**Group B**  
*[Answer all the questions]*

4.	<b>Answer any FIVE</b>	5x2=10
a)	If I want to print something by printing object, how would you do it?	
b)	Differentiate- Set vs Map	
c)	What is the difference between .java and .class files?	
d)	Explain the naming convention for the java packages.	
e)	Explain why it is discouraged to use 'static' thoroughly.	
f)	If a class want to partially implement an interface, what is the solution?	
g)	Explain garbage collection in JAVA.	
5.	<b>Answer any FOUR</b>	4x5=20
a)	What is the output of the following Java program?	5
	<pre> 1. public class Test 2. { 3.     Test(int a, int b) 4.     { 5.         System.out.println("a = "+a+" b = "+b); 6.     } 7.     Test(int a, float b) 8.     { 9.         System.out.println("a = "+a+" b = "+b); 10.    } 11.    public static void main (String args[]) 12.    { 13.        byte a = 10; 14.        byte b = 15; 15.        Test test = new Test(a,b); 16.    } 17. }</pre>	
b)	What do you understand by instance variable and local variable? Explain.	5
c)	Explain Method and constructor Overloading in Java.	5
d)	How does polymorphism enable you to program "in the general" rather than "in the specific"? Discuss the key advantages of programming "in the general."	5
e)	Compare and contrast abstract classes and interfaces. Why would you use an abstract class? Why would you use an interface?	5
f)	Use inheritance to create an exception superclass (called ExceptionA) and exception subclasses ExceptionB and ExceptionC, where ExceptionB inherits from ExceptionA and ExceptionC inherits from ExceptionB. Write a program to demonstrate that the catch block for type ExceptionA catches exceptions of types ExceptionB and ExceptionC.	5
6.		2x10=20
a)	In light of three principles of OOP, explain with example method overloading, overriding. Concisely explain encapsulation with example.	8+2
b)	A puzzler for chess buffs is the Eight Queens problem, which asks: Is it possible to place eight queens on an empty chessboard so that no queen is "attacking" any other (i.e., no two queens are in the same row, in the same column or along the same diagonal)? For instance, if a queen is placed in the upper-left corner of the board, no other queens could be placed in any of the marked squares shown in figure below. Solve the problem recursively.  	10
c)	Write a multithreaded program, in which main thread prints serially while secondary thread prints number in reverse order.	10

**Shahjalal University of Science and Technology**  
**Institute of Information and Communication Technology (IICT)**

**Software Engineering**

**2<sup>nd</sup> Year 1<sup>st</sup> Semester Final Examination' Jun 2022 (Session: 2019-20)**

**Course Code: SWE 225 Credits: 2 Course Title: Software Requirement Engineering**  
**Time: 2 hrs Total Marks: 50**

**Group A**  
[Answer all the questions]

**1. Answer any FIVE**

- |    |   |   |
|----|---|---|
| a) | What is 'Feature Driven Development'?   | 1 |
| b) | What is the agile process in software development?  | 1 |
| c) | State the attributes of Analysis Modeling?  | 1 |
| d) | 'Every project and every team has something in common' - true or false?   | 1 |
| e) | What is the overriding goal of Software Engineering Practice?   | 1 |
| f) | What are the objectives of software testing?  | 1 |
| g) | 'Problems are harder to solve when they are subdivided into separate concerns, each distinct, individually solvable, and verifiable' - true or false? | 1 |

**5x1=5**

**2. Answer any FOUR**

- |    |   |     |
|----|---|-----|
| a) | What information is produced as a consequence of requirements gathering?  | 2.5 |
|    | Explain the answer with an example?   |     |
| b) | Why do we say that the requirements model represents a snapshot of a system in time?  | 2.5 |
| c) | Is it possible to begin coding immediately after an analysis model has been created? Explain your answer.   | 2.5 |
| d) | An analysis rule of thumb is that the model "should focus on requirements that are visible within the problem or business domain." What types of requirements are not visible in these domains? Provide a few examples. | 2.5 |
| e) | What happens if I can't come to an agreement with the customer on some project-related issue?   | 2.5 |
| f) | What is the difference between a functional and non-functional requirement?   | 2.5 |

**4x2.5=10**

**3. Answer any ONE**

- a) Suppose you are responsible for building an 'Attendance System' for the students of Software Engineering. Students can give attendance by swiping their id cards into a machine. Teachers can see the attendance for any given class with a dashboard and the system automatically assigns attendance marks to the student and shows this to only the teacher. The director is the admin of this system. He can add teachers, and assign courses. The manager is responsible for updating the student information.

**10x1=10**

- i) Develop an ER diagram for all the users in the above system. 4  
ii) Develop the Level 0, Level 1 DFD model for all the users mentioned above. 6

- b) The department of public works for a large city has decided to develop a Web-based pothole tracking and repair system (PHTRS). A description follows:

Citizens can log onto a website and report the location and severity of potholes. As potholes are reported they are logged within a "public works department repair system" and are assigned an identifying number, stored by street address, size (on a scale of 1 to 10), location (middle, curb, etc.), district (determined from street address), and repair priority (determined from the size of the pothole). Work order data are associated with each pothole and include pothole location and size, repair crew identifying number, number of people on the crew, equipment assigned, hours applied to repair, hole status (work in progress, repaired, temporary repair, not repaired), amount of filler material used, and cost of repair (computed from hours applied, number of people, material and equipment used). Finally, a damaged file is created to hold information about reported damage due to the pothole and includes the citizen's name, address, phone number, type of damage, and dollar amount of damage. PHTRS is an online system; all queries are to be made interactively.

- i) Draw a UML use case diagram for the PHTRS system. You'll have to make a number of assumptions about the manner in which a user interacts with this system. 4
- ii) Develop a class model for the PHTRS system. 6

### Group B

*[Answer all the questions]*

**4. Answer any FIVE**

- |    |   |   |
|----|---|---|
| a) | What is meant by the statement "a use case must describe end-to-end behavior"?  | 1 |
| b) | What do you understand by 'External Entities'?  | 1 |
| c) | What three "domains" are considered during requirements modeling?   | 1 |
| d) | 'Any software model intends to communicate information' - true or false?  | 1 |
| e) | 'Problems are easier to solve when they are subdivided into separate concerns, each distinct, individually solvable, and verifiable' - true or false? | 1 |
| f) | State the attributes of Analysis Modeling?  | 1 |
| g) | What is an 'Entity-Relationship Diagram'?   | 1 |
| h) | What is a stereotype?   |   |

**5. Answer any FOUR**

**5x1=5**

- |    |  |     |
|----|--|-----|
| a) | You have been given the responsibility to elicit requirements from a customer who tells you he is too busy to meet with you. What should you do?                                     | 2.5 |
| b) | What is the fundamental difference between structured analysis and object-oriented strategies for requirements analysis?   | 2.5 |
| c) | What information is produced as a consequence of requirements gathering?   | 2.5 |
| d) | Let's assume that you've convinced the customer (you're a very good salesperson) to agree to every demand that you have as a developer. Does that make you a master negotiator? Why? | 2.5 |
| e) | What does win-win mean in the context of negotiation during the requirements engineering activity?   | 2.5 |
| f) | How does a sequence diagram differ from a state diagram? How are they similar?   | 2.5 |

**6. Answer any ONE**

**1x10=10**

- a) You are given the task to develop 'a network-based course registration system for your university. Students can enroll in a course at the beginning of a semester. Some courses can have prerequisites. If a student doesn't have the prerequisite complete then he can't register for that course. The course along with its details and prerequisites is prepared by the department. The exam controller is responsible for all the approval of a student's course registration.

- |      |  |   |
|------|--|---|
| i)   | Identify all the actors along with their categories for the system.                                      | 2 |
| ii)  | Develop an ER Diagram that describes data objects, relationships, and attributes for the above scenario. | 4 |
| iii) | Develop the state diagram for the users of the above system.   | 4 |

- b) Suppose you are given a task to build 'a simple invoicing system for a small business. That is keep track of the products in the shop and scan them while selling to generate the invoice and update the stock. The shop manager updates the inventory while new products arrive, and the salesperson scans them while selling. All have their user id and password to login into the system.

- |      |   |   |
|------|---|---|
| i)   | Design the swimlane diagram for the above system.             | 4 |
| ii)  | Design the class responsibility diagram for the above system. | 4 |
| iii) | Design the use case UML for the above system.                 | 2 |

**Shahjalal University of Science & Technology, Sylhet.**

**Institute of Information & Communication Technology (IICT)**

**BSc. in Software Engineering Program; (2/1) Session: 2019-2020**

**Semester Final Examination**

Course Code: BUS 201W(SWE) Course Title: Cost & Management Accounting

Total Marks: 100

Time: 03 Hours

(Answer any **02 (Two)** questions from each of the following Groups. Marks in the margin indicate full marks. All the parts of a question must be answered chronologically)

**Group: 'A'**

01. a. What is cost accounting? How does Cost Accounting differ in technique and procedure from Financial Accounting? 07
- b. What are the different classifications of cost? Explain. 09
- c. Explain the importance of managerial accounting in the field of Software Engineering. 09
02. (a) What are the three major elements of product costs in a manufacturing company? 05
- (b) The following cost and inventory data for the just completed year are taken from the accounting records of Eccles Company:

Costs incurred:		
Advertising expense .....	.....	\$100,000
Direct labor cost .....	.....	\$90,000
Purchases of raw materials .....	.....	\$132,000
Rent, factory building .....	.....	\$80,000
Indirect labor .....	.....	\$56,300
Sales commissions .....	.....	\$35,000
Utilities, factory .....	.....	\$9,000
Maintenance, factory equipment .....	.....	\$24,000
Supplies, factory .....	.....	\$700
Depreciation, office equipment .....	.....	\$8,000
Depreciation, factory equipment .....	.....	\$40,000
	Beginning of Year	End of Year
Inventories:		
Raw materials .....	\$8,000	\$10,000
Work in process .....	\$5,000	\$20,000
Finished goods .....	\$70,000	\$25,000

**Required:**

1. Prepare a schedule of cost of goods manufactured.  
2. Prepare the cost of goods sold section of Eccles Company's income statement for the year. 20

03. (a) "A variable cost is a cost that varies per unit of product, whereas a fixed cost is constant per unit of product." Do you agree? Explain. 05
- (b) Speedy Parcel Service operates a fleet of delivery trucks in a large metropolitan area. A careful study by the company's cost analyst has determined that if a truck is driven 120,000 miles during a year, the average operating cost is 11.6 cents per mile. If a truck is driven only 80,000 miles during a year, the average operating cost increases to 13.6 cents per mile.

**Required:**

1. Using the high-low method, estimate the variable and fixed cost elements of the annual cost of truck operation. 08
2. Express the variable and fixed costs in the form  $Y=a+bX$ .
3. If a truck were driven 100,000 miles during a year, what total cost would you expect to be incurred?
- (c) The administrator of Azalea Hills Hospital would like a cost formula linking the administrative costs involved in admitting patients to the number of patients admitted during a month. The admitting department's costs and the number of patients admitted during the immediately preceding eight months are given in the following table: 12

Month	Number of Patients Admitted	Admitting Department Costs
May .....	1,800	\$14,700
June .....	1,900	\$15,200
July .....	1,700	\$13,700
August .....	1,600	\$14,000
September .....	1,500	\$14,300
October .....	1,300	\$13,100
November .....	1,100	\$12,800
December .....	1,500	\$14,600

Required:

1. Use the high-low method to establish the fixed and variable components of admitting costs.
2. Express the fixed and variable components of admitting costs as a cost formula in the form  $Y=a+bX$ .

04. a. What is meant by a product's CM ratio? Draw a breakeven chart. 05  
 b. Chabir & Co. distributes a lightweight lawn chair that sells for Tk. 25 per unit. Variable costs are Tk. 15 per unit and fixed costs total Tk. 1,50,000 annually.

Requirement:

- (i) Uses the CM ratio to determine the breakeven point in units.
- (ii) Company estimates that sales will increase by Tk. 100,000 in the coming year. How much profit will be increased?
- (iii) If the variable cost per unit decreases by 10% what will be the new breakeven point? Use CM Ratio.
- (iv) If a company sells 10,000 units and others remain the same. What will be the selling price per unit where no loss or no profit will earn?

$$\text{CM per unit} = \frac{10}{25} \times 100 = 40\%$$

20

$$\text{BEP} = \frac{\text{Fixed Cost}}{\text{CM ratio}} = \frac{150,000}{40\%} = 375,000$$

Group: 'B'

$$\text{In SEP, CM} = F.C = \frac{150,000}{10,000} = 15$$

$$10,000(x-15)$$

$$10,000x - 150,000 = 150,000$$

$$10,000x = 300,000$$

$$x = 30$$

05. (a) If the units produced and unit sales are equal, which method would you expect to show the higher net operating income, variable costing or absorption costing? Why? 05  
 (b) Sierra Company incurs the following costs to produce and sell a single product.

Variable costs per unit:	
Direct materials	\$9
Direct labor	\$10
Variable manufacturing overhead	\$5
Variable selling and administrative expenses	\$3
Fixed costs per year:	
Fixed manufacturing overhead	\$1,50,000
Fixed selling and administrative expenses	\$4,00,000

During the last year, 25,000 units were produced and 22,000 units were sold. The Finished Goods inventory account at the end of the year shows a balance of \$72,000 for the 3,000 unsold units.

Required:

1. Is the company using absorption costing or variable costing to cost units in the Finished Goods inventory account? Show computations to support your answer. 20
2. Assume that the company wishes to prepare financial statements for the year to issue to its stockholders.
  - a. Is the \$72,000 figure for Finished Goods inventory the correct amount to use on these statements for external reporting purposes? Explain.
  - b. At what dollar amount should the 3,000 units be carried in the inventory for external reporting purposes?

06. (a) "Accounting plays a relatively unimportant role in budgeting." Do you agree? Explain. 03  
 (b) What budget is the starting point in preparing the master budget? 02  
 (c) Colter Company prepares monthly cash budgets. Relevant data from operating budgets for 2014 are:

	January	February
Sales	\$3,60,000	\$4,00,000
Direct materials purchases	1,20,000	1,25,000
Direct labor	90,000	1,00,000
Manufacturing overhead	70,000	75,000
Selling and administrative expenses	79,000	85,000

All sales are on account. Collections are expected to be 50% in the month of sale, 30% in the first month following the sale, and 20% in the second month following the sale. Sixty percent (60%) of direct materials purchases are paid in cash in the month of purchase, and the balance due is paid in the month following the purchase. All other items above are paid in the month incurred except for selling and administrative expenses that include \$1,000 of depreciation per month.

Other data:

- 1. Credit sales: November 2013, \$250,000; December 2013, \$320,000.
  - 2. Purchases of direct materials: December 2013, \$100,000.
  - 3. Other receipts: January—collection of December 31, 2013, notes receivable \$15,000; February—proceeds from sale of securities \$6,000.
  - 4. Other disbursements: February—payment of \$6,000 cash dividend.
- The company's cash balance on January 1, 2014, is expected to be \$60,000. The company wants to maintain a minimum cash balance of \$50,000.

**Instructions:**

- (a) Prepare schedules for (1) expected collections from customers and (2) expected payments for direct materials purchases for January and February. 20
- (b) Prepare a cash budget for January and February in columnar form.

07. Papiya Corporation manufactures and sells a product that has seasonal variations in demand. The following information concerns operations for 2012 and for the first two quarters of 2013:

- a. The company's single product sells for Tk. 10 per unit. Budgeted sales in units for the next six-quarters are as follows:

Particulars	2012				2013	
	Q1	Q2	Q3	Q4	Q1	Q2
Budgeted sales	80,000	120,000	200,000	100,000	140,000	160,000

- b. Sales are collected in the following pattern: 70% in the quarter the sales are made and the remaining 30% in the following quarter. On January 1, 2012 the company's balance sheet showed 130,000 in Account Receivables all of which will be collected Q1 of the year.
- c. The company desires an ending inventory of finished units on hand at the end of each quarter equal to 25% of the budgeted sales for the next quarter. On December 31, 2011, the company had 24000 units on hand.
- d. Five pounds of raw materials are required to complete one unit of product. The company requires an ending inventory of raw materials on hand at the end of each quarter equal to 15% of the production needs of the following quarter. On December 2011, 23,000 pounds of raw materials on hand.
- e. The raw material costs Tk. 1.00 per pound. Pattern: 60% paid in the quarter the purchases are made, and the remaining 40% paid in the following quarter.
- f. On January 2012, the company's balance sheet showed Tk. 81,500 in accounts payable for raw material purchases, all of which will be paid for in the first quarter of the year.

*Required:*

Prepare the following budgets and schedules for the year, showing both quarterly and total figures:

- i. A sales budget and a schedule of expected cash collections. 08
- ii. A production budget. 07
- iii. A direct materials purchases budget and a schedule of expected cash payments for material purchases. 10

08. Write short notes on the following: 05x5= 25

- (i) Managerial Accounting and Business Environment
- (ii) Variable vs. Absorption Costing
- (iii) Standard Costs and Balanced Scorecard
- (iv) Sales budget and Production budget
- (v) Fixed cost vs. Variable cost

**Shahjalal University of Science and Technology**  
**Institute of Information and Communication Technology (IICT)**  
**Software Engineering**  
2<sup>nd</sup> Year 1<sup>st</sup> Semester Final Examination June 2022 (Session: 2019-20)  
Course Code: ECO 205w Credits: 3 Course Title: Principles of Economics  
Time: 3 hrs Total Marks: 100

**Group A**  
*[Answer all the questions]*

**1. Answer any FIVE** 5x2=10

- a) Why is scarcity central to the study of economics
- b) What is the difference between a change in demand and a change in quantity demanded?
- c) What do economists mean by market equilibrium?
- d) What is the midpoint method for calculating price elasticity of demand?
- e) What is meant by increasing marginal opportunity cost
- f) Define monopoly market
- g) What are the factors of production?

**2. Answer any FOUR** 4x5=20

- a) What is a production possibility frontier? how can we show economic efficiency on a PPF?  
For each of the following pair of products state which are compliments which are substitutes and which are unrelated.
- i. Pepsi and coke
- ii. Pran sausages and Fulkoli bread
- iii. Iphone and iPhone cases
- iv. Tea and coffee
- v. Fish and Chips

c) Rank the following goods from the lowest income elasticity of demand to highest income elasticity of demand. Briefly explain your ranking.

- i. Bread ii. Pepsi iii. Toyota cars iv. Laptop v. Salt

d) State and explain the properties of an indifference curve.

e) Suppose the government restricts the number of dairy farmers which results the supply for milk shifting to the left. Briefly explain using a demand-supply graph whether each of the following will increase or decrease.

- i. Consumer surplus
- ii. Producer surplus
- iii. Economic surplus

**3. Answer Any TWO** 2x10=20

- a) i. What are the key determinants of price elasticity of demand? Which determinant is the most important?  
ii. Define cross price elasticity of demand, what does it mean if cross price elasticity is negative or positive?  
iii. Define income elasticity of demand using income elasticity distinguish a normal good from an inferior good

b) Explain the basic assumptions about preferences. Define utility Show consumer's equilibrium using indifference curve.

*Total utility, marginal utility. Explain*

*The law of diminishing marginal utility.*

c) Explain the difference between a positive and a negative externalities and explain why they are an externality.

- i. After eating a burger, you vomit all your best friend
- ii. A flood in ~~south~~ it causes the prices of bananas to increase
- iii. Your mobile phone goes off during the lecture
- iv. You visit the doctor and get a flu vaccination
- v. Tension in the Middle East increases the prices of petrol

### Group B

[Answer all the questions]

4. Answer any FIVE

2x5=10

- a) Why does the size of a country's GDP matter?
- b) How does GDP affect the quality of life of the country's people?
- c) How does the value added of a business differ from the profits of a business?
- d) How is the unemployment rate calculated?
- e) Which is a greater problem: anticipated inflation or unanticipated inflation?
- f) What is participation rate?
- g) What is potential GDP? Does it remain constant over time?
- h) Give a definition of poverty.

5. Answer any Four

4x5=20

- a) Distinguish between nominal GDP and real GDP. How can we calculate economic growth rate?
- b) What determines the long run economic growth?
- c) What is GDP deflator and how is it calculated?
- d) What potential biases exist in calculating the consumer price index?
- e) Distinguish between demand pull inflation and cost push inflation
- f) What are the functions of money?
- g) What is the impact of inflation on purchasing power of consumers?

6. Answer any TWO

2x10=20

- a) Describe the four major components of <sup>expenditure</sup> teachers in GDP. Why is GDP an imperfect measure of economic well-being? What types of production does GDP not measure?
- b) Explain the costs of unemployment considering costs to the economy, cost to the individual and the social cost.
- c) How does a central bank control the price level using the open market operation - explain?

**Shahjalal University of Science and Technology**  
**Institute of Information and Communication Technology (IICT)**  
**Software Engineering Program**  
**2<sup>nd</sup> Year 1<sup>st</sup> Semester Final Examination' June 2022 (Session: 2019-20)**  
**Course Code: CSE219W Credits: 3 Course Title: Computer Architecture**  
**Time: 3 hrs Total Marks: 100**

**Group A**  
*[Answer all the questions]*

**1. Answer any FIVE**

- a) Write differences between RISC and CISC processor.
- b) State four aspects that make differences among Instruction Set Architectures.
- c) For what purpose benchmark programs are used? Give example of a benchmark suite.
- d) "Pipeline does not reduce the latency of a single instruction; it improves throughput of entire workload" – explain in brief.
- e) A 4-stage pipeline has the stage delays 150, 120, 160 and 140 nanoseconds. Registers that are used between the stages have a delay of 5 nanoseconds each. Assuming no dependency among the instructions, what will be the total time to process 100 instructions in this pipeline?
- f) What are control hazards?
- g) Explain the function of 1-bit branch predictor.
- h) Write the difference among super-pipelining and superscalar processors?

5x2=10

**2. Answer any FOUR**

- a) Explain MIPS register addressing with examples.
- b) Write three design principle that are used to efficient computer system.
- c) Derive the equation for speed up of a computer system using Amdahl's law. Suppose that we want to enhance the processor used for Web serving. The new processor is 10 times faster on computation in the Web serving application than the original processor. Assuming that the original processor is busy with computation 40% of the time and is waiting for I/O 60% of the time, what is the overall speedup gained by incorporating the enhancement?
- d) Consider the MIPS program with variable *moder*  
 a, b, c, d, e, f in memory. What does the program do? Assume that operand forwarding is action. Considering that the program starts at clock cycle 1, when each of the instructions will finish its work?  
 Rearrange the instructions, so that total number of clock cycles is reduced.  
 LW R1, b  
 LW R2, c  
 ADD R0, R1, R2  
 SW a, R0  
 LW R4, e  
 LW R5, f  
 SUB R3, R4, R5  
 SW d, R3

4x5=20

5

5

2+3

1+2+2

- e) Show the structure of a Branch Target Buffer (BTB). Explain how a BTB is used to reduce the stall caused by the branch instructions.

1+4

- f) Write how simultaneous multithreading works. How does it differ from fine-grained multithreading?

5

**3. Answer any TWO**

- a) Suppose, inside a 5-stage pipeline of a running CPU, five instructions I1, I2, I3, I4, I5 are in WB, MEM, EX, ID, IF stages, respectively. Answer the following questions:

2x10=20

2+2+2+4

- i. Note that both I2 and I5 require access to the main memory and are in a conflicting situation. What is the name of such conflict and how it is solved?  
~~~~~
- ii. Note that that both I1 and I4 require access to the register file and are in a conflicting situation. How is this conflict resolved?
- iii. Which types of instructions do not use MEM/WB stages? Justify your answer.
- iv. If I1 is ADD R1, R2, R3 and I2 is SUB R4, R1, R5 , what type of hazard will occur? How is it resolved? Explain with figure.

- b) Assume a multi-cycle MIPS pipeline with 1 integer unit (EX), 1 FP Adder (4 stage pipelined unit), 1 Multiplier (7 stage pipelined unit), 1 Divider (24 stage un-pipelined unit). Assume that, in such a machine, there is a float type array in memory.

2+2+3+3

- i) Write an assembly language program to increase each of the elements of the array by any arbitrary value.
- ii) Calculate the number of stalls of this program.
- iii) Unroll the loop considering unrolling factor 4.
- iv) Schedule the unrolled loop to minimize stalls.

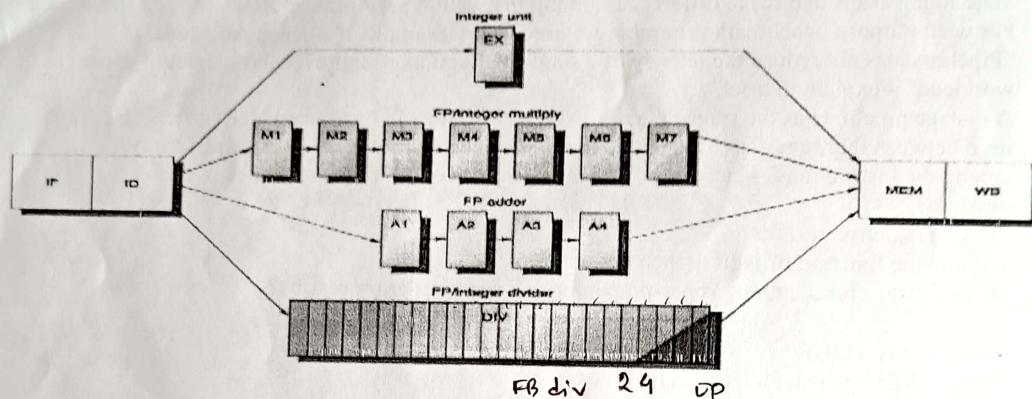
- g) i) Write the issues that occur in longer latency multi-cycle pipelines.

3+5+2

ii) Consider the following instruction sequence executed on a MIPS floating point pipeline as shown in the figure. Operand forwarding is implemented.[R indicates integer registers and F indicates floating point registers]. Find the clock cycle in which STOR instruction reaches MEM stage.

LOAD F4, 8(R2);  
FMUL F0, F4, F2;  
FADD F3, F0, F2;  
STOR F3, 16(R3);

iii) In the following figure, what are the latency and repeat intervals of FP multiplier and FP divider. Assume that FP multiplier is pipelined whereas FP divider is not.



### Group B [Answer all the questions]

#### 4. Answer any FIVE

- a) What is the reason to keep small and fast cache memory near to the CPU?
- b) How many sets are there in a fully set associative cache and how many? What is the value of  $n$  when we say a cache memory is direct map ~~and~~
- c) A cache is  $n$ -way set associative and there are  $m$  number of sets. What is the value of  $n$  when it is direct mapped when it is fully associative?
- d) What are the benefits of using separate cache for data and instructions?
- e) What is the function and advantage of using a victim buffer?
- f) "Conflict misses decrease as associativity increases" - why?
- g) With 4KB pages, how many bytes can a 16-way set associative VIPT cache store?
- h) How do virtual memory running programs from one another?  
*prot*

$5 \times 2 = 10$

#### 5. Answer any FOUR

- a) What two types of locality principles? "If a consecutive sequence of content of main memory is transferred to cache at a time, system can be benefited by both of the localities" - why?
- b) Define write-allocate and No write allocate methods. Assume a fully associative ~~write-back~~ cache with many cache entries that starts empty. Below is a sequence of five memory operations (the address is in square brackets):

$4 \times 5 = 20$

3+2

2+3

Write Mem[100];  
Write Mem[100];  
Read Mem[200];  
Write Mem[200];  
Write Mem[100].

(1,1) (2,2)

- c) What are the number of hits and misses when using no-write allocate versus write allocate?
- c) Which has the lower miss rate: a 16 KB instruction cache with a 16 KB data cache or a 32 KB unified cache? Use the miss rates shown in following figure, assuming 36% of the instructions are data transfer instructions. Assume a hit takes 1 clock cycle and the miss penalty is 100 clock cycles. A load or store hit takes 1 extra clock cycle on a unified cache if there is only one cache port to satisfy two simultaneous requests. What is the average memory access time in each case? Assume write-through caches with a write buffer and ignore stalls due to the write buffer.

5

| Size (KB) | Instruction cache | Data cache | Unified cache |
|-----------|-------------------|------------|---------------|
| 16        | 3.82              | 40.9       | 51.0          |
| 32        | 1.36              | 38.4       | 43.3          |

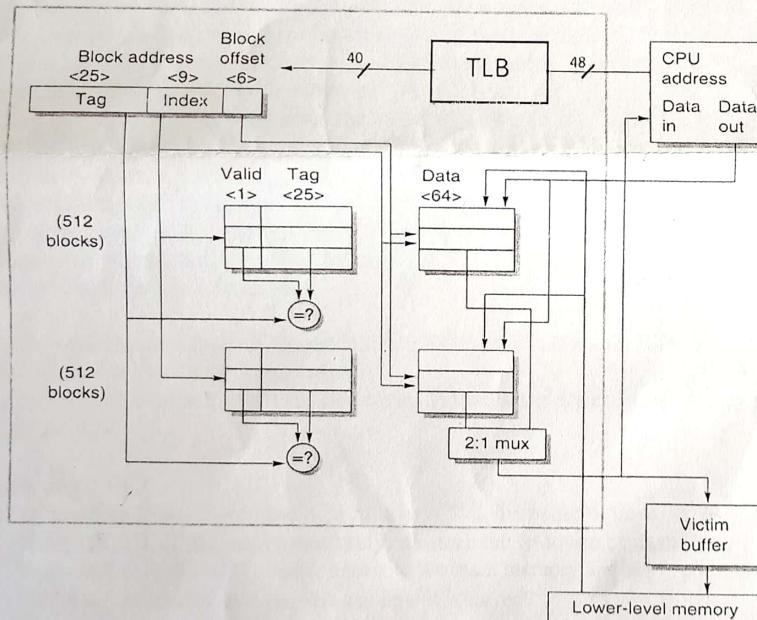
Figure Miss per 1000 instructions for instruction, data, and unified caches of different sizes. The percentage of instruction references is about 74%. The data are for two-way associative caches with 64-byte blocks

- d) What are the reasons to use multi-level caches? Suppose that in 1000 memory references there are 40 misses in the first-level cache and 20 misses in the second-level cache. What are the various miss rates? Assume the miss penalty from the L2 cache to memory is 200 clock cycles, the hit time of the L2 cache is 10 clock cycles, the hit time of L1 is 1 clock cycle, and there are 1.5 memory references per instruction. What is the average memory access time? 2+3
- e) Briefly explain the classic five-stage pipelining for a RISC processor. 5
- f) Show with a block diagram the architecture of a Tiled Chip Many Core Processor and briefly state the function of each component. 5

#### 6. Answer any TWO

- a) Consider the organization of the data cache in Opteron processor as shown in the figure. Answer the following questions:

- i) How many sets are there and how they are identified?
- ii) If the block size is 64 byte, what is the size of each bank of cache memory?
- iii) Suppose CPU want to read one byte from the cache memory, write the steps to get the byte. In your explanation clarify the function of the 40 bit physical address, valid bit and 2:1 multiplexer.
- iv) If the associativity of this cache were doubled keeping cache size unchanged, what would be the number of tag and index bits?



- b) i) Why simple and small L1 cache is desirable?  
 ii) How does a non-blocking cache increases bandwidth?  
 iii) What are the benefits of using multi-banked cache?  
 iv) Explain with an example how a compiler can improve the cache performance by interchanging loops. 3+2+2+3
- c) Suppose a CPU generates 48 bit virtual address. The size of the physical memory is 4GB.  
 i) What will be number of the page-offset bits and physical page number bits if the page size is 64KB? What will be number of page table entries?  
 ii) What benefits will we get if a TLB is used? Explain with figure how TLB works?  
 iii) What is a multi level page table and why is it necessary? 3+5+2+2