



**Comprehensive Examination (R) – Software Engineering and Management (SS G562)**

**First Semester: 2023-24**

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Name and ID: \_\_\_\_\_

**Important Information:**

- Write your name and ID on the question paper.
- Please check the completeness of the exam booklet (**3 double-sided pages**)
- Use only **blue** or **black** pen to answer the questions; Pencils, green and red pens are not allowed!
- You are only allowed to answer the questions using the provided exam sheets.
- Working time is **180 minutes** for **6 questions** of **40 points!**
- On any attempt to **cheat**: the exam will be assessed with a **0** and you would be barred from the makeup exam too!
- Permitted writing aids: calculator & printed handout — **partially open book exam!**

**1. Software Development Methodologies**

**Question 1: 5 pts**

- (a) You are a software engineering consultant and have been called in by the vice-president for finance of a corporation that manufactures tires and sells them via its large chain of retail outlets. She wants your organization to build a product that will monitor the company's stock, starting with the purchasing of the raw materials and keeping track of the tires as they are manufactured, distributed to the individual stores, and sold to customers. What criteria would you use in selecting a life-cycle model for the project? [1]
- (b) Suppose you have to build a product to determine the cube root of 9384.2034 to four decimal places. Once the product has been implemented and tested, it will be thrown away. Which life-cycle model would you use? Give reasons for your answer. [1/2]
- (c) Your development of the stock control product for the tire company is so successful that your organization decides that it must be reimplemented as a package to be sold to a variety of different organizations that manufacture and sell products via their own retailers. The new product must therefore be portable and easily adapted to new hardware and/or operating systems. How would the criteria you use in selecting a life-cycle model for this project differ from those in your answer to Problem 1(a)? [1]
- (d) What is the connection between the waterfall model and the iterative-and-incremental model? [1/2]
- (e) What is the connection between Miller's Law and stepwise refinement? [1]
- (f) Does stepwise refinement correspond to iteration or incrementation? Justify [1/2]
- (g) How are a workflow, an artefact, and a baseline related? [1/2]

**2. Requirement Elicitation and Specification**

**Question 2: 7 pts**

- (a) Write a formal algebraic specification of the sort symbol-table whose operations are informally defined as follows: [2]
- create** bring a symbol table into existence.  
**enter** enter a symbol table and its type into the table.  
**lookup** return the type associated with a name in the table.  
**delete** remove a name, type pair from the table, given a name as a parameter.  
**replace** replace the type associated with a given name with the type specified as its parameter.
- The enter operation fails if the name is already present in the table. The lookup, delete, and replace operations fail if the name is not available in the table.
- (b) Define the finite termination and unique termination properties of algebraic specifications? Why is it necessary for an algebraic specification to satisfy these properties? [1 1/2]
- (c) Represent the decision making involved in the following (**decision tree**) functional requirement of a library automation system in the form of a table: Issue Item: An item when submitted at the counter along with the library identity card, first it is determined if the member has exceeded his quota. If he has exceeded his quota, then no items can be issued to him. If the requested item is a journal, then it is issued for two days only. If it is a book, then it is checked whether it is a reference book. Reference books can not be issued out. If it is not a reference book, it is determined if any one has reserved it. Reserved books can not be issued out. If the book issue request of the member meets all the mentioned criteria, then the book is issued to the member for one month, appropriate entry is made in the member's account and an issue slip is printed. [2]
- (d) Express the decision making involved in the following withdraw cash function of a bank ATM using a **decision table**. To withdraw cash, first a valid customer identification is required. For this, the customer is prompted to insert his ATM card in the card checking machine. If his card is found to be invalid, the card is ejected out along with an appropriate message displayed. If the card is verified to be a valid card, the customer is prompted to type his password. If the password is invalid, an error message is shown and the customer is prompted to enter his password again. If the customer enters incorrect password consecutively for three times, then his card is seized and he is asked to contact the bank manager. On the other hand, if the customer enters his password correctly, then he is considered to have validly identified himself and is prompted to enter the amount he needs to withdraw. If he enters an amount that is not a multiple of ₹100, he is prompted to enter the amount again. After he enters an amount that is a multiple of ₹100, the cash is dispensed if sufficient amount is available in his account and his card is ejected; otherwise his card is ejected out without any cash being dispensed along with a message display regarding insufficient fund position in his account. to satisfy these properties? Provide examples. [1 1/2]

**3. Estimation Techniques**

**Question 3: 4 pts**

- (a) For the following C program estimate the Halstead's length and volume measures. Compare Halstead's length and volume measures of size with the LOC measure. [1 1/2]

```

1      /* Program to calculate GCD of two numbers */
2      int compute_gcd(int x, int y)
3      {
4          while (x != y)
5              if (x>y) then x=x-y;
6              else y=y-x;
7          return x;
8      }

```

- (b) What does Halstead's volume metric represent conceptually? How according to Halstead is the effort dependent on program volume? [1]
- (c) Consider a software project with 5 tasks T1–T5 . Duration of the 5 tasks in weeks are 3,2,3,5,2 respectively. T2 and T4 can start when T1 is complete. T3 can start when T2 is complete. A T5 can start when both T3 and T4 are complete. Draw the PERT chart representation of the project. When is the latest start date of the task T3. What is the slack time of the task T4. Which tasks are on the critical path? [1½]

## 4. Software Testing

Question 4: 12 pts

- (a) Consider the program given below. Construct the program graph and derive test cases so that 100% statement coverage and path coverage is achieved. [5]

```

1      void main()
2      {
3          char fname[30],address[100],Email[100];
4          int valid=1,flag=1;
5          clrscr();
6          printf("Enter first name:");
7          scanf("%s",fname);
8          printf("\nEnter address:");
9          scanf("%s",address);
10         printf("\nEnter Email:");
11         scanf("%s",Email);
12         if(strlen(fname)<4||strlen(fname)>30){
13             printf("\nInvalid first name");
14             valid=0;
15         }
16         if(strlen(address)<4||strlen(address)>100){
17             printf("\nInvalid address length");
18             valid=0;
19         }
20         if(strlen(Email)<8||strlen(Email)>100){
21             printf("\nInvalid Email length");
22             flag=0;
23             valid=0;
24         }
25         if(flag==1){
26             if(strchr(Email, '.')==0||strchr(Email, '@')==0){
27                 printf("\nEmail must contain . and @ characters");
28                 valid=0;
29             }
30         }
31         if(valid) {
32             printf("\nFirst name: %s \t Address: %s \t Email: %s",fname,address,Email);
33         }
34         getch();
35     }

```

- (b) Consider the program for the determination of the division problem. Its input is a triple of positive integers (mark1, mark2, mark3) and values for each of these may be from interval [0, 100]. The program is given below. The output may have one of the options given below: [5]

- Fail
- Third division
- Second division
- First division
- First division with distinction
- Invalid marks

Construct the program graph. Find all du-paths and identify those du-paths that are definition clear. Also find all du-paths, all-uses and all-definitions and generate test cases for these paths.

```

1      void main()
2      {
3          int mark1, mark2,mark3,avg;
4          clrscr();
5          printf("Enter marks of 3 subjects (between 0-100)\n");
6          printf("Enter marks of first subject:");
7          scanf("%d", &mark1);
8          printf("Enter marks of second subject:");
9          scanf("%d", &mark2);
10         printf("Enter marks of third subject:");
11         scanf("%d",&mark3);
12         if(mark1>100||mark1<0||mark2>100||mark2<0||mark3>100||mark3<0) {
13             printf("Invalid Marks! Please try again");
14         }
15         else {
16             avg=(mark1+mark2+mark3)/3;
17             if(avg<40) {
18                 printf("Fail");
19             }
20             else if(avg>=40&&avg<50) {
21                 printf("Third Division");
22             }
23             else if(avg>=50&&avg<60) {
24                 printf("Second Division");
25             }
26             else if(avg>=60&&avg<75) {
27                 printf("First Division");
28             }
29             else {
30                 printf("First Division with Distinction");
31             }

```

```

32     }
33     getch();
34     }
    
```

(c) Find the cyclomatic complexity of the below graph (Figure 1). Identify a set of basis paths for the graph. [2]

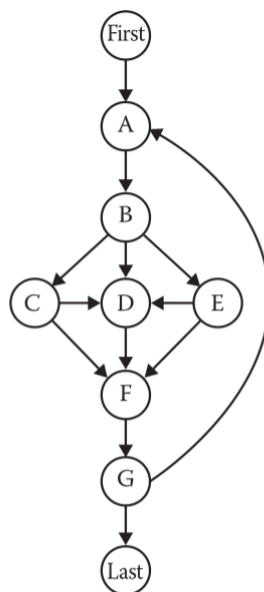


Figure 1: Figure for Question 4 (c)

5. Project Crashing and Earned Value Analysis

Question 5: 7 pts

(a) Consider the data of a project as shown in Figure 2. If the indirect cost per week is ₹200, find the optimal crashed project completion time. The activities stand for edges in the resultant graph. [5]

Activity	Normal Time (weeks)	Normal Cost (Rs.)	Crash Time (weeks)	Crash Cost (Rs.)
1-2	7	700	4	850
1-3	5	500	3	700
1-4	8	600	5	1200
2-5	9	800	7	1250
3-5	5	700	3	1000
3-6	6	1100	5	1300
4-6	7	1200	5	1450
5-7	2	400	1	500
6-7	3	500	2	850

Figure 2: Figure for Question 5 (a)

(b) Compute Estimate At Completion (EAC) and Variance At Completion (VAC) if both SPI and CPI influence the project work when given variables are: [2]

- Budget At Completion (BAC) = ₹22,000
- Earned Value (EV) = ₹13,000
- Planned Value (PV) = ₹14,000
- Actual Cost (AC) = ₹15,000

6. Project Size, Cost, Time and Manpower estimation

Question 6: 5 pts

(a) What amount of software can be delivered in 1 year and 10 months in an organization whose technology factor is 2400 if a total of 25 PY is permitted for development effort? [2½]

(b) A software project of application generator category with estimated 100 KLOC has to be developed. The scale factor (B) has low precedentness, high development flexibility and low team cohesion. Other factors are nominal. The early design cost drivers like platform difficult (PDIF) and Personnel Capability (PERS) are high and others are nominal. Calculate the effort in person months for the development of the project. [2½]

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(Don't let fear get the better of you. All the best!)