KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2017/2018 ACADEMIC YEAR

SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF
COMPUTER SCIENCE

COURSE CODE : **CSC 467E**

COURSE TITLE : SOFTWARE METRICS

DATE: 17/10/2018   **TIME:** 11.30AM – 1.30PM

INSTRUCTIONS TO CANDIDATES
ANSWER QUESTIONS ONE AND ANY OTHER TWO.

Section A (30 Marks)

Answer <u>ALL</u> Questions in This section

Question One (30 marks)

a) Explain why software metrics are more useful as indicators of what's wrong rather than what's right about a system?   [2 marks]

b) For each of the following measure in a software project indicate the appropriate scale type i.e. either nominal, ordinal, ratio, interval, or absolute giving an appropriate explanation for your choice in each case   [4 marks]

   i)   Number of programmers to work on a software project
   ii) Project activity duration
   iii) Programmer productivity
   iv) Type of database to be used

c) Object-points are an alternative function-related measure to function points

   i).   Would it be appropriate to use object points to estimate cost for software to be developed using C programming language? Provide an explanation for your answer
                                                                          [2 marks]

   ii).   Identify The THREE elements that may be used to compute the number of object-points in a program   [3 marks]

   iii). What is the benefit of object point measure over Lines of code?   [2 marks]

   iv).   Assessment of a software system shows that the system includes
          - 6 screens: 2 simple + 3 medium + 1 difficult
          - 3 reports: 2 medium + 1 difficult
          - 2 3GL components
          - 30 % of the objects could be supplied from previously developed components
          - Productivity is high

          Compute the estimated effort PM 'Person-months' needed to develop the system.
                                                                          [6 marks]

d) For each of the following metrics, describe what it measures and how it can be used to improve software.
   i)   Code Coverage,   [2 marks]

   ii) Weighted methods per class.   [2 marks]

e)
   i).   Explain the meaning of the term Software Reliability   [2 marks]

ii).   Assume that a software system is undergoing system level testing. The initial failure intensity of the system was 25 failures/CPU hours, and the current failure intensity is 5 failures/CPU hour. It has been decided by the project manager that the system will be released only after the system reaches a reliability level of at most 0.001 failures/CPU hour. From their experience the management team estimates that the system will experience a total of 1200 failures over infinite time. Calculate the additional length of system testing required before the system can be released.

[6 marks]

Question Two (20 marks)

a) Many researchers argue that MTBF is a far more useful measure than defects/KLOC (i.e. defects per 1000 lines of code) Explain.   [2 marks]

b) Failure intensity of a system is usually expressed using FIT (Failure-In-Time) unit which is 1 failure per 10^9 device hours. Given that the failure intensity of an electric pump system used for pumping crude oil is constant and is 10,000 FITs and 100 such pumps are operational.

   i).   Calculate the pumps mean time to failure (MTTF)   [2 marks]

   ii).   If for continuous operation all failed units are to be replaced immediately what would be the minimum inventory size of pump units for one year of operation.

[4 marks]

c) Distinguish between the terms *"bug"* and *"code smell"* as applied in software development   [2 marks]

d)
   i) Explain what you understand by the term "code refactoring"   [2 marks]

   ii) Identify any TWO situations that may motivate a programmer to consider doing code refactoring and explain how each situation may be addressed by refactoring.

[4 marks]

   iii) Describe TWO general categories of benefits to the activity of refactoring.   [4 marks]

Question Three (20 marks)

a) Cyclomatic complexity is software metric that gives a numerical value for complexity. Exaplain how it measures software complexity?   [2 marks]

b) One principal application of cyclomatic complexity is design of unit tests. Outline the FOUR steps that you would follow to derive test cases using cyclomatic complexity   [4 marks]

c) You are require to applied path testing in order to design a set of unit tests for the sorting program whose pseudocode is given bellow

```
S1          i := 2
C1          while (i is less than or equal to n) do
S2            j := i - 1
C2            while ((j is greater than or equal to 1) and
                    (A[j] is greater than A[j+1])) do
S3              temp := A[j]
S4              A[j] := A[j+1]
S5              A[j+1] := temp
S6              j := j-1
              end while
S7            i := i + 1
            end while
```

i) Develop a flow graph for this program and determine the cyclomatic complexity of the graph   [5 marks]

ii) Derive all the independent paths from the flow graph   [3 marks]

iii) Design appropriate test cases to cover the identified paths   [6 marks]

Question Four (20 marks)

a)

i). Provide a brief description of each of the following software cost estimation techniques   [8 marks]

    I.   Pricing to win:

    II.   Parkinson's law:

    III. Expert Judgment:

    IV. Estimating by Analogy

ii). Outline TWO problems of estimating cost using Parkinson's law. Which of the two problems is worse? Explain.   [3 marks]

b) Use the Basic COCOMO coefficients shown bellow to answer the questions that follow

project	a_b	b_b	c_b	d_b
Organic	2.4	1.05	2.5	0.38
semidetached	3.0	1.12	2.5	0.35

embedded	3.6	1.20	2.5	0.32

i) A project with estimated 400 KLOC embedded system has to be developed calculate the effort and the development time for organic, semi-detached and embedded system modes
[6 marks]

ii) How do the effort and the development time of the three modes compare? Explain the implications of these comparisons
[3 Marks]

Question Five (20 marks)

a) How is function point metric advantageous over LOC metric? Explain [6 marks]

b) The basis of function point analysis is that computer based information systems comprises five major components or external user types that are of benefit to the users. These external user types are assigned functional units complexity multipliers or weighting factors as per the table bellow

Functional units with weighting factors / Albrecht complexity multipliers

External user types/ functional units	Weighting factors or multiplies		
	low	average	High
External input types	3	4	6
External output types	4	5	7
Logical internal files	7	10	15
External interface files	5	7	10
External inquiry type	3	4	6

(i). Explain the FIVE functional units (external user types) as applied in function point analysis

c) Dr. Bob, a recent graduate from a medical university, is starting her medical practice in a small town. She is planning to hire a receptionist. She approaches software company Y to build a software system to manage the patients' appointments. The following is her problem description.

When a patient calls for an appointment, the receptionist will ask the patient's name or patient's ID number and will check the calendar and will try to schedule the patient as early as possible to fill in vacancies. If the patient is happy with the proposed appointment, the receptionist will enter the appointment with the patient name and purpose of appointment. The system will verify the patient name and supply supporting details from the patient records, including the patient's ID number. After each appointment the Dr. X will mark the appointment as completed, add comments, and then schedule the patient for the next visit if appropriate The system will answer queries by patient name, by patient ID and by date. Supporting details from the patient's records are displayed along with the appointment information. The receptionist can cancel appointments. The receptionist can print out a notification list for making reminder calls 2 days before appointments. The system includes the patient's phone numbers from the patient records. The receptionist can also print out daily and weekly work schedules with all the patients.

Suppose that you are the analyst in charge of estimating the cost of this system and you base your estimation of the function point (FP) count for this system.

(i). Identify the external inputs (EI), external outputs (EO), external Enquiries (EQ), internal Logical files (ILO), and external Interface files (EIF) [5 marks]

(ii). Calculate the unadjusted function point count (UFC) for the system assuming the average weight for all entries. [4 marks]