Ref No: EX/EE/T/424C/2018

BACHELOR OF ELECTRICAL ENGINEERING EXAMINATION, 2017-2018

(4th Year, 2nd Semester)

SUBJECT: - Principles of Software Engineering (Special Paper II)

Time: -Three hours Full Marks 100

(50 marks for each part)

Answer any three questions from each part. 2 marks are reserved for neat & well organized answers.

PART I — **Marks**

1. a) With the help of a suitable diagram, explain what a spiral life cycle model is. — 8
   b) When is it necessary to develop a software prototype? What are the advantages of developing a prototype? — 4
   c) Explain the problems that might be faced by an organization if it does not follow any software life cycle model. — 4

2. a) A task set consists of four periodic real-time tasks T_i (Φ_i, e_i, p_i, d_i) as follows: — 10
   T1(20, 25, 150, 100), T2 (40, 7, 40, 40), T3 (60, 10, 60,50), T4 (25, 10,30, 20)

   Can the task set be feasibly scheduled on a uniprocessor using Rate Monotonic Analysis? Assuming a context switch overhead of 1 milli-seconds (ms), determine the schedulability of the task set.

   b) Consider the following set of periodic real-time tasks T_i (e_i, p_i,): — 6
   T1 (10 ms, 50 ms), T2 (25ms, 150ms), T3 (50 ms, 200 ms).

   Assume that the self suspension times of T1, T2 andT3 are 3 ms, 3 ms & 5 ms respectively. Determine whether the tasks would meet their deadlines.

3. a) The following table indicates the various tasks involved in completing a software project, the corresponding activities, and the estimated effort for each task in person months. — 12

Task	Activity	Effort (person months)
T1	Requirement Specification	1
T2	Design	2
T3	Code actuator interface module	2
T4	Code sensor interface module	5
T5	Code user interface part	3
T6	Code control processing part	1
T7	Integrate and test	6
T8	Write user manual	3

   The following precedence relationships are known among the different tasks:
   i) T1 ≤ T2 ≤ {T3, T4, T5, T6} ≤ T7,
   ii) T1 ≤ T8
   Where, the precedence relation Ti ≤ { Tj, Tk} implies that the task Ti must complete before tasks Tj or Tk can start.

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		Draw the activity network and use it to find the critical path for the project. Also draw the Gantt Chart for the above project.	
	b)	Suppose an on-the-shelf software product for a business application costs Rs. 5 lakhs and its size is 40KLOC. Assuming that in-house engineers cost Rs 60,000 per month (including overheads), would it be cost effective to buy the product or build it? (Hint: Use BASIC COCOMO Model to calculate cost to build a semi-detached software)	4
4.	a)	Draw the control flow graph for the following function named "**find-maximum**". From the control flow graph, determine a suitable test suite consisting of test cases, each of which requires to input three integers (Hint: use conditional coverage strategy.) *int find-maximum(int i, int j, int k) {* *int max;* *if(i>j) then* *if(i>k) then max = i;* *else max = k;* *else if(j>k) max = j;* *else max = k;* *return(max); }*	8
	b)	Why is it necessary to test modules in isolation? Why are stub modules necessary for unit testing?	2+2
	c)	What do you understand by Statistical Quality Assurance? How is defect index calculated for a particular phase during the life cycle of software development?	2+2
5.		Write short notes on any four of the following topics: i. Need for ISO/CMM certification ii. Necessity for Configuration Management iii. White-Box Testing Strategies iv. Risk Assessment & Containment v. Software Quality Factors (any four) vi. Pros of Cons of any two of the software life cycle model	4*4

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	PART II	Marks
6.	a) Consider the requirements for software to be developed for controlling a chemical plant. This plant has a number of emergency conditions. When each of these occurs, a corresponding action needs to be taken as stated below: i. If temperature of the plant falls below T1 °C, the water shower should be turned OFF and heater turned ON ii. If temperature of the plant exceeds T2 °C, the water shower should be turned ON and heater turned OFF iii. If pressure of the plant exceeds P1, valve V1 should be opened iv. If pressure of the plant exceeds P3, and temperature of the plant exceeds T3 °C, then the water shower should be turned ON, valves V1 and V2 should be opened and alarm bell sounded Write the above requirements in the form of a decision table or a decision tree.	8
	b) Draw an ERD for an employee payroll system illustrating the relationship between the following entities: employer, employee, department, salary. Components of salary processed are Basic, HRA, DA, Medical Allowance and Incentive etc. Assume a few relevant attributes for each entity.	8
7.	An automated car painting system has a car conveyer, which moves the cars one by one, to a painting station. The events and associated actions are as follows: • An operator has the ability to start and stop the system • On initialization, the controller issues a "car move" command and waits. • The conveyer moves just one car on receipt of the "car move" command. • When the car is in the painting station (car ready event), the controller puts the painting system ON. A painting robot applies a coat of paint on the car body. • The robot signals when the spraying is complete. The controller puts the painting system OFF and starts an optical scanner to detect any painting defect. • On detection of any defect, a retouch command is issued. On receiving this command, the painting robot retouches the defective spots. • After retouch, the scanning continues and defects are repaired until there are no more defects detected by the optical scanner. • The controller then issues a "car move" commands to get the next car to the painting station by moving the conveyor.	
	a) Prepare an event list showing the events and the responses for the system	6
	b) Draw a Context Diagram (Level 0 DFD/CFD) for the controller of the automated car painting system described above.	8
	c) What is the advantage of having a Context Diagram?	2

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8.	a) Explain the importance of modularity, coupling and cohesion in software design OR Ward & Mellor Methodology is a methodology that is used for the development of real time systems. How is it different for the conventional structured analysis and design methodology that is used in the development of application software?	8
	b) Draw State Transition Diagram for the system described in Q7 above	8
9.	Perform Structured Analysis for a Medicine Shop Automation Software with the following requirements: • The shop owner stocks different medicines in numbered racks. The software shall maintain an inventory of these items, including their codes, batch numbers, sale prices, locations, date of expiry etc. • The system also maintains a list of the vendors along with their names, addresses and the medicines they deal with • Whenever any item is sold to the customer, the shop owner shall enter details of the sales (item code with quantity).The software will be able to generate a cash receipt for the sales • The system should be able to calculate the threshold value for each such item based on the average sales for an item over the past week, and maintain a minimum seven days inventory for all ingredients. • Purchase orders are generated on a daily basis for those items for which stock falls below its threshold value. • Whenever the ordered medicines arrive, the invoice data regarding the price and quantity is entered, and the stock inventory is updated.. The software should also be able to print a cheque in favour of the vendor • The software should be able to print a number of reports such as revenue and profit for a given period , vendor-wise payments for a period Analyze the different functionalities, entities involved and the data to be stored. Following this analysis, create a Context Diagram and Level 1 DFD for the software to be developed.	16
10.	Refer to the same problem statement of Q9. Now, use an object-oriented approach for the analysis and design of the same software. a) Develop a Use-Case Diagram showing the requirements at a high level b) Develop a **UML class diagram** showing the different classes (shop owner, customer, item, purchase order, vendor), their attributes and relationships **OR** Draw an **UML activity diagram** showing the login activity for the shop owner, followed by the parallel activities that can be done after logging in.	6 10