THERE ARE 12 QUESTIONS

PART-A: HAND-WRITTEN QUESTIONS (1 through 6)

1. **HAND-WRITTEN:** Your Company sells a coronavirus human digital certificate system with microchip implants to show if a person is vaccinated. These microchip implants are ordered from a manufacturer located in China. This system has a probabilistic daily sales demand and re-order lead time; which is the time it takes to receive implants after they have been ordered from China. Your company keeps a certain number of microchip implants in its inventory. When they fall under a certain threshold, you need to re-order them. However, you do not place another new order if there is already a pending order. Another point is that, if for example, Re-Order Lead Time is 1 (Random Number Interval-2 is between 01- 05), and you have placed the order on Wednesday, it means that you will receive your order the next day; i.e. Thursday. Based on the historical data, the following are given:
   - Beginning microchip implants inventory = 500
   - Microchip implants order quantity = 400
   - Microchip implants re-order threshold = 100

Daily Demand for the System	Random Number Interval-1
0	01 - 05
50	06 - 25
100	26 - 35
150	36 - 70
200	71 - 00

Re-Order Lead Time Day(s)	Random Number Interval-2
1	01 - 05
2	06 - 25
3	26 - 35
4	36 - 70
5	71 - 00

Do 10 runs of Monte Carlo simulation to calculate "Average Ending Inventory" and "Average Lost Sales". Use the following probabilistic Daily Demand (Random Number Interval-1) and Re-Order Lead-Time ("Random Number Interval-2") tables for your simulation. Use Random Number Interval-2 table as many times as required starting with the first Random Number Interval -2 which is 10. Make sure to show daily beginning inventory, ending inventory, and daily lost sales. Show steps and explain your solution. (20 Points)

Random Number Interval-1	Random Number Interval-2
50	10
30	30
80	4
60	55
10	87
99	
10	
60	
4	
34	

Calculate:

- Average Ending Inventory = 155
- Average Lost Sales = 15

Day	Implants Received	Beginning Inventory	Random Number Interval-1	Demand	Ending Inventory	Lost Sales	Order	Random Number Interval-2	Lead Time
1	N/A	500	50	150	350	0	No	N/A	N/A
2	0	350	30	100	250	0	No	N/A	N/A
3	0	250	80	200	50	0	Yes	10	2
4	0	50	60	150	0	100	No	N/A	N/A
5	400	400	10	50	350	0	No	N/A	N/A
6	0	350	99	200	150	0	No	N/A	N/A
7	0	150	10	50	100	0	Yes	30	3
8	0	100	60	150	0	50	No	N/A	N/A
9	0	0	4	0	0	0	No	N/A	N/A
10	400	400	34	100	300	0	No	N/A	N/A
					155	15			

2. **HAND-WRITTEN:** By applying the Function Point Analysis (FPA), you have found the Unadjusted Function Points (UFP) of Functionality-A as 100. You will implement Functionality-A with C++ programming language. Also, you will incorporate Functionality-B by modifying 1,000 lines of C++ code. Based on the COCOMO Re-Use and Post-Architecture models, explain the steps to estimate the combined software development effort. (20 Points)

   Algorithmic cost modeling such as COnstructive COst MOdel (COCOMO) is a formulaic approach is used to compute the software project effort based on estimates of product attributes, such as size (Line Of Code LOC, Use Case Points (UCP), number of class diagrams, etc.) and process characteristics, such as experience of staff involved.

$$PM = A \times Size^{E} \times \prod_{i=1}^{n} EM_i$$

where $A = 2.94$ (for COCOMO II.2000)

Step-1: New Code

- Unadjusted Function Point (UFP) of Functionality-A = 100
- C++ Conversion Factor = 55
- New code to be written in C++ = 5.5 KLOC

Step-2: COCOMO Re-Use Model (Equivalent KSLOC to modify existing C++ code for Functionality-B). Conversion required as if we were going to write new C++ code.

- Modified Code: Functionality-B = 1 KLOC C++
- Effort required to modify 1KLOC C++ code will depend on:
- Software Understanding (SU) = Structure, Application Clarity, Self-Descriptiveness), Assessment & Assimilation (AA), Programmer Unfamiliarity (UNFM), and Adaptation Adjustment Factor (AAF) which contains the quantities, Design Modified, Code Modified, and Integration Required).
- For example, if programmer works with the software every day, the 0.0 multiplier for UNFM will add no software understanding increment. If the programmer has never seen the software before, the 1.0 multiplier will add the full software understanding effort increment.

$$\text{Equivalent KSLOC} = \text{Adapted KSLOC} \times \left(1 - \frac{AT}{100}\right) \times AAM$$

$$\text{where } AAM = \begin{cases} \dfrac{[AA + AAF(1 + (0.02 \times SU \times UNFM))]}{100}, & \text{for } AAF \le 50 \\ \dfrac{[AA + AAF + (SU \times UNFM)]}{100}, & \text{for } AAF > 50 \end{cases}$$

$$AAF = (0.4 \times DM) + (0.3 \times CM) + (0.3 \times IM)$$

Step-3: Combined Size: (New Code + Equivalent Code)

- For example, if 1KSLOC Re-Used code (Adapted Code) becomes 0.3 KLOC after applying the factors, then total Size = 5.5 + 0. 3 = 5.8 KSLOC

Step-4: COCOMO Post-Architecture Model – 5 Scale Factors

$$E = B + 0.01 \times \sum_{j=1}^{5} SF_j$$

where $B = 0.91$ (for COCOMO II.2000)

- Precedentedness (PREC)
- Development Flexibility (FLEX)
- Architecture/Risk Resolution (RESL)
- Team Cohesion (TEAM)
- Process Maturity (PMAT)

- For example, PREC is HIGH if it is similar to several previously developed projects.
- For example, TEAM is HIGH if they get along just fine.

Step-4: COCOMO Post-Architecture Model – 17 Effort Multipliers (Cost Drivers)

- Product Factors
- Platform Factors
- Personnel Factors
- Project Factors

- For example, if required product reliability is Risk to Human Life – Very High, multiplier is 1.26
- For example, programmer capability is Very High, multiplier is 0.76.

3. **HAND-WRITTEN:** Explain how a project manager makes uses of activity slacks. (8 Points)

- When the human or hardware resources are limited, the priority is given to critical activities i.e. the ones with no slack. Therefore, the activities with slack time can be shifted or splitted since delay will not change the project completion time. So, a project manager can use slacks for allocation of human & hardware resources.
- Because of company budgeting, financial situations, or tax consequences, activities with slack time can be delayed.

4. **HAND-WRITTEN:** You need to decide to invest in Product-A, Product-B, or no investment at all. Probability of favorable market is exactly the same as unfavorable market. In favorable market, Product-A will gain 100$, and Product-B will gain 70$. In unfavorable market, Product-A will lose 60$, and Product-B will lose

10$. However, you can purchase marketing research report, that will tell you certainty whether the market is favorable or not. Based on Expected Monetary Value (EMV) analysis, find the Expected Value of Perfect Information (EVPI). Make sure to show steps and explain your solution. (6 Points)

Alternative	Favorable	Un-favorable	EMV
A	100	60	20
B	70	10	30
Do nothing	0	0	0
With Perfect Information	100	0	50

- EVwPI = 0.5 * 100 + 0 * 0.5 = 50
- EVPI = EVwPI – Best EMV = 50 – 30 = 20

5. **HAND-WRITTEN:** Explain the difference and similarity between Earned Value Management (EVM) chart and Burn-Up chart. (6 Points)

- Earned Value Management (EVM) is a project tracking chart shows the schedule and cost variances. It is also used to forecast the project completion schedule and cost based on the collected data so far. It is used by plan-driven project management.
- Burn-Up chart shows how much work has been completed mostly per iteration. Work usually defined as Story Points (SP). It is used by agile project management.

6. **HAND-WRITTEN:** There are 2 risks in the risk register: Risk-A and Risk-B. Risk budget is $20, and you can use this money to mitigate either Risk-A or Risk-B. Risk-A has %30 probability and $400 impact. Risk-B has %20 probability and $500 impact. Do you spend $20 to mitigate Risk-A or Risk-B? (4 Points)

- Risk Exposure, RE = P x C
  - P is the probability of occurrence for a risk, and
  - C is the cost to the project should the risk occur.
- RE-A – Before= 0.3 * 400 = 120
- RE-B – Before = 0.2 * 500 = 100
- RE for A is higher, and should be spent on it.

NOTE: Risk Leverage Factor (RLF) is defined as:

- Risk Leverage Factor (RLF) = (REb - REa) / RMc
- REb = Risk Exposure Before risk mitigation; REa = Risk Exposure After risk mitigation
- RMc = Risk Mitigation Cost
- Therefore, it depends on RE-After. In other works, how much $20 reduces the RE (cost-benefit analysis). Higher values of RLF is better.

PART-B: TYPED QUESTIONS (7 through 12)

7. **TYPED:** Explain how you would motivate your employees based on the following theories by giving examples. (6 Points)

a) Herzberg's Two-factor Theory

- People will not be dissatisfied if extrinsic factors are adequate, but they won't necessarily be satisfied either. For a person to be satisfied, intrinsic factors must also be adequately met. Therefore, "Hygiene factors" such as larger salaries & health benefits should be provided so that employees will not be de-motivated. However, to motivate them motivational factors such as recognition & advanced must be provided.

b) Adam's Equity Theory

- Equity theory suggests that individuals compare their work inputs and outcomes with those of others and then respond to eliminate inequities. It is most powerful predicting absenteeism or job quitting. Therefore, employees should be treated equally in every respect – salaries, promotion, advancements based on performance.

8. **TYPED:** Tuckman states that team development has five consecutive stages: forming, storming, norming, performing, adjourning. (6 Points)

a) During which stage(s) conflicts occurs the most between team members and why?

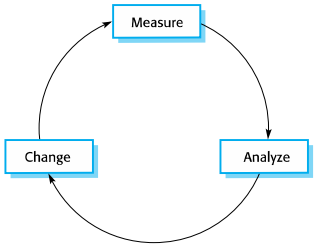
- During forming stage conflict is avoided. Group members try to become familiar with each other and group goals. However, once pass this stage, storming stages comes along. They start questioning tasks, roles & responsibilities. The different working styles can become problematic. Storming stage is where most conflict happens.

b) Do you think conflict is good or bad? Explain the kinds of techniques that you would use to resolve conflicts by giving examples.

- Conflict can be good or bad. Task related conflict such as new ideas and better alternatives improves team performance and keeps them alive. However, some conflict can also stimulated. However, too much conflict prevents work do be done. Therefore there has to be a balance. Depending on the type and level of conflict, different conflict resolution techniques can be used. For example, if an immediate decision has to be made then I can be very assertive Competing (my way) technique can be used. If the issue is trivial, such as where to eat, I would use avoiding (whatever) technique. If there has to be mutual agreement, for example software development environment, then Collaborating is the best.

9. **TYPED:** Based on Dominance, Influence, Steadiness Compliance (DISC) tool, explain how you would organize your team members and communicate with them by giving examples. (6 Points)
   - People can be classified as:
     - People-Directed
     - Task-Directed
   - People can be classified as:
     - Tell-Directed
     - Ask-Directed
   - Dominance: Task & Tell Directed
   - Influence: People & Tell Directed
   - Steadiness: People & Ask Directed
   - Compliance: Task & Tell Directed
   - For example each DISC style has a different type of working style:
     - D-styles are direct, results-oriented, and they want thing to be done immediately. They can be very good managers, but they cannot get along with S people.
     - I-Styles: social, want to be center of attention, talkative, do not like details, and they can make decisions fast. I styles are usually are not very good programmer, but they be very good business analysts.
     - S-Styles: do not like change, and they like to communicate one-on-one. They are slow in decision making. They need a lot of detailed information. They can be good coders.
     - C-Styles: perfectionist, detail-oriented, and want to know facts. They prefer written communication. They are slow in decision making because they want to make the best decision without any errors. They over analyze and require information. They are focused on details and can find minor errors. They can be good test engineers.

10. **TYPED:** At the end of your current project, you collected process metric "percent of requirements changes" as %36, which is a very high number. Explain what you would do so that in your next project this metric will be a lower number. (4 Points)



   - Measure: "percent of requirements changes" as %36
   - Analyze: the reasons for such as high number. It may be lack of communication skills of requirements engineers, not building a requirements prototype, not enough UML skills, etc.
   - Change: Once the root cause of the problem(s) is identified, change the process. Hopefully, for the next similar project "percent of requirements changes" should be a number lower than %36.

11. **TYPED:** Explain the differences between "Plan-Driven Project Management" and "Agile Project Management" by giving examples. (8 Points)

Both are based on 5 phases: Initiation, Planning, Executing, Monitoring & Control, and Closing. However, the approach and tools & techniques are different:

- Plan-Driven Project Management: Project is based on a "Plan". Therefore, during planning phase a full plan mainly (scope, cost, quality – iron triangle) is planned, and project plan is executed. During execution project plan is executed. Monitoring & Control uses tools such as Tracking Gantt Chart to detect deviations from the cost & schedule. WBS, EVM, Crashing are other examples of Plan-Driven Project Management.
- Agile Project Management: Planning is incremental to support incremental software development. At the end of each increment, re-planning is done. However, similar to Plan-Driven Project Management, within each increment, progress is measured by daily stand-up meeting and Burn-down & burn-up charts.

12. **TYPED:** Which contract type(s) do you think more suitable for agile development methods such as eXtreme Programming (XP)? Explain why or why not? (6 Points)

Agile development methods such as eXtreme Programming (XP) do not use a Software requirements Specification (SRS). They rely on a customer representative being part of the software development team. Therefore, a fixed price contract type is not suitable since it is based on what is specified in the SRS document. Therefore, cost reimbursable contracts in which buyer pays to the seller for direct and indirect costs, and Time & Material contracts, mostly used consultants charged for hourly basis are more suitable.