First Part. Questions from the Galin Text. (5 points each)

1. One of the three components of maintenance service is adaptive maintenance. List and describe all three.

Pages 255-256
Corrective – User support services and software corrections
Adaptive – Adapt the software to differences in new customer requirements, changing environmental conditions, and the like
Functionally improvement – Combines (1) perfective maintenance of new functions added to the software and (2) preventative maintenance activities that improve reliability and system infrastructure for easier and more efficient future maintenance.

2. Galin discusses four risks in having external participants within the framework of a project. One is low quality of parts. List the other three.

Pages 283-284
Delays in completion of the project
Low quality of parts supplied by the external participants
Future maintenance difficulties
Loss of control over project parts
3. Define *classic* and *real* CASE tools.

Page 299
Classic tools are well established ones such as interactive debuggers, compliers, and project control systems. Real case tools are more recent and support different phases of development. Upper CASE tools support design and analysis, while lower CASE tools support the coding phase. Integrated tools support design and analysis, as well as coding.

4. Galin discusses four contributions of templates to software quality. One is *facilitates the process of preparing documents*. List the other three.

Pages 326-327
Facilitates the process of preparing documents
Ensures that documents prepared by the developer are more complete
Provides for easier integration of new team members
Facilitates review of documents

5. Galin discusses four issues related to document security (including their disposal). One is *determine the storage period*. List the other three.

Page 395
Provide restricted access to document types
Prevent unauthorized changes to stored documents
Provide back-up for stored paper as well as electronic files
Determine the storage period
Second Part: Questions from the Lectures and Notes

1. We discussed four roles of individuals involved in change. One is sponsor. List and briefly define all four. 5 points

   **Champions** - Initiate the change process. They bring management’s attention to the subject, obtain the blessings of a sponsor, and establish the credibility to get the change program launched

   **Sponsors** - People in authority who supply the resources and the official backing to implement the change

   **Change agents** - People who lead the change planning and implementation

   **Targets** - People who will be expected to change their work habits

2. We discussed software risk management. In that context,
   a. If a house is worth $250,000 and the probability it will burn is 10%, what is the risk exposure? 5 points

   Risk Exposure = Prob(Loss) x Size(Loss) = 0.10 x $250,000 = $25,000

   b. Define the terms: 5 points each

   A **risk** is the probability of unwanted consequences of an event and decision

   An **opportunity** is the probability of exceeding expectations. A risk is the probability of failing to meet expectations

   A **problem** is something requiring thought and skill to arrive at a proper conclusion or decision
c. We discussed three causes of risk based on uncertainty. One is uncertainty in information. List and briefly define all three. 5 points

Uncertainty in Time - Uncertainty about when certain events may occur or the ability to react to them

Uncertainty in control - Inadequate authority to make or influence decisions

Uncertainty in information - Inadequate or inaccurate information on which to base decisions

d. We discussed three risk-handling strategies. One is avoid. List and briefly discuss all three. 5 points

- Mitigate - Reduce the probability and/or impact of the risk
- Avoid - Eliminate the possibility of a specific risk by choosing an alternative path. May mean swapping one risk for more acceptable ones
- Transfer - Get someone else to share or assume the risk
- Accept - Plan a contingency, track the risk, and enact if it becomes a problem

3. We discussed case studies of software process improvement based on CMM. Answer the following.

a. While productivity (as measure in source lines of code) generally increases markedly as an organization climbs the CMM ladder from level 1 to level 5, sometimes a slight dip occurs before resuming the improvement. When does this dip usually happen? 5 points

Going to level 3 from level 2
b. Many organizations reported *lessons learned*. List at least three of the ones common across organizations. 5 points

The following were all copied from the class notes

- Strong sponsorship by the chief executive officer is critical.
- A central, experienced team should participate in software improvement initiatives.
- In-house groups should be trained together to effect a cultural change.
- The path to improvement requires investment, risk, time, and the pain of cultural change. Delegation is not strong enough to overcome these roadblocks. Commitment is. Process improvement should be tied to the salary or promotion of senior management
- A focal point is essential...The SEI calls this focal point an SEPG. Hughes calls it an engineering council. Whatever the name, there must be a focal point.
- Focus on improving new projects. It is extremely difficult to change projects, especially at lower maturity levels, once they have started.
- Adopt a top-down focus before immersing yourself in CMM details; start by assessing the intent of each KPA so that you can determine how it fits into your environment;
- Emphasize productivity, quality, and cycle time. Avoid process for its own sake;
- Management commitment is needed from all levels; commitment from upper management won’t be enough unless individual project leaders and managers are determined to succeed;
- Practitioners and task leaders, not outside experts, should be used to define processes;
- Managers must be convinced of process improvement’s value; it’s not free, but in the long run it more than pays for itself.
- The customer must be kept informed about the process, especially when process changes occur;
- Copying process documents from other organizations usually does not work well; the process must match your organization;
- Overcoming resistance to change is probably the most difficult rung to climb on the CMM ladder
- Advancing from level 2 to level 3 is most difficult because of the number of KPAs at level 3 and the impact process maturity plays in SPI.
- Charter the SEPG based on continuous process improvement and provide it real authority to make a difference. Do not let the SEPG falter after an assessment is completed;
- Members of the SEPG must be key leaders and domain experts from the projects in the organization and not outsiders. The process owners must make decisions about their processes to cause institutionalization;
- Provide sponsorship from all levels of management;
- Be sure the SEPG understands its changing role as an organization matures;
- View an assessment as an opportunity for further process improvement;
• The SEPG’s charter should include process definition, process change management, technology insertion, process evaluation, training, process improvement support, and process assessment;
• Empower the SEPG to make decisions within its charter with no further approval;
• Make SEPG members accountable.
• Management commitment is needed from all levels; commitment from upper management will not be enough unless individual project leaders are determined to succeed.
• Practitioners and task leaders, not outside process experts, should be used to define processes.
• Managers need to be convinced of the value of process improvement. It is not free, but in the long run it certainly pays for itself.
• Overcoming resistance to change is probably the most difficult hurdle when climbing the CMM ladder.
• There are no silver bullets! Process change takes time, talent, and a commitment with which many organizations are uncomfortable.

4. We discussed CMM and ISO. In that context, answer the following:
   a. What are the major differences between CMM and ISO with respect to continuous improvement? 5 points

   The biggest difference is the emphasis in CMM on continuous process improvement. ISO only addresses minimum criteria for an acceptable quality system.

   CMM focuses strictly on software, while ISO 9001 has includes hardware, software, processed materials, and services.

   For both CMM and ISO 9001, the bottom line is “Say what you do; do what you say.”
b. What ISO 9001 clauses have no strong relationship to any CMM KPAs? 5 points
The ISO 9001 clauses with no strong relationship to CMM KPAs are control of customer-supplied products and handling, packaging, preservation and delivery.

c. If a software organization has ISO 9001 certification, what CMM level might that reasonable imply? 5 points

Given a reasonable implementation of the software process, a ISO 9001 certified organization should be at least close to CMM Level-2.
5. Consider the following flowchart and proof. Recall that it is supposed to represent and prove the computation of \( M \times N \) (The product of \( M \) and \( N \)), provided \( M \) and \( N \) are integers and \( M \geq 0 \). On the following page is a flowchart that supposedly computes \( N^M \), where \( M \) and \( N \) are integers.

Find a loop invariant and prove the flowchart is totally correct. Are there any other restrictions on \( N \) or \( M \)？ You may remove this page and the following page from the exam if that helps you in constructing the proof. 15 points
Proof:
i) Show $J = (M - I) * N$ first time at point 1.
   $$J = (M - M) * N = 0 * N = 0$$

ii) Assume $J_n = (M_n - I_n) * N_n$ and show
   $$J_{n+1} = (M_{n+1} - I_{n+1}) * N_{n+1}$$
   at point 1

   $J_{n+1} = J_n + N_{n+1} = (M_n - I_n) * N_n + N_{n+1}$ (Inductive Hypothesis)
   $M$ and $N$ are constant, so $M_n = M_{n+1}$ and $N_n = N_{n+1}$.
   Hence, $J_{n+1} = (M_{n+1} - I_n) * N_{n+1} + N_{n+1}$
   $$= (M_{n+1} - I_n + 1) * N_{n+1}$$
   Now, $I_{n+1} = I_n - 1$
   Therefore,
   $$J_{n+1} = (M_{n+1} - (I_n - 1)) * N_{n+1} = (M_{n+1} - I_{n+1}) * N_{n+1}$$
   QED

Show termination:
I starts with the value $M$ and is decremented until it reaches the value 0. It is decremented $M+1$ times, but the $M + 1^{st}$ time execution stops, so it will have added $N$ to itself $M$ times, so $J$ will be $M*N$. 
Proof:
i) Show $J = N^{(M-I)}$ the first time at point 1.
$J = N^{(I-0)} = N^0 = 1$

ii) Assume $J_n = N_n^{(M - I_n)}$ and show

$J_{n+1} = N_{n+1}^{(M - I_{n+1})}$

Because $N$ and $M$ are constant,
$N_n = N_{n+1} = N$ and $M_n = M_{n+1} = M$

$I_{n+1} = I_n - 1$

$J_{n+1} = J_n * N_{n+1} = N_n^{(M - I_n)} * N$ (Induc Hyp)

$= N_{(M - I_{n+1})}^{(n+1)}$
$= N_{(M - I_n)}^{(n)}$
$= N_{n+1}^{(M - I_{n+1})}$

Termination
Because $M >= 0$, $M$ is an integer, and $I$ is initially $= M$, $I$ will eventually $= 0$ because it is decremented by 1 each time through the loop. It is decremented $M + 1$ times, but the $M + 1^{st}$ execution stops so $N$ will have been multiplied by itself $N$ times, so $J = N^M$. 

$A^B_C$