UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1999

MSc Degree in Computing Science
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the Diploma of Membership of Imperial College

PAPER M 3.02

SOFTWARE ENGINEERING

Wednesday, May 12th 1999, 10.00 – 12.00

Answer THREE questions

For admin. only:
paper contains 4 questions

1a *Briefly* compare and contrast object, dynamic and functional modelling, giving an example technique for each kind of modelling approach, and indicating when it is useful to deploy that technique.

b The emergency services in the UK include the police force, the fire brigade and the ambulance services. All three services respond to calls made to one telephone number: "999". The ambulance services despatch ambulances, the fire brigade despatches fire engines, while the police force despatches either police cars, police vans or police motor-cycles. The police force has a number of employees that include one Police Chief and many Police Officers.

Draw a *Class Diagram* to model the structure of the emergency services above. Indicate any abstract classes, inheritance relationships and aggregation relationships.

c i) At the start of their work shift, resting fire officers change to a standby mode where they monitor telephone calls to emergency services. At the end of their work shift, they rest again, spending their time sleeping. On getting a despatch instruction, if they are on standby, they get into their fire engine and travel to the emergency site. All during their journey to the emergency site, they drive the fire engine quickly. When they arrive at the fire scene, they fire-fight (by sprinkling water on the fire) until the fire is extinguished, whereupon they return to standby mode.

Draw a *state-transition diagram* to model the above scenario.

ii) New regulations stipulate that fire officers may be called upon (despatched) to fight a fire even when they are resting. In such cases, they are expected to react as if they were on standby.

Use *clustering* to re-draw your state-transition diagram above as a statechart, taking into account the new regulations.

iii) A fire engine's siren is switched on while the fire engine is *en route* to the fire site and during fire-fighting, but is switched off while the fire officers are resting or are on standby.

Extend your statechart in part c(ii) above to model the siren behaviour. [Hint: You can use orthogonality with conditions on events or broadcast events to synchronise behaviour].

The three parts carry, respectively, 30%, 25%, 45% of the marks.

2a Briefly explain what is a *Context Diagram* and why it is useful.

b A new robot is being developed that is capable of "memorising" course notes provided by a lecturer and then sitting exam papers set by the lecturer on the subject matter of the course. The completed exam paper is returned by the robot to the lecturer for marking, and the lecturer then posts the results on the departmental notice board.

i) Draw a *Context Diagram* for the above robot system.

ii) Decompose the context diagram into an *Overview Diagram*, indicating how course notes are stored in the robot's memory and recalled during an examination.

iii) Provide an explanation for each process you have used, and a data dictionary for all the data flows.

c If an M.Sc. student obtains a total course mark of over 80%, then she is awarded a pass with distinction. If she fails in her labs, then she fails her degree. If she gets over 50% in her exams, and passes her lab, then she passes her degree.

i) Construct a *Decision Table* to model the above student's situation.

ii) Expand the table in part c(i) to determine if the specification is consistent and/or complete. Assume that "passing" and "passing with distinction" are not contradictory.

d i) Give *one benefit* of using decision tables in conjunction with data flow diagrams.

ii) Very *briefly* explain another extension of data flow diagrams.

The four parts carry, respectively, 10%, 40%, 35%, 15% of the marks.

[Turn over ...]

3a i) What is *requirements traceability* and why it is useful?

ii) Briefly explain how you would decide if an expression of a requirement was *measurable* or *testable*. Illustrate your answer using the requirements expression:

"the system shall respond to user queries quickly".

b The project manager of Microscape Inc., Mr. B.G. Ates, has been asked by a customer, Mr. Stuart Pid, to develop a new product line of *Thingamejigs*. The customer is not quite sure what features to include in each *Thingamejig*, but he suggests that he would know if he wants a particular feature if he sees it in the product. However, Mr. Pid is not prepared to accept the additional costs of building throwaway prototypes.

Suggest a development life cycle and associated requirements engineering strategy that might be suitable for developing a *Thingamejig* for Mr. Pid.

The life cycle you describe should be compared to at least one alternative, and your requirements engineering strategy should also be contrasted to throwaway prototyping or other approaches for eliciting requirements.

c Are there any benefits of using a requirements management tool for eliciting the requirements of the *Thingamejig* in part b? Justify your answer.

The three parts carry, respectively, 30%, 50%, 20% of the marks.

4a Compare and contrast *Observational* and *Analytical* methods for evaluating human-computer interfaces. In particular, suggest a strength and a weakness of each method.

b Discuss two input and two output devices that might be suitable physical interfaces for a web-based electronic examination application. The application should present exam questions, mark allocations and examination rubrics to the user, and the user should be able to browse, select and answer questions in a fixed time period. Suggest a *dialogue style* that may be suitable for this kind of application.

c Briefly describe an approach for evaluating the system in part b, explaining the criteria you would use for evaluation, the products of the evaluation and the chosen process (method) of evaluation.

The three parts carry, respectively, 30%, 40%, 30% of the marks.

[End of paper]