UNTVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2004/2005

February - March 2005

ZCE 537/2 - Ultrasound and Magnetic Resonance Imaging
[Ultrasound dan pengimejan Resonans Magnet]

Duration: 2 hours
[Masa : 2 jam]

Please check that the examination paper consists of **FOUR** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **EMPAT** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

Instruction: Answer **FOUR** questions only. **TWO** from Section A and **TWO** from Section B. Students are allowed to answer all questions in Bahasa Malaysia or in English.

*[**Arahan**: Jawab **EMPAT** soalan sahaja. **DUA** dari Bahagian **A** dan **DUA** dari Bahagian B. Pelajar dibenarkan menjawab semua soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]*

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SECTION A
[BAHAGIANA]

1. (a) Using appropriate diagrams, describe the beam generated by a single element (flat) disc transducer operating in the continuous wave mode.
[Berbantukan gambarajah yang sesuai, perihalkan alur yang dijanakan oleh suatu transduser cakera (leper) unsur tunggal yang beroperasi dalam mod gelombang selanjar.]

(30/100)

(b) Describe how the ultrasonic beam from a rectangular crystal differs from the beam of a circular transducer.
[Perihalkan bagaimanakah alur ultrasonik yang dijanakan daripada suatu hablur segi empat bujur berbeza daripada alur yang dihasilkan oleh suatu transduser membulat.]

(30/100)

(c) Why is it necessary to use gel between the probe and the patient?
[Mengapa perlunya disapukan gel di antara prob dan pasien?]

(10/100**)**

(d) A source of pulsed ultrasound and a target are separated by normal soft tissue. Discuss the effect of each of the following on the amplitude of the ultrasonic pulse reflected back to the source:
[Suatu sumber ultrasound terdenyut dan suatu sasaran dipisahkan oleh tisu lembut normal. Bincangkan kesan ke atas amplitud denyut ultrasonik yang terpantul balik pada sumber oleh setiap satu yang berikut:]

(i) The size and shape of the target.
[Saiz dan bentuk sasaran itu.]

(ii) The distance between source and target.
[Jarak di antara sumber dan sasaran itu.]

(iii) The range to which the transmission focus has been set.
[Julat yang mana fokus pemancaran telah disetkan.]

(iv) The frequency of the ultrasound.
[Frekuensi ultrasound itu.]

(v) The acoustic power of the source.
[Kuasa akustik sumber itu.]

(30/100)

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2. (a) What factors determine the reflection coefficient of an ultrasound pulse at a tissue interface? What differences would you expect in the ultrasonic appearance of specularly and diffusely reflecting interfaces?
[Apakah faktor-faktor yang menentukan pekali pantulan denyut ultrasound pada antaramuka suatu tisu? Apakah perbezaan yang anda jangkakan dalam perlihatan ultrasound terhadap antaramuka-antaramuka berpantul berbintik dan berbaur?]

(30/100)

(b) Using appropriate diagrams, describe the basic principle of pulse–echo ranging and explain the importance of knowing the average speed of propagation in echo-ranging.
[Berbantukan gambarajah yang sesuai, perihalkan prinsip asas penjulatan denyut gema dan terangkan pentingnya mengetahui laju purata perambatan ultrasound dalam penjulatan gema.]

(30/100)

(c) Draw a block diagram of an A-mode instrument, and explain the role of each functional block in the device. Explain briefly the limitations of A-mode scanning.
[Lakarkan suatu gambarajah blok peranti mod-A, dan terangkan peranan setiap blok fungsian dalam peranti itu. Terangkan secara ringkas keterbatasan pengimbasan mod-A.]

(40/100)

3. (a) What is the purpose of the backing layer, the impedance matching layer and the lens in a typical ultrasound transducer? What would be the consequences on image quality of leaving out each of these in turn?
[Apakah tujuan lapisan pelapik, lapisan pemadanan impedans dan kanta dalam suatu transduser ultrasound yang biasa? Apakah konsekuens terhadap kualiti imej jika setiap perkara tersebut ditiadakan?]

(30/100)

(b) Describe a basic B-mode scanning instrument and explain the functional components in the system.
[Perihalkan suatu peranti pengimbasan mod-B asas dan terangkan komponen-komponen fungsian dalam sistem itu.]

(30/100)

(c) Discuss ONE application of either static B-mode or dynamic B-mode scanning in the clinical setting.
[Bincangkan SATU aplikasi sama ada pengimbasan mod-B statik atau mod-B dinamik dalam kesekitaran klinik]

(40/100)

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SECTION B
[BAHAGIAN B]

4. (a) With the aid of Larmour's precession equation explain briefly the meaning of resonance in 3.0 Tesla MRI technique.
[Berpandukan persamaan liukan Larmour terangkan dengan ringkas maksud resonans di dalam teknik MRI 3.0 Tesla.]

Your explanation should include aspect of the spin phase, the curves for both longitudinal magnetization Mz and transverse magnetization Mxy.
[Penerangan anda perlu merangkumi aspek-aspek fasa, graf-graf pemagnetan membujur Mz dan pemagnetan melintang Mxy.]

(35/100)

(b) Describe the meaning of T_{2*} effect.
[Terangkan maksud kesan T_{2*}.]

(15/100)

(c) (i) With the aid of pulse sequence diagram describe the technique of spin echo.
[Terangkan teknik spin echo dengan bantuan lakaran jujukan picu.]

(ii) Describe the time TE and TR.
[Terangkan maksud masa TE dan TR.]

(50/100)

5. (a) With the aid of relevant graphs discuss T2WI (T2-weighted image).
[Bincangkan dengan bantuan lakaran graf yang relevan mengenai T2WI (T2-weighted image).]

(25/100)

(b) Explain the meaning of phase encoding.
[Terangkan maksud penskodan fasa.]

(35/100)

(c) Describe the basic principles of functional MRI using BOLD response.
[Terangkan prinsip asas MRI kefungsian menggunakan respons BOLD.]

(40/100)

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