UNIVERSITI 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]*

SECTION A
[BAHAGIAN A]

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 pesien?]

(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)

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 perantı mod-A, dan terangkan peranan setiap blok fungsian dalam perantı 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 perantı 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)

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 M_z and transverse magnetization M_{xy}
[Penerangan anda perlu merangkumi aspek-aspek fasa, graf-graf pemagnetan membujur M_z dan pemagnetan melintang M_{xy}]

(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 pengkodan fasa]

(35/100)

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

(40/100)