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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]*

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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.  
*[Berbantuan gambarajah yang sesuai, perihalkan alur yang dijanakan oleh suatu transduser cakera (leper) unsur tunggal yang beroperasi dalam mod gelombang selanjur.]*  
(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)

**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 kefungsiian menggunakan respons BOLD.]*
- (40/100)

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.  
*[Berbantuan 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 pepadanan impedans dan kanta dalam suatu transduser ultrasound yang biasa? Apakah konsekuensi 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 keskitaran klinik.]*  
 (40/100)