Appendix A

New Course Code and Title: (Revised)	**MS7072 - PRINCIPLES AND APPLICATIONS OF SOLID STATE NMR**
Conducted By:	**John Hanna**
Details of Course	**Summary of course content** *(please note that this information provided will also be uploaded to the web for viewing at large)* This course will introduce the basic principles of nuclear magnetic resonance that is relevant to both the solution and solid states. It will examine the equilibrium introduced in the nuclear spin states when a sample is placed in a strong magnetic field, and then it will further examine what happens when this spin system is perturbed by rf pulses of energy which drives it into a non-equilibrium state, thus facilitating analytical measurements to be made. This course will then start to focus primarily on solid state NMR, and it will introduce the different magnetic and electric interactions that can influence experimentation and measurements undertaken on solid systems. All the basic contemporary solid state NMR pulsed experimental methods will be explained, and their general applicability to the different nuclei in the NMR periodic table will be outlined. In conjunction with this lecture series, practical sessions will be concurrently run that will introduce the students to the Bruker TOPSPIN software package where data manipulation and handling pertaining to many nuclei and materials systems will be introduced.
	Rationale for introducing this course The School of Materials Science and Engineering at NTU has embarked upon a major initiative to install state-of-the-art high field solid state NMR capability (operating at 14.1 and 20.0 T) to augment the extensive suite of characterization techniques already existing. At present NTU (and Singapore as a whole) lacks the technical and research experience, personnel and teaching profile to support this technique and thus extract its full potential within the present and future research programs. This course sets out to introduce the basic theoretical principles, experimentation and applications that underpin the technique and make it such an influential tool in materials research. This course will be aimed at the postgraduate level, as they will the first candidates to have contact with the implementation of the technique towards their respective research areas.
	Aims and objectives On completion of this course, students will have a basic appreciation of the experimental solid state NMR technique, its theoretical background and its potential as a characterization and analysis tool for materials systems. The students will gain experience with relevant commercial software packages for the processing and presentation of measured experimental data so that a degree of independence and self-reliance can be established at this early stage of exposure of the technique to the Department.

	Course Syllabus • Basic principles of magnetism • Effect of an rf pulse, nutation & relaxation • The free induction decay • Fourier transformations & data processing • Magic angle spinning • The chemical shielding interaction • The dipolar (or direct) interaction • The quadrupolar interaction • The scalar (or indirect) interaction • Other magnetic interactions • Magic angle spinning • The single and spin-echo experiments • The cross-polarisation experiment • Basic principles of 2D NMR • The MQMAS experiment • Other 2D MAS NMR experiments	
Assessment (Individual)	Continuous Assessment: - Multiple Choice Questions (MCQ) - Attendance - Participation - Assignments	 *50%* *15%* *15%* *20%*
	Total:	*100%*
To be offered with effect from (state Academic Year and Semester)	*Semester 1 2017/18*	
Cross Listing (if applicable)	*N.A.*	
Prerequisites (if applicable)	*N.A.*	
Preclusions (if applicable)	*N.A.*	
Mode of Teaching & Learning (Lectures, regular tests, Q&A, problem-based learning)	• *Lectures and discussion* • *Tutorials on data processing and software familiarization directly after each lecture*	
Basic Reading List • **Compulsory Reading** • **Supplementary Reading**	*K. Mackenzie & M. E. Smith, "Multinuclear Solid State NMR of Inorganic Materials"* *D. C. Apperley, R. K. Harris, P. Hodgkinson, "Solid State Nuclear Magnetic Resonance, Basic Principles & Progress"* *M. H. Levitt, "Spin Dynamics"*	
Maximum Class Size	*20 - 30 (depends on availability of laboratory equipment)*	
Hours of Contact/Academic Units	*39 hours / 3 AUs*	
Workload Per Week (The workload for a 3-AU course must add up to 39 hours of contact hours)	*Lecture hours per week* *Tutorial/laboratory hours per week*	*4.5 hours* *4.5 hours*
	Total hours per week	*9 hours*