

1.	Name of Course/Module	Information theory
2.	Course Code	TIT3441
3.	Status of Subject	Major for B.IT Security Technology
4.	MQF Level/Stage	Bachelor Degree – MQF Level 6
5.	Version (state the date of the last Senate approval)	June 2012
6.	Requirement for Registration	TCE2311 Data Communication and Networking
7.	Name(s) of academic/teaching staff	Nazrul Muhaimin B Ahmad Jin Zhe
8.	Semester and Year offered	Trimester 2 (Gamma Level)
9.	Objective of the course/module in the programme :	
	<p>The aims of this course are to introduce the basic theoretical techniques of information theory. The course will study how information is measured in terms of probability and entropy, and the relationships among conditional and joint entropies and how these are used to calculate the capacity of a communication channel. Furthermore the various parts of a Shannon communications system are examined, including coding and decoding with or without the presence of noise, coding schemes and error correcting codes.</p>	
10.	Learning Outcomes :	
	<p>At the completion of the subject, students should be able to:</p> <p>LO1: Define information source coding and channel capacity using Shannon's Theorems (Cognitive, Level 1).</p> <p>LO2: Design efficient codes for information source by using various lossless compression techniques (Cognitive, Level 5).</p> <p>LO3: Describe the relationship between entropy, conditional entropy, mutual information, and channel capacity of the communication channel (Cognitive, Level 1).</p> <p>LO4: Compute a priori and posterior entropies, conditional entropies and mutual information of the communication system (Cognitive, Level 3).</p> <p>LO5: Apply block code coding and convolutional coding techniques and construct reliable codes for data on noisy communication channels (Cognitive, Level 3).</p>	
11.	Synopsis:	
	<p>This subject introduces information theory which covers channel capacity and coding, linear block and cyclic error, and convolution coding.</p>	
	<p>Subjek ini memperkenalkan teori maklumat yang merangkumi kapasiti saluran dan pemrograman, blok linear dan kesalahan putaran, dan pemrograman 'convolution'.</p>	
12.	Mapping of Subject to Programme Outcomes :	
	Programme Outcomes	<b>% of Contribution</b>

	PO1: Apply soft skills in work and career related activities	40
	PO7: Demonstrate knowledge and understanding of essential facts, concepts, principles, and theories relating to security technology	20
	PO8: Apply principles and knowledge of security technology in relevant areas	40
13.	Assessment Methods and Types :	
	Method and Type	Description/Details
	Test	Written Test
	Quizzes	5 Quizzes for each topic
	Final Exam	Written Exam
14.	Details of Subject	
	Topics	Mode of Delivery
		Lecture
		Tutorial
	<b>1. Information Sources and Sources Coding</b> Logarithmic measure for information, self and average information. Entropy, information rate, discrete sources, extensions of a discrete source, Shannon's source coding theorem. Markov source. Joint and conditional entropy. Source coding theorem and algorithms. Kraft inequality, Huffman code, prefix code, Lempel-Ziv code, rate distortion theory. Scalar and vector quantization, waveform coding.	6
	<b>2. Channel Capacity and Coding</b> Discrete channels, a priori and a posteriori entropies, equivocation, mutual information, noiseless channel, deterministic channel, channel capacity, Shannon's channel coding theorem, bandwidth-S/N trade-off. Channel capacity theorem. Continuous information source, maximum relative entropy.	6
	<b>3. Linear Block and Cyclic Error-Correction Coding</b> Model of digital communication system employing coding. Algebraic coding theory. Definition of terms: redundancy, code efficiency, systematic codes, Hamming distance, Hamming weight, Hamming bound. Types of codes: parity check codes, Hamming codes, BCH codes, maximum-length or pseudo-random codes, Reed-Solomon codes, concatenated codes. Linear block codes, generator and parity check matrix, syndrome decoding. Cyclic codes, generation and detection. Coding for reliable communication, coding gain, bandwidth expansion ratio. Comparison of coded and uncoded systems.	8
	<b>4. Convolutional Codes</b> Burst error detecting and correcting codes. Convolutional codes, time domain and frequency domain approaches. Code tree, Trellis and state diagram. Decoding of convolutional codes, Viterbi's algorithm, sequential decoding. Transfer function and distance properties of convolutional codes. Bound on the bit error rate. Coding gain.	6
	<b>5. Applications of Coding</b> Coding for bandwidth constrained channels: combined coding and modulation, Trellis coded modulation (TCM), decoding of TCM codes. Coding for white Gaussian noise channel. Coding for compound-error channels, coding for error control in data storage.	2
	<b>Total</b>	<b>28</b>
		<b>14</b>
15.	Tutorials	

	<ul style="list-style-type: none"> <li>• Information Sources and Sources Coding</li> <li>• Channel Capacity and Coding</li> <li>• Linear Block Coding</li> <li>• Cyclic Error-Correction Coding</li> <li>• Convolutional Codes</li> </ul>		
16.	Total Student Learning Time (SLT)	Face to Face (Hour)	Total Guided and Independent Learning
	Lecture	28	28
	Tutorials	14	14
	Laboratory/Practical		
	Presentation		
	Assignment	-	-
	Mid Term Test	2	10
	Final Exam	2	20
	Quizzes	5 times	5
	Sub Total	46	77
	Total SLT	$123/40 = 3.075 \Rightarrow 3$	
17.	Credit Value	3	
18.	Reading Materials :		
	Textbook	Reference Materials	
	1. Simon Haykin, "Communication Systems", Wiley, 5 <sup>th</sup> Edition, ISBN 978-0-471-69790-9, 2009.	1. S. Lin, D. J. Costello, "Error Control Coding", 2 <sup>nd</sup> Edition, ISBN 978-0130426727, 2004. 2. C.E. Shannon, "A Mathematical Theory of Communications", Bell System Tech. Journal, Vol. 27, July and Oct. 1948.	
19.	Appendix (to be compiled when submitting the complete syllabus for the programme) :		
	<ol style="list-style-type: none"> <li>1. Mission and Vision of the University and Faculty</li> <li>2. Mapping of Programme Objectives to Vision and Mission of Faculty and University</li> <li>3. Mapping of Programme Outcome to Programme Objectives</li> <li>4. Programme Objective and Outcomes (Measurement and Descriptions)</li> </ol>		