Version 1.0: 0810

General Certificate of Education
June 2010

ELECTRONICS ELEC5

Unit 5 Communications Systems

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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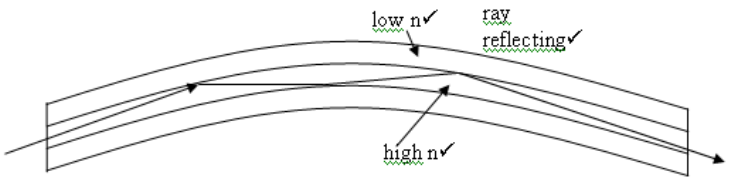
1	(a)		input transducer to modulator✓ carrier generator to modulator✓ modulator to transmitter✓	**3**
	(b)	(i)	no input, produces an oscillating signal✓ at desired frequency✓	**2**
	(b)	(ii)	takes a signal from the environment✓ and converts it to an electrical signal✓	**2**
	(b)	(iii)	uses the signal from the input transducer✓ to change some property of the signal produced by the carrier generator✓ to carry the information signal and feeds it to the transmitter✓	**3**
	(b)	(iv)	converts the modulated carrier signal✓ into a radio wave✓	**2**

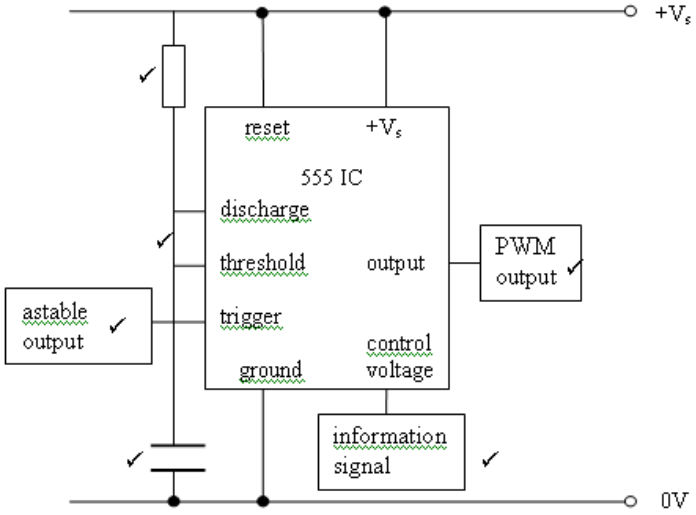
Total Mark: 12

2	(a)	(i)		**3**
	(a)	(ii)	ray travels in a straight line until it hits interface✓ then totally internally✓ reflects✓	**3**
	(b)		some ray paths are longer than others (may be drawn)✓ causing a pulse to be spread out in time ✓	**2**
	(c)	(i)	impurities in fibre✓ causing signal to weaken✓	**2**
	(c)	(ii)	misalignment/sharp bend of fibre or plug/socket ✓ causing some signal to escape✓	**2**
	(d)		greater bandwidth✓ greater security✓	**2**

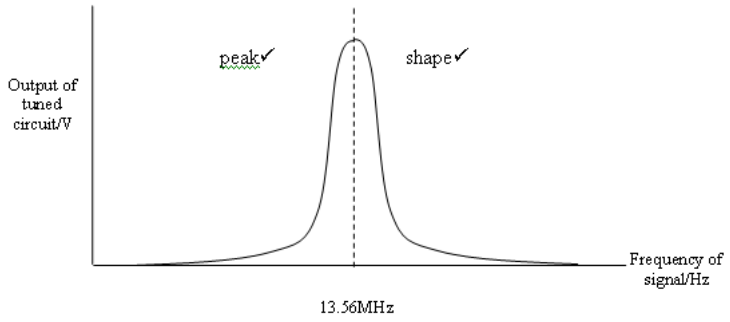
Total Mark: 14

3	(a)		The aerial converts radio waves into an electrical signal✓ this is amplified (and filtered) by the rf amplifier✓ and fed to the mixer which combines the rf signal ✓ with the local oscillator signal✓ and produces sum and difference signals✓ one of which, (lower) is filtered out and amplified✓	**6**
	(b)	(i)	455kHz✓ 1841kHz✓	**2**
	(b)	(ii)	455kHz✓	**1**
	(b)	(iii)	1148 + 455 = 1603kHz✓	**1**

Total Mark: 10

4	(a)	(i)	pulse width modulation✓	**1**
	(a)	(ii)	information signal controls the width of the output pulses✓	**1**
	(b)			**6**
	(c)		T = 1.1 RC, R = T/ 1.1 C✓ $2 \times 10^{-5}/1.98\ \ 10^{-9} = 10k\Omega$✓	**2**

Total Mark: 10

5	(a)	(i)	use of $f_o = 1/2\pi\sqrt{LC}$, $L = 1/ 4\pi^2f^2C$✓ $L = 1/4 \times 9.87 \times 183.87 \times 10^{12} \times 150 \times 10^{-12} = 918nH$✓	**2**
	(a)	(ii)		**2**
	(a)	(iii)	Selectivity, the ability to respond only to a narrow range of frequencies (channel) ✓ Quality factor, sharpness of curve, or calc $f/2\Delta f$✓	**2**
	(b)		Communication on one channel✓ one way communication✓	**2**
	(c)		Transmission is 106×1024 bits s^{-1}, 1024×10 bits transmitted for 1K data✓ $10240/106 \times 1024 = 94ms$✓	**2**

Total Mark: 10

6	(a)		VHF✓	**1**
	(b)		Channel spacing calc, e.g.: 220.352 − 218.640 = 1.712MHz✓ greater than 1.536 so guard band either side prevents interference✓	**2**
	(c)		λ = 300/225 = 1.33m✓ λ/2 = 0.67m✓	**2**
	(d)		Classical music, high quality wide dynamic range stereo needs highest bit rate✓ Pop music has less dynamic range, still in stereo, lower bit rate✓ Speech, restricted frequency range often mono only, lowest bit rate✓	**3**
	(e)		$48 \times 10^3 \times 16 \times 2$✓ = 1536000 bit s^{-1}✓	**2**

Total Mark: 10

7	(a)	(i)	$f_o = 1/ 2\pi RC$, $R = ½\pi f_o C$✓ $1/6.28 \times 500 \times 10^{-8}$✓ 31847Ω✓	**3**
	(a)	(ii)	33kΩ✓ it will lower the breakpoint frequency✓	**2**
	(b)	(i)	bass cut✓	**1**
	(b)	(ii)	$Xc = 1/2\pi fC = 1/6.28 \times 50 \times 10^{-6}$✓ 3183Ω✓	**2**
	(b)	(iii)	3.3kΩ✓	**1**
	(b)	(iv)	in series with the input resistor✓	**1**
	(b)	(v)	−33/3.3✓ = −10✓	**2**
	(c)		op-amp has no dc feedback path so it drifts✓ high value resistor across feedback circuit✓	**2**

Total Mark: 14