Version 1.0: 0810

General Certificate of Education
June 2010

ELECTRONICS ELEC5

Unit 5 Communications Systems

Mark Scheme

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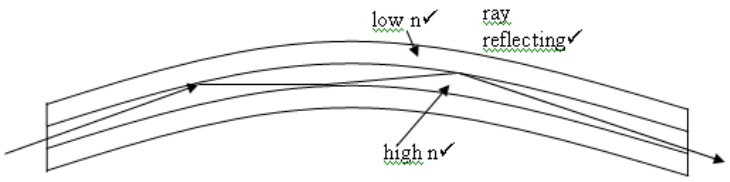
1	(a)		input transducer to modulator✓ carrier generator to modulator✓ modulator to transmitter✓	**3**
	(b)	(i)	no input, produces an oscillating signal✓ at desired frequency✓	**2**
	(b)	(ii)	takes a signal from the environment✓ and converts it to an electrical signal✓	**2**
	(b)	(iii)	uses the signal 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**

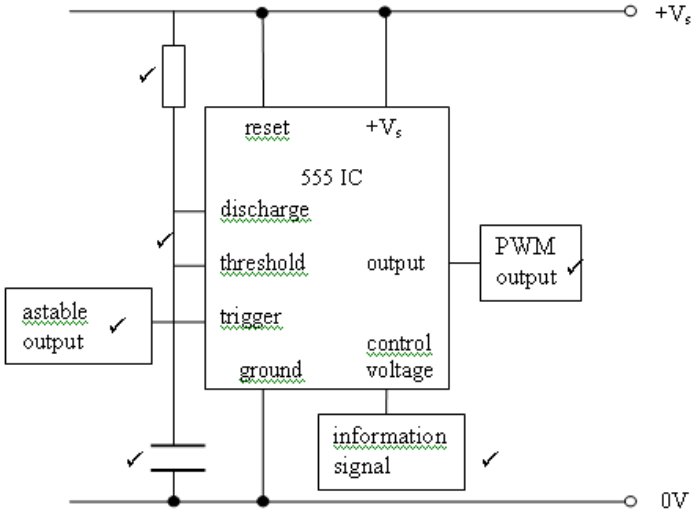
Total Mark: 12

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**

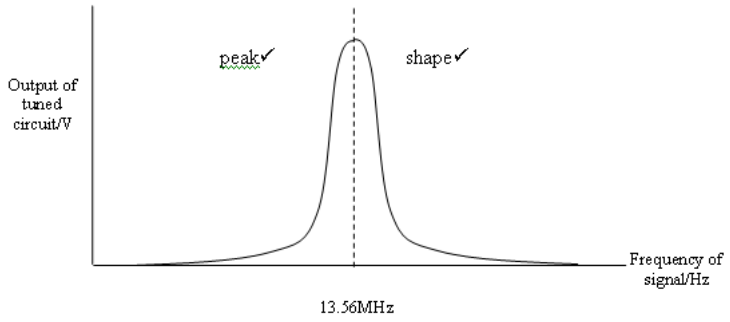
Total Mark: 14

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