General Certificate of Education
Advanced Level Examination
June 2010

Electronics ELEC4

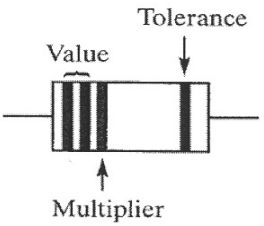
Data Sheet
Unit 4 ELEC 4 Programmable Control Systems

Resistors
Preferred values for resistors (E24) series:
1.0, 1.1, 1.2, 1.3, 1.5, 1.6, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.6, 3.9, 4.3, 4.7, 5.1, 5.6, 6.2, 6.8, 7.5, 8.2, 9.1 ohms etc.

Resistor Printed Code (BS 1852)
This code consists of letters and numbers:
R means × 1
K means × 1000 (i.e. 10^3)
M means × 1 000 000 (i.e. 10^6)
Position of the letter gives the decimal point
Tolerances are given by the letter at the end of the code,
F = ± 1%, G = ± 2%, J = ± 5%, K = ± 10%, M = ± 20%.

Resistor Colour Code

Number	Colour
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Grey
9	White



Tolerance, gold = ±5%, silver = ±10%, no band = ±20%

Silicon diode $V_F = 0.7$ V

Silicon transistor $V_{be} \approx 0.7$ V in the on state, $V_{ce} \approx 0.2$ V when saturated

Resistance
$R_T = R_1 + R_2 + R_3 + \ldots$ series

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$ parallel

Capacitance
$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots$ series

$C_T = C_1 + C_2 + C_3 + \ldots$ parallel

Time constant $T = CR$, $T_{½} = 0.69\,CR$

ac theory

$I_{rms} = \frac{I_0}{\sqrt{2}}$

$V_{rms} = \frac{V_0}{\sqrt{2}}$

$X_C = \frac{1}{2\pi fC}$ reactance

$X_L = 2\pi fL$ reactance

$f = \frac{1}{T}$ frequency, period

$f_0 = \frac{1}{2\pi\sqrt{LC}}$ resonant frequency

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Operational amplifier	$G_V = \frac{V_{out}}{V_{in}}$	voltage gain
	$G_V = -\frac{R_f}{R_1}$	inverting
	$G_V = 1 + \frac{R_f}{R_1}$	non-inverting
	$V_{out} = -R_f\left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right)$	summing
	$V_{out} = (V_+ - V_-)\frac{R_f}{R_1}$	difference
555 Astable and Monstable	$T = 1.1RC$	monostable
	$t_H = 0.7\,(R_A + R_B)C$ $t_L = 0.7\,R_BC$	astable
	$f = \frac{1.44}{(R_A + 2R_B)C}$	astable frequency
Electromagnetic waves	$c = 3 \times 10^8\ \text{m s}^{-1}$	speed in vacuo

Assembler language microcontroller instructions

Mnemonic	Operands	Description	Operation	Flags	Clock cycles
NOP	none	No operation	none	none	1
CALL	K	Call subroutine	stack <=PC PC <=K	none	2
RET	none	Return from subroutine	PC <= stack	none	2
INC	R	Increments the contents of R	(R) <= (R) + 1	Z	1
DEC	R	Decrements the contents of R	(R) <= (R) – 1	Z	1
ADDW	K	Add K to W	W <= W + K	Z, C	1
ANDW	K	AND K with W	W <= W • K	Z, C	1
SUBW	K	Subtract K from W	W <= W – K	Z, C	1
ORW	K	OR K and W	W <= W + K	Z, C	1
XORW	K	XOR K and W	W <= W ⊕ K	Z, C	1
JMP	K	Jump to K (GOTO)	PC <= K	none	2
JPZ	K	Jump to K on zero	PC <= K if Z=1	Z=1	2
JPC	K	Jump to K on carry	PC <= K if C=1	C=1	2
MOVWR	R	Move W to the contents of R	(R) <= W	Z	1
MOVW	K	Move K to W	W <= K	Z	1
MOVRW	R	Move the contents of R to W	W <= (R)	Z	1