Work sheet- 7
(Transients)

Transients in series connected *L–R* circuits

Q.1 A coil has an inductance of 1.2 H and a resistance of 40 Ω and is connected to a 200 V, d.c. supply. Draw the current/time characteristic and hence determine the value of the current flowing 60 ms after connecting the coil to the supply. **[4.3 A]**

Q.2 A 25 V d.c. supply is connected to a coil of inductance 1 H and resistance 5 Ω. Determine the value of the current flowing 100 ms after being connected to the supply. **[2 A]**

Q.3 An inductor has a resistance of 20 Ω and an inductance of 4 H. It is connected to a 50 V d.c. supply. By drawing the appropriate characteristic find (a) the value of current flowing after 0.1 s and (b) the time for the current to grow to 1.5 A. **[(a) 1 A (b) 0.18 s]**

Q.4 The field winding of a 200 V d.c. machine has a resistance of 20 Ω and an inductance of 500 mH. Calculate: (a) the time constant of the field winding, (b) the value of current flow one time-constant after being connected to the supply, and (c) the current flowing 50 ms after the supply has been switched on. **[(a) 25 ms (b) 6.32 A (c) 8.65 A]**

Q.5 A circuit consists of a 200 Ω non-reactive resistor in parallel with a coil of 4 H inductance and 100 Ω resistance. If this circuit is switched across a 100 V d.c. supply for a period of 0.06 s and then switched off, calculate the current in the coil 0.012 s after the instant of switching off. What is the maximum p.d. across the coil? **[0.316 A, 155.5 V]**

Q.6 The field winding of a d.c. machine has an inductance of 10 H and takes a final current of 2 A when connected to a 200 V d.c. supply. Calculate: (a) the initial rate of growth of current; (b) the time constant; and (c) the current when the rate of growth is 5 A/s. **[21. 20 A/s, 0.1 s, 1.5 A]**

Q.7. A 200 V d.c. supply is suddenly switched across a relay coil which has a time constant of 3 ms. If the current in the coil reaches 0.2 A after 3 ms, determine the final steady value of the current and the resistance and inductance of the coil. Calculate the energy stored in the magnetic field when the current has reached its final steady value. **[0.316 A, 632 Ω 1.896 H, 94.6 mJ]**

Q.8 A coil of inductance 4 H and resistance 80 Ω is in parallel with a 200 Ω resistor of negligible inductance across a 200 V d.c. supply. The switch connecting these to the supply is then opened, the coil and resistor remaining connected together. State, in each case, for an instant immediately before and for one immediately after the opening of the switch: (a) the current through the resistor; (b) the current through the coil; (c) the e.m.f. induced in the coil; and (d) the voltage across the coil. **[1 A, 2.5 A, 0, 200 V; 2.5 A, 2.5 A, 700 V, 500 V]**

Transients in series connected *C –R* circuits

Q.9 An uncharged capacitor of 0.2 μF is connected to a 100 V, d.c. supply through a resistor of 100 kΩ Determine, either graphically or by calculation the capacitor voltage 10 ms after the voltage has been applied. **[39.35 V]**

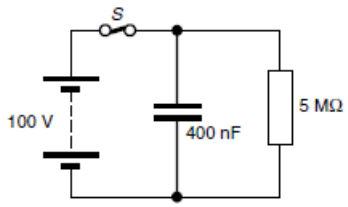
Q.10 A circuit consists of an uncharged capacitor connected in series with a 50 kΩ resistor and has a time constant of 15 ms. Determine either graphically or by calculation (a) the capacitance of the capacitor and (b) the voltage drop across the resistor 5 ms after connecting the circuit to a 20 V, d.c. supply. **[(a) 0.3 μF, (b) 14.33 V]**

Q.11 A10μF capacitor is charged to 120 V and then discharged through a 1.5 MΩ resistor. Determine either graphically or by calculation the capacitor voltage 2 s after discharging has commenced. Also find how long it takes for the voltage to fall to 25 V. **[105.0 V, 23.53 s]**

Q.12 A capacitor is connected in series with a voltmeter of resistance 750 kΩ and a battery. When the voltmeter reading is steady the battery is replaced with a shorting link. If it takes 17 s for the voltmeter reading to fall to two-thirds of its original value, determine the capacitance of the capacitor. **[55.9 μF]**

Q.13 A 5μF capacitor is connected in series with a 20 kΩ resistor and the circuit is connected to a 10 V d.c. supply. Determine (a) the initial value of current flowing, (b) the value of the current 0.4 s after connection, (c) the value of the capacitor voltage 30 ms after connection, and (d) the time after connection when the resistor voltage is 4 V. **[(a) 0.5 mA (b) 9.16 μA (c) 2.59 V (d) 91.63 ms]**

Q.14 A 100 V d.c. supply is connected across a 400 nF capacitor as shown in Figure. When the switch S is opened the capacitor is left isolated except for a parallel resistor of 5 MΩ. Determine the p.d. across the capacitor 5 s after opening the switch. **[8.21 V]**



Q.15 A 20 μF capacitor is found to have an insulation resistance of 50 MΩ, measured between the terminals. If this capacitor is charged off a d.c. supply of 230 V, find the time required after disconnection from the supply for the p.d. across the capacitor to fall to 60 V. **[1344 s]**

Q.12 A circuit consisting of a 6 μF capacitor, an electrostatic voltmeter and a resistor in parallel is connected across a 140 V d.c. supply. It is then disconnected and the reading on the voltmeter falls to 70 V in 127 s. When the test is performed without the resistor, the time taken for the same fall in voltage is 183 s. Calculate the resistance of the resistor. **[100 MΩ]**

Q.16 A 10 ΩF capacitor in series with a 10 kΩ resistor is connected across a 500 V d.c. supply. The fully charged capacitor is disconnected from the supply and discharged by connecting a 1000 Ω resistor across its terminals. Calculate: (a) the initial value of the charging current; (b) the initial value of the discharge current; and (c) the amount of heat, in joules, dissipated in the 1000 Ω resistor. **[50 mA, 500 mA, 1.25 J]**