Pre Lab:

For the above circuits,

i) Find the differential equations, transfer functions, pole locations and time constants.

ii) Find the step responses analytically (using Laplace Transforms) and sketch them.

iii) Use PSpice to plot the step responses.

iv) Use Matlab to plot the step responses.

v) If resistance is increased in circuit (i), predict how the step response will change. How would the effect of an increased capacitance be different than the effect of an increased resistance? How would it be the same? Explain your predictions. Check with Matlab.

vi) If capacitance is decreased in circuit (ii), predict how the step response will change. Explain your predictions. Check with Matlab.
Lab experiment:

For the above circuits,

i) Design and implement experiments to obtain the step responses for each circuit experimentally. (Hint: use a square wave source voltage to produce the step responses.)

ii) Verify experimentally part (v) of the pre-lab.

iii) Verify experimentally part (vi) of the pre-lab.

iv) Compare all responses (obtained in lab experiments and pre lab) and explain any discrepancies. Describe the mathematical relationship between the response of Circuit i) and the response of Circuit ii).

Key topics:

First-order circuit, Laplace transform, transfer function, pole, time constant, step response.

Reference material:

Electric Circuits, Nilsson and Reidel, Chapters 7, 12, 13