Pre Lab:
For the above given circuits, for which all initial conditions are zero,

i) If the input voltage is a 1 volt (peak) sine wave with frequency of 3 KHz, find the output voltage using Laplace transforms. Identify both the transient and the steady state parts of the response.

ii) Make a graph of the total response in part i) using the Matlab “lsim” command. Compare your graph to your answer in part i).

iii) Use Eq. (13.120) from Nilsson and Reidel to find the steady state response and compare with your answer for the steady state response in part i).

iv) Find the frequency response analytically and sketch it on log paper. Find the bandwidth, where appropriate.

v) Find the frequency response of the circuit using Matlab (Bode command).

vi) Find the frequency response of the circuit using PsPice and match with (v).

vii) Find the frequency response of the circuit using PsPice for frequency range of 435Hz to 5665 Hz using a linear frequency scale (for ease of comparison with parts (1.iv) and (2.i) of the experiment).

viii) What type of filter is Circuit (i)? What type of filter is Circuit (ii)? Explain your answers.
Lab experiment:

1. For Circuit (i),

   i) Verify experimentally part (iii) of the pre-lab using an oscilloscope. At the frequency of 3KHz, find the gain and the phase shift between the input and output voltages. Have both voltages displayed on the scope, and use the cursors to assist you with the determination of gain and phase shift.

   ii) Check your answer to part (i) of the experiment using the Gain-Phase meter.

   iii) Get the frequency response experimentally using Gain-Phase meter. Note down at least 5 readings per decade. Plot the readings and match them with plots obtained by(iv), (v) and (vi) of pre-lab.

   iv) Use the oscilloscope to plot the frequency response of the circuit. (This will require that you connect the Gain-Phase meter to the oscilloscope. The instructor will explain this process to you in the lab.) Compare with your results from part (iii) of the experiment.

   v) Is it possible to verify the transient response of the circuit experimentally? Verify the response if possible. If it is not possible, explain why.

   vi) Compare all responses (obtained in lab experiments and pre lab) and explain any discrepancies.

2. For Circuit (ii),

   i) Use the oscilloscope (in combination with the Gain-Phase meter) to plot the frequency response of the circuit.

   ii) Compare all responses (obtained in lab experiments and pre lab) and explain any discrepancies.

Key topics:

First-order filters, low pass filters, high pass filters, bandwidth.

Reference material:

Electric Circuits, Nilsson and Reidel, Section 13.7, Chapter 14.