LCR Resonant Circuit

Group 12

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Aim:

To study resonance eﬀect in series and parallel LCR circuits.

Apparatus:

Oscillator (1 to 1 M Hz), resistors, capacitors, inductors, AC milli-ammeter.

Procedure:

1. The connections of the series LCR circuit were made appropriately and the values of L and C were chosen such that the value of the resonant frequency was of the order a few kHz.
2. The frequency of the oscillator was varied in steps and the voltage across the resistor was noted.
3. The values of L, C and R were changed and the experiment was repeated.
4. The connections of the parallel LCR circuit were made appropriately and four set of readings with various values of L, C and R were taken by varying the frequency in steps.
5. Graphs were plotted according to the readings.

Observations:

Experiment 1

Part 1(a)

|  |  |  |  |
| --- | --- | --- | --- |
|  | r=100ohm | c=1microF | l=15mH |
| frequency(Hz) | current (mA) | |  |
| 345 | 1.192 |  |  |
| 445 | 1.458 |  |  |
| 545 | 1.658 |  |  |
| 645 | 1.904 |  |  |
| 745 | 3.03 |  |  |
| 845 | 3.327 |  |  |
| 945 | 3.58 |  |  |
| 1045 | 3.785 |  |  |
| 1145 | 3.917 |  |  |
| 1245 | 3.983 |  |  |
| 1300 | 3.99 |  |  |
| 1345 | 3.983 |  |  |
| 1445 | 3.931 |  |  |
| 1545 | 3.841 |  |  |
| 1645 | 3.726 |  |  |
| 1745 | 3.598 |  |  |
| 1845 | 3.462 |  |  |
| 1945 | 3.324 |  |  |
| 2045 | 3.191 |  |  |
| 2145 | 3.058 |  |  |
| 2245 | 2.941 |  |  |
| 2345 | 2.821 |  |  |
| 2445 | 2.716 |  |  |

Graph part 1(a)

Part 1(b)

|  |  |  |  |
| --- | --- | --- | --- |
|  | r=100ohm | c=10microf | l=15mH |
| frequency(Hz) | current (mA) | |  |
| 300 | 4.084 |  |  |
| 310 | 4.097 |  |  |
| 320 | 4.107 |  |  |
| 330 | 4.116 |  |  |
| 340 | 4.123 |  |  |
| 350 | 4.131 |  |  |
| 360 | 4.135 |  |  |
| 370 | 4.138 |  |  |
| 380 | 4.142 |  |  |
| 390 | 4.143 |  |  |
| 400 | 4.144 |  |  |
| 410 | 4.144 |  |  |
| 420 | 4.143 |  |  |
| 430 | 4.141 |  |  |
| 440 | 4.138 |  |  |
| 450 | 4.137 |  |  |
| 460 | 4.136 |  |  |
| 470 | 4.129 |  |  |
| 480 | 4.124 |  |  |
| 490 | 4.119 |  |  |
| 500 | 4.114 |  |  |
| 510 | 4.109 |  |  |
| 520 | 4.103 |  |  |
| 530 | 4.097 |  |  |
| 540 | 4.089 |  |  |

Graph part1(b)

Part 1 (c)

|  |  |  |  |
| --- | --- | --- | --- |
|  | R=47 ohm | c=1microF | l=15mH |
| frequency(Hz) | current (mA) | |  |
| 500 | 2.541 |  |  |
| 600 | 3.039 |  |  |
| 700 | 3.479 |  |  |
| 800 | 3.908 |  |  |
| 900 | 4.388 |  |  |
| 1000 | 4.907 |  |  |
| 1050 | 5.128 |  |  |
| 1100 | 5.346 |  |  |
| 1150 | 5.524 |  |  |
| 1200 | 5.662 |  |  |
| 1250 | 5.746 |  |  |
| 1300 | 5.78 |  |  |
| 1350 | 5.764 |  |  |
| 1400 | 5.713 |  |  |
| 1500 | 5.51 |  |  |
| 1600 | 5.226 |  |  |
| 1700 | 4.924 |  |  |
| 1800 | 4.618 |  |  |
| 1900 | 4.321 |  |  |
| 2000 | 4.052 |  |  |
| 2100 | 3.811 |  |  |
| 2200 | 3.585 |  |  |
| 2300 | 3.383 |  |  |
| 2400 | 3.194 |  |  |
| 2500 | 3.039 |  |  |

Graph part 1(c)

Part 1(d)

|  |  |  |  |
| --- | --- | --- | --- |
|  | r=100ohm | c=1microF | l=2mH |
| frequency(Hz) | current (mA) | |  |
| 2500 | 4.233 |  |  |
| 2600 | 4.246 |  |  |
| 2700 | 4.257 |  |  |
| 2800 | 4.264 |  |  |
| 2900 | 4.268 |  |  |
| 2950 | 4.27 |  |  |
| 3000 | 4.27 |  |  |
| 3050 | 4.271 |  |  |
| 3100 | 4.27 |  |  |
| 3150 | 4.269 |  |  |
| 3200 | 4.268 |  |  |
| 3250 | 4.266 |  |  |
| 3300 | 4.264 |  |  |
| 3350 | 4.263 |  |  |
| 3400 | 4.261 |  |  |
| 3500 | 4.26 |  |  |
| 3600 | 4.254 |  |  |
| 3700 | 4.244 |  |  |
| 3800 | 4.234 |  |  |
| 3900 | 4.233 |  |  |

Graph part 1(d)

Experiment 2

Part 2(a)

|  |  |  |  |
| --- | --- | --- | --- |
|  | r=100ohm | c=10microf | l=15mH |
| frequency(Hz) | current (mA) | |  |
| 300 | 3.921 |  |  |
| 310 | 3.859 |  |  |
| 320 | 3.79 |  |  |
| 330 | 3.709 |  |  |
| 340 | 3.62 |  |  |
| 350 | 3.506 |  |  |
| 360 | 3.394 |  |  |
| 370 | 3.256 |  |  |
| 380 | 3.104 |  |  |
| 390 | 2.947 |  |  |
| 400 | 2.782 |  |  |
| 410 | 2.616 |  |  |
| 420 | 2.454 |  |  |
| 430 | 2.323 |  |  |
| 440 | 2.218 |  |  |
| 450 | 2.19 |  |  |
| 460 | 2.285 |  |  |
| 470 | 2.419 |  |  |
| 480 | 2.576 |  |  |
| 490 | 2.733 |  |  |
| 500 | 2.888 |  |  |
| 510 | 3.027 |  |  |
| 520 | 3.163 |  |  |
| 530 | 3.285 |  |  |
| 540 | 3.396 |  |  |
| 550 | 3.487 |  |  |

Graph part 2(a)

Part 2(b)

|  |  |  |  |
| --- | --- | --- | --- |
|  | r=100ohm | c=1microF | l=15mH |
| frequency(Hz) | current (mA) | |  |
| 500 | 3.641 |  |  |
| 600 | 3.536 |  |  |
| 700 | 3.406 |  |  |
| 800 | 3.209 |  |  |
| 900 | 2.912 |  |  |
| 1000 | 2.543 |  |  |
| 1100 | 2.173 |  |  |
| 1150 | 1.996 |  |  |
| 1200 | 1.293 |  |  |
| 1250 | 1.156 |  |  |
| 1300 | 1.066 |  |  |
| 1350 | 1.024 |  |  |
| 1400 | 1.066 |  |  |
| 1500 | 1.382 |  |  |
| 1600 | 1.642 |  |  |
| 1700 | 1.844 |  |  |
| 1800 | 2.874 |  |  |
| 1900 | 3.081 |  |  |
| 2000 | 3.281 |  |  |
| 2100 | 3.44 |  |  |
| 2200 | 3.561 |  |  |
| 2300 | 3.671 |  |  |
| 2400 | 3.76 |  |  |

Graph part 2(b)

Part 2(c)

|  |  |  |  |
| --- | --- | --- | --- |
|  | R=47 ohm | c=10microf | l=15mH |
| frequency(Hz) | current (mA) | |  |
| 300 | 5.443 |  |  |
| 310 | 5.33 |  |  |
| 320 | 5.2 |  |  |
| 330 | 5.048 |  |  |
| 340 | 4.88 |  |  |
| 350 | 4.71 |  |  |
| 360 | 4.512 |  |  |
| 370 | 4.306 |  |  |
| 380 | 4.082 |  |  |
| 390 | 3.858 |  |  |
| 400 | 3.627 |  |  |
| 410 | 3.411 |  |  |
| 420 | 3.199 |  |  |
| 430 | 3.015 |  |  |
| 440 | 2.86 |  |  |
| 450 | 2.777 |  |  |
| 460 | 2.906 |  |  |
| 470 | 3.099 |  |  |
| 480 | 3.32 |  |  |
| 490 | 3.52 |  |  |
| 500 | 3.708 |  |  |
| 510 | 3.92 |  |  |
| 520 | 4.107 |  |  |
| 530 | 4.292 |  |  |
| 540 | 4.468 |  |  |
| 550 | 4.64 |  |  |

Graph part 2(c)

Part 2(d)

|  |  |  |  |
| --- | --- | --- | --- |
|  | r=100ohm | c=10microf | l=2mH |
| frequency(Hz) | current (mA) | |  |
| 500 | 4.35 |  |  |
| 600 | 4.355 |  |  |
| 700 | 4.347 |  |  |
| 800 | 4.293 |  |  |
| 900 | 4.173 |  |  |
| 950 | 4.055 |  |  |
| 1000 | 3.86 |  |  |
| 1050 | 3.567 |  |  |
| 1100 | 3.137 |  |  |
| 1150 | 2.795 |  |  |
| 1200 | 2.929 |  |  |
| 1250 | 3.305 |  |  |
| 1300 | 3.636 |  |  |
| 1400 | 3.989 |  |  |
| 1500 | 4.149 |  |  |
| 1600 | 4.236 |  |  |
| 1700 | 4.282 |  |  |
| 1800 | 4.311 |  |  |

Graph part 2(d)

Graphs:

Part 1(a)

Part 1(b)

part 1(c)

Part 1(d)

Part 2(a)

Part 2(b)

Part 2(c)

Part 2(d)

Error analysis:

1. Error in measuring current is **±0.01 mA.**
2. Error in measuring frequency is ±**0.1 Hz.**
3. Other sources of error are human error which can be taken into account.

Precautions:

1. Calculate the expected resonance frequency before beginning to take readings, and make sure to take suﬃcient number of readings in the vicinity of this frequency to be able to draw the shape of the resonance curve.
2. Make sure the range of readings you take is suﬃcient to go beyond the half-power points on both sides of resonance.
3. Make the connections correctly.

Result:

Experiment 1 (maximum point on graph)

Part 1(a) natural frequency = 1300Hz

Part 1(b) natural frequency = 410Hz

Part 1(c) natural frequency = 1300Hz

Part 1(d) natural frequency = 3050Hz

Experiment 2 (minimum point on graph)

Part 2(a) natural frequency = 450Hz

Part 2(b) natural frequency =1350Hz

Part 2(c) natural frequency = 450Hz

Part 2(d) natural frequency = 1150Hz

All the graphs are bell curves as expected

Theoretically natural frequency can be calculated by

f= 1/ [(2\*π)(L\*C)^0.5] Hz