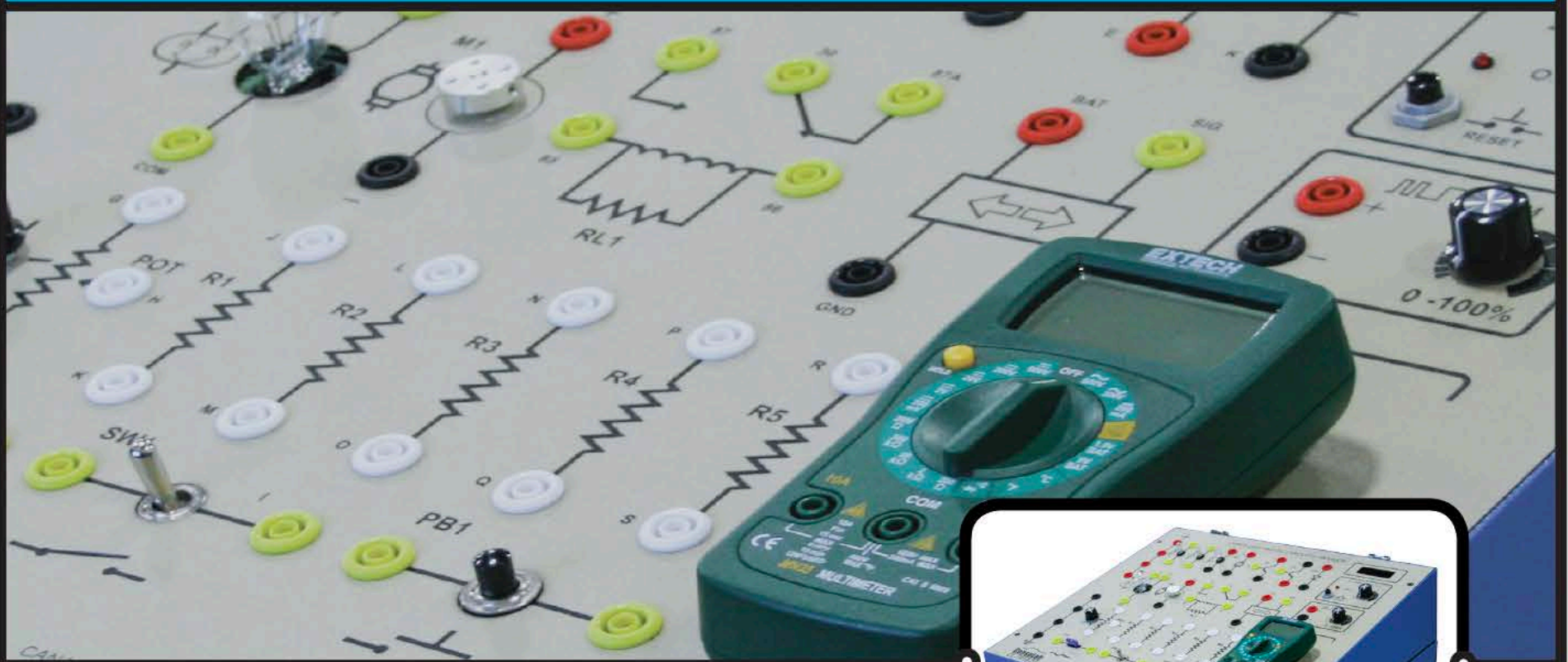


# OHM'S LAW AND DC CIRCUITS TRAINER

## OPERATION AND STUDENT ACTIVITY MANUAL



**CL-1919-05**



**CL-1919-05**

**OHM'S LAW AND DC CIRCUITS TRAINER**

**OPERATION AND STUDENT ACTIVITY MANUAL**

**VERSION 2015-2R**

**PRINTED IN CANADA**

© All rights reserved . No part of this work may be reproduced or transmitted in any form by any means, electronic, mechanical, including photocopying and recording, or by any information storage or retrieval system, without written permission from the publisher.

Consulab Training Aids  
4210, rue Jean-Marchand  
Québec, QC G2C 1Y6  
CANADA  
Phone : 418 688 9067  
Toll Free : 800 567 0791 (Canada & USA)  
Fax : 418 843 3444  
E-mail: [info@consulab.com](mailto:info@consulab.com)  
Web site: [www.consulab.com](http://www.consulab.com)



## TABLE OF CONTENTS

|  |               |
|--|---------------|
| <b>TRAINER LAYOUT AND FAMILIARIZATION .....</b>  | <b>9</b>      |
| CL-1919-05 PANEL LAYOUT AND COMPONENT LOCATION .....   | 11            |
| CL-1919-05 ELECTRICAL COMPONENT IDENTIFICATION .....   | 12            |
| CL-1919-05 ELECTRICAL ACCESSORIES IDENTIFICATION .....   | 14            |
| NATEF AND CANADIAN CURRICULUM TASKS COVERED BY THE CL-1919-05 .....                                      | 15            |
| NATEF 2012 AUTOMOTIVE TASKS MAST (MASTER AUTOMOTIVE SERVICE TECHNICIAN) TASKS .....                      | 17            |
| ALBERTA CURRICULUM TASKS APPLICABLE TO THE CL-1919-05 .....  | 18            |
| CANADA RED SEAL CURRICULUM TASKS APPLICABLE TO THE CL-1919-05 .....                                      | 18            |
| CL-1919-05 TRAINER USE AND OPERATION .....   | 19            |
| <br><b>CL-1919-05 STUDENT LEARNING MODULES .....</b>   | <br><b>23</b> |
| The CL-1919-05 Ohm's Law and DC Circuits Trainer manual contains the following Student Learning Modules. |               |
| <b>1- UNDERSTANDING BASIC DIGITAL MULTI-METER SETUP, USE &amp; INTERPRETATION .....</b>                  | <b>27</b>     |
| Safety precautions .....   | 30            |
| Meter symbols .....  | 31            |
| Meter setup and function switch .....  | 31            |
| Installing the meter test leads and reading a digital meter .....  | 32            |
| Assignment # 1 — Measuring resistance — Student activity .....   | 33            |
| Assignment # 1 — Student answer sheet .....  | 36            |
| Assignment # 2 — Measuring DC voltage — Student activity .....   | 38            |
| Assignment # 2 — Student answer sheet .....  | 41            |
| Assignment # 3 — Measuring DC current — Student activity .....   | 42            |
| Assignment # 3 — Student answer sheet .....  | 45            |
| Test # 1 — Basic Meter Understanding Test .....  | 46            |
| Test # 1 — Student answer sheet .....  | 49            |
| <b>2- BASIC ELECTRICITY .....</b>  | <b>51</b>     |
| Theory and understanding .....   | 53            |
| Types of electricity .....   | 55            |
| Sources of electricity .....   | 56            |
| Common electrical terms .....  | 57            |
| Test # 2 — Basic Electricity Test .....  | 59            |
| Test # 2 — Student answer sheet .....  | 62            |
| <b>3- OHM'S LAW .....</b>  | <b>63</b>     |
| Definition and relationships .....   | 65            |
| Using Ohm's law to understand <i>circuit behavior</i> .....  | 66            |
| Electrical circuit .....   | 67            |
| Types of circuits in automotive electrical systems .....   | 67            |
| Test # 3 — Ohm's law and circuits test .....   | 68            |
| Test # 3 — Student answer sheet .....  | 70            |
| <b>A- Series circuits explanation .....</b>  | <b>71</b>     |
| Assignment # 4 — Series circuit — Student activity .....   | 74            |
| Assignment # 4 — Student answer sheet .....  | 75            |
| Assignment # 5 — Series circuit with one resistance — Student activity .....                             | 76            |
| Assignment # 5 — Student answer sheet .....  | 78            |



|  |            |
|--|------------|
| Assignment # 6 — Series circuit with two resistances – Student activity .....  | 79         |
| Assignment # 6 — Student answer sheet .....  | 82         |
| Assignment # 7 — Series circuit with two or more resistances – Student activity .....  | 83         |
| Assignment # 7 — Student answer sheet .....  | 85         |
| Assignment # 8 — Available voltage test – Student activity .....   | 86         |
| Assignment # 8 — Student answer sheet .....  | 87         |
| Test # 4 — Series Circuit Understanding Quiz .....   | 88         |
| Test # 4 — Student answer sheet .....  | 89         |
| <b>B- Voltage drop testing explanation .....</b>   | <b>91</b>  |
| Assignment # 9 — Positive voltage drop testing – Student activity .....  | 94         |
| Assignment # 9 — Student answer sheet .....  | 95         |
| Assignment # 10 — Ground side voltage drop testing – Student activity .....  | 96         |
| Assignment # 10 — Student answer sheet .....   | 97         |
| Test # 5 — Voltage Drop Testing Understanding Quiz .....   | 98         |
| Test # 5 — Student answer sheet .....  | 99         |
| <b>C- Parallel circuits explanation .....</b>  | <b>101</b> |
| Assignment # 11 — Parallel circuits with two resistances – Student activity .....  | 104        |
| Assignment # 11 — Student answer sheet .....   | 105        |
| Assignment # 12 — Parallel circuits with three resistances – Student activity .....  | 106        |
| Assignment # 12 — Student answer sheet .....   | 108        |
| Assignment # 13 — Circuit behavior in series & parallel circuits – Student activity .....  | 109        |
| Assignment # 13 — Student answer sheet .....   | 111        |
| Test # 6 — Parallel Circuit Understanding Quiz .....   | 112        |
| Test # 6 — Student answer sheet .....  | 114        |
| <b>D- Combination series/parallel circuits explanation .....</b>   | <b>115</b> |
| Assignment # 14 — Combination series/parallel circuit – Student activity .....   | 118        |
| Assignment # 14 — Student answer sheet .....   | 120        |
| Assignment # 15 — Series/parallel circuit with resistance in one branch of the ground paths – Student activity .....   | 121        |
| Assignment # 15 — Student answer sheet .....   | 123        |
| Test # 7 — Combination Circuits Understanding Quiz .....   | 124        |
| Test # 7 — Student answer sheet .....  | 126        |
| <b>4- COMPONENT EXPLANATION .....</b>  | <b>127</b> |
| Light bulbs, LED, buzzer, diode, transistors, motor, relay, electronic flasher, potentiometer, resistors, fuses, circuit breakers, fusible links, switches and pulse width modulation. |            |
| Test # 8 — COMPONENT OPERATION COMPREHENSION TEST .....  | 144        |
| Test # 8 — Student answer sheet .....  | 147        |
| <b>5- STUDENT EXPERIMENTS AND ASSIGNMENTS .....</b>  | <b>149</b> |
| Assignment # 16 — Light bulb with diode – Student activity .....   | 152        |
| Assignment # 16 — Student answer sheet .....   | 154        |
| Assignment # 17 — Light bulb circuits – Student activity .....   | 155        |
| Assignment # 17 — Student answer sheet .....   | 157        |
| Assignment # 18 — Light bulb circuits with resistances – Student activity .....  | 158        |
| Assignment # 18 — Student answer sheet .....   | 161        |
| Assignment # 19 — Light bulb circuits with problems – Student activity .....   | 162        |
| Assignment # 19 — Student answer sheet .....   | 164        |
| Assignment # 20 — Relay controlled circuit – Student activity .....  | 165        |
| Assignment # 20 — Student answer sheet .....   | 167        |
| Assignment # 21 — Flasher controlled circuit – Student activity .....  | 168        |
| Assignment # 21 — Student answer sheet .....   | 170        |



|   |                |
|---|----------------|
| Assignment # 22 — Pulse width modulation circuit w/motor — Student activity .....   | 171            |
| Assignment # 22 — Student answer sheet .....  | 173            |
| Assignment # 23 — NPN & PNP transistor controlled circuits — Student activity ..... | 174            |
| Assignment # 23 — Student answer sheet .....  | 178            |
| <b>6- ADVANCED STUDENT CIRCUIT ASSIGNMENTS .....</b>                                | <b>179</b>     |
| Assignment # 24 — Alarm system simulation — Option 1 .....                          | 181            |
| Assignment # 25 — Alarm system simulation — Option 2 .....                          | 181            |
| Assignment # 26 — Alarm system simulation — Option 3 .....                          | 181            |
| Assignment # 27 — Turn signal / Parking lights alternately flashing .....           | 181            |
| Assignment # 28 — Light bulb dimmer circuit .....                                   | 181            |
| Assignment # 29 — Horn circuit with relay .....                                     | 181            |
| Assignment # 30 — Horn circuit with relay and lighted switch .....                  | 181            |
| Assignment # 31 — Alternately flashing bulbs (L1 & L2) .....                        | 181            |
| <b>7- COMPREHENSION TESTS .....</b>   | <b>183</b>     |
| Test # 9 — Relay Competency Test .....  | 185            |
| Test # 9 — Student answer sheet .....   | 190            |
| Test # 10 — General Competency Test .....   | 191            |
| Test # 10 — Student answer sheet .....  | 193            |
| Test # 11 — Final General Information & Competency Test .....                       | 194            |
| Test # 11 — Student answer sheet .....  | 198            |
| <b>ASSIGNMENT INSTRUCTOR'S ANSWER KEYS .....</b>                                    | <b>199-224</b> |
| <b>TEST &amp; QUIZ INSTRUCTOR'S ANSWER KEYS .....</b>                               | <b>225-238</b> |
| <b>ASSIGNMENT SCHEMATIC INSTRUCTOR'S WIRING KEYS .....</b>                          | <b>239-265</b> |
| <b>BLANK TRAINER SCHEMATIC SHEET .....</b>  | <b>266</b>     |