

| DUTY AREAS AND TASKS                                       | NATIONAL SKILL STANDARD-ETA/ECT |
|--|---------------------------------|
| <b>A. BASIC CONCEPTS</b>                                   |                                 |
| 1. Work and energy   | 1.0                             |
| 2. Efficiency  | 1.0                             |
| 3. Structure of matter                                     | 1.1                             |
| 4. Electric charge   | 1.1                             |
| 5. Valence electronics, free electrons, and ions           | 1.1                             |
| 6. Static electricity                                      | 1.3                             |
| <b>B. ELECTRICAL QUANTITIES AND UNITS</b>                  |                                 |
| 1. Units of charge   | 1.3                             |
| 2. Current carriers-in solids, liquids, gasses, and vacuum | 1.0                             |
| 3. Unit of current - ampere                                | 1.5                             |
| 4. Unit of voltage - volt, polarity, sources of voltage    | 1.5                             |
| 5. Resistance, conductors, insulators, semiconductors      | 1.6                             |
| 6. Unit of resistance, the Ohm                             | 1.5                             |
| 7. Resistivity and resistors                               | 1.6                             |
| 8. Power and efficiency                                    | 1.6                             |
| 9. Powers of 10  | 9.0                             |
| <b>C. BASIC CIRCUITS, LAWS AND MEASUREMENTS</b>            |                                 |
| 1. Circuit essentials                                      | 2.0                             |
| 2. Symbols   | 4.1                             |
| 3. Calculating and measuring electrical quantities         | 7.0                             |
| 4. Instruments and measurements                            | 7.1                             |
| <b>D. CIRCUIT COMPONENTS</b>                               |                                 |
| 1. Batteries   | 2.0                             |
| 2. Resistors, Switches                                     | 2.0                             |
| 3. Wires and cables  | 5.1                             |

| DUTY AREAS AND TASKS  | NATIONAL SKILL STANDARD-ETA/ECT |
|---|---------------------------------|
| 4. Fuses and circuit breakers   | 2.0                             |
| <b>E. MULTIPLE LOAD CIRCUITS</b>  |                                 |
| 1. Subscripts   | 9.0                             |
| 2. Power  | 9.1                             |
| 3. Series circuits and maximum power transfer                           | 11.1                            |
| 4. Parallel circuits and conductance                                    | 11.1                            |
| 5. Series-parallel circuits   | 11.1                            |
| <b>F. COMPLEX CIRCUITS</b>  |                                 |
| 1. Simultaneous equations   | 9.2                             |
| 2. Loop Technique   | 9.2                             |
| 3. Superposition  | 9.2                             |
| 4. Thevenin   | 9.2                             |
| 5. Current and voltage source   | 9.2                             |
| 6. Norton   | 9.2                             |
| <b>G. MAGNETISM AND ELECTROMAGNETISM</b>                                |                                 |
| 1. Magnets, fields, flux, and poles                                     | 1.8                             |
| 2. Electromagnetism   | 1.8                             |
| 3. Magnetic materials   | 1.8                             |
| 4. Magnetomotive force and saturation                                   | 1.8                             |
| 5. Demagnetizing and residual magnetism                                 | 1.8                             |
| 6. Reluctance and shielding   | 1.8                             |
| 7. Induced voltage  | 2.3                             |
| 8. Quantities and units   | 9.0                             |
| 9. Electromagnets, dc motors, solenoids, relays and Hall effect devices | 2.3                             |
| <b>H. ALTERNATING CURRENT</b>   |                                 |
| 1. Terminology  | 11.2                            |

| DUTY AREAS AND TASKS                               | NATIONAL SKILL STANDARD-ETA/ECT |
|--|---------------------------------|
| 2. Wave forms                                      | 11.2                            |
| 3. Quantifying AC                                  | 11.2                            |
| 5. AC generator                                    | 11.2                            |
| 6. Advantages of AC                                | 11.2                            |
| 7. Three phase                                     | 11.2                            |
| <b>I. POWER IN AC CIRCUITS</b>                     |                                 |
| 1. Resistive circuits                              | 11.2                            |
| 2. Out of phase circuits                           | 11.2                            |
| 3. True and apparent power                         | 1.13                            |
| 4. Power factor                                    | 1.13                            |
| <b>J. CAPACITANCE</b>                              |                                 |
| 1. Terminology                                     | 1.7                             |
| 2. Capacitor action and voltage ratings            | 1.7                             |
| 3. Unit of capacitance and determining capacitance | 1.7                             |
| 4. Types of capacitors                             | 2.2                             |
| 5. Symbols   | 4.1                             |
| 6. Capacitors in AC and DC circuits                | 1.7                             |
| 7. Capacitors in series and parallel               | 11.2                            |
| 8. Detecting faulty capacitors and capacitor specs | 2.2                             |
| 9. Undesired capacitance                           | 1.7                             |
| 10. Uses of capacitors                             | 2.2                             |
| <b>K. INDUCTANCE</b>                               |                                 |
| 1. Unit of inductance-Henry                        | 2.3                             |
| 2. Factors determining inductance                  | 1.8                             |
| 3. Types of inductors                              | 2.3                             |
| 4. Inductors in AC and DC circuits                 | 11.2                            |

| DUTY AREAS AND TASKS                          | NATIONAL SKILL STANDARD-ETA/ECT |
|---|---------------------------------|
| 5. Inductors in series and parallel           | 11.0                            |
| 6. Time constants                             | 9.0                             |
| 7. Mutual inductance and undesired inductance | 11.2                            |
| <b>L. TRANSFORMERS</b>                        |                                 |
| 1. Fundamentals                               | 2.4                             |
| 2. Efficiency                                 | 2.4                             |
| 3. Core differences and types of transformers | 2.4                             |
| 4. Impedance matching and ratings             | 2.4                             |
| 5. Winding types                              | 2.4                             |
| 6. Three phase                                | 2.4                             |
| <b>M. R, C, AND L CIRCUITS</b>                |                                 |
| 1. Impedance                                  | 11.3                            |
| 2. Phasors                                    | 11.3                            |
| 3. Solving combination circuits               | 11.3                            |
| 4. Resonance                                  | 11.3                            |
| 5. Filters                                    | 11.3                            |
| <b>N. INTRODUCTION</b>                        |                                 |
| 1. History                                    | N/A                             |
| 2. Analog functions                           | N/A                             |
| 3. Circuits with both AC and DC               | 11.1-2                          |
| 4. Trends                                     | N/A                             |
| <b>O. SEMICONDUCTORS</b>                      |                                 |
| 1. Conductors and insulators                  | 2.6                             |
| 2. Semiconductors                             | 2.6                             |
| 3. N and P type semiconductors                | 2.5                             |
| 4. Majority and minority carriers             | 2.5                             |

| DUTY AREAS AND TASKS                               | NATIONAL SKILL STANDARD-ETA/ECT |
|--|---------------------------------|
| <b>P. DIODES</b>                                   |                                 |
| 1. DIODES  | 2.6                             |
| <b>Q. POWER SUPPLIES</b>                           |                                 |
| 1. Rectification                                   | N/A                             |
| 2. Conversion of RMS to average                    | N/A                             |
| 3. Filters   | 6.4                             |
| 4. Voltage multipliers                             | 6.7                             |
| 5. Ripple and regulation                           | 6.4                             |
| 6. Zener Regulators                                | 2.8/6.5                         |
| 7. Troubleshooting and replacement parts           | N/A                             |
| <b>R. TRANSISTORS</b>                              |                                 |
| 1. Amplification                                   | 2.5                             |
| 2. Characteristic curves                           | 2.5                             |
| 3. Transistor data, testing and types              | 2.5                             |
| 4. Used as switches                                | 2.5                             |
| <b>S. SMALL SIGNAL AMPLIFIERS</b>                  |                                 |
| 1. Measuring gain                                  | 12.4                            |
| 2. Common emitter amplifier                        | 12.1                            |
| 3. Stabilization                                   | 12.2                            |
| 4. Other configurations, common base and collector | 12.1                            |
| 5. Amplifier coupling                              | 12.2                            |
| 6. Gain  | 12.4                            |
| 7. FETs  | 2.10                            |
| 8. Negative feedback                               | 12.4                            |
| 9. Frequency response                              | 12.5                            |
| <b>T. LARGE SIGNAL AMPLIFIERS</b>                  |                                 |

| DUTY AREAS AND TASKS                            | NATIONAL SKILL STANDARD-ETA/ECT |
|---|---------------------------------|
| 1. Class A, B, AB, and C power amplifiers       | 12.3                            |
| 2. Switch mode amplifiers                       | 12.3                            |
| <b>U. OPERATIONAL AMPLIFIERS</b>                |                                 |
| 1. Differential amplifiers/analysis             | 12.7                            |
| 2. Setting gain                                 | 12.7                            |
| 3. Effect of frequency                          | 12.5                            |
| 4. Applications                                 | N/A                             |
| 5. Comparators                                  | 12.3                            |
| 6. Troubleshooting                              | N/A                             |
| <b>V. OSCILLATORS</b>                           |                                 |
| 1. Characteristics                              | 11.4                            |
| 2. RC/RL circuits                               | 11.3                            |
| 3. Crystal circuits                             | N/A                             |
| 5. Relaxation oscillators                       | 11.4                            |
| 6. Undesired oscillations and troubleshooting   | 11.5                            |
| 7. Direct digital synthesis and troubleshooting | N/A                             |
| <b>W. COMMUNICATIONS</b>                        |                                 |
| 1. Modulation and demodulation                  | N/A                             |
| 2. Simple receivers                             | 10.6                            |
| 3. Superhetrodyne receivers                     | 10.6                            |
| 4. FM and single side band                      | 10.6                            |
| 5. Troubleshooting                              | N/A                             |
| <b>X. INTEGRATED CIRCUITS</b>                   |                                 |
| 1. Fabrication                                  | 14.0                            |
| 2. 555 timer                                    | 14.0                            |

| DUTY AREAS AND TASKS                              | NATIONAL SKILL STANDARD-ETA/ECT |
|---|---------------------------------|
| 3. Other ICs                                      | 14.0                            |
| 4. Troubleshooting                                | 14.0                            |
| <b>Y. ELECTRONIC CONTROL DEVICES AND CIRCUITS</b> |                                 |
| 1. Silicon controlled rectifiers                  | 2.7                             |
| 2. Full wave devices                              | 2.7                             |
| 3. Feedback in control circuitry                  | N/A                             |
| 4. Troubleshooting                                | N/A                             |
| <b>Z. REGULATED POWER SUPPLIES</b>                |                                 |
| 1. Open and closed loop regulation                | 6.0                             |
| 2. Current and voltage limiting                   | 6.0                             |
| 3. Switch mode regulators                         | 6.0                             |
| 4. Troubleshooting                                | 6.0                             |
| <b>A2. DIGITAL ELECTRONICS</b>                    |                                 |
| 1. Introduction                                   | N/A                             |
| <b>B2. NUMBERS USED IN DIGITAL ELECTRONICS</b>    |                                 |
| 1. Decimal and binary                             | 9.4                             |
| 2. Conversions                                    | 9.4                             |
| 3. Electronic translators                         | 14.0                            |
| 4. Hexadecimal numbers                            | 9.4                             |
| 5. Octal numbers                                  | 9.4                             |
| 6. Bits, bytes, nibbles, and word size            | 14.0                            |
| <b>C2. LOGIC GATES</b>                            |                                 |
| 1. AND/OR gates                                   | 14.2                            |
| 2. Inverters and buffers                          | 14.2                            |
| 3. NAND/NOR gates                                 | 14.2                            |
| 4. Exclusive gates                                | 14.2                            |

| DUTY AREAS AND TASKS  | NATIONAL SKILL STANDARD-ETA/ECT |
|---|---------------------------------|
| 5. Universal gate   | 14.2                            |
| 6. Multiple input gates                                     | 14.2                            |
| 7. Using inverters  | 14.0                            |
| 8. TTL and CMOS Logic                                       | 14.0                            |
| 9. Troubleshooting  | N/A                             |
| 10. IEEE symbols  | N/A                             |
| 11. Applications  | N/A                             |
| <b>D2. COMBINING LOGIC GATES</b>                            |                                 |
| 1. Constructing circuits from Boolean expressions           | 9.5                             |
| 2. Maxterm and minterm circuits                             | 9.5                             |
| 3. Truth tables and Boolean expressions                     | 14.3                            |
| 4. Simplifying Boolean expressions                          | 9.5                             |
| 5. Karnaugh maps  | 14.0                            |
| 6. Solving logic problems with data selectors               | 14.0                            |
| 7. Programmable logic devices                               | 15.5                            |
| 8. DeMorgan's theorem                                       | 14.0                            |
| <b>E2. IC SPECS AND INTERFACING</b>                         |                                 |
| 1. Logic levels/noise margins                               | 14.0                            |
| 2. Interfacing TTL and CMOS                                 | 14.0                            |
| 3. Interfacing with buzzers, relays, motors, etc.           | 14.0                            |
| 4. Troubleshooting  | 14.0                            |
| <b>F2. ENCODING, DECODING, AND SEVEN SEGMENT DISPLAYS22</b> |                                 |
| 1. 8421 BCD code  | 14.0                            |
| 2. Excess 3, Gray and ASCII codes                           | 14.0                            |
| 3. Encoders   | 14.0                            |

| DUTY AREAS AND TASKS                           | NATIONAL SKILL STANDARD-ETA/ECT |
|--|---------------------------------|
| 4. 7 segment displays                          | 2.9                             |
| 5. Decoders                                    | 14.0                            |
| 6. BCD to 7 segment decoder/drivers            | 14.0                            |
| 7. Liquid crystal                              | 2.9                             |
| 8. Vacuum fluorescent displays                 | 2.9                             |
| 9. Troubleshooting                             | N/A                             |
| <b>G2. FLIP FLOPS</b>                          |                                 |
| 1. RS and clocked                              | 14.5                            |
| 2. D   | 14.5                            |
| 3. JK  | 14.5                            |
| 4. IC latches                                  | 14.5                            |
| 5. Triggering and Schmitt triggered flip flops | 14.5                            |
| 6. IEEE logic symbols                          | N/A                             |
| <b>H2. COUNTERS</b>                            |                                 |
| 1. Ripple and Mod 10 ripple                    | 14.4                            |
| 2. Synchronous                                 | 14.4                            |
| 3. Down and self stopping                      | 14.4                            |
| 4. Frequency dividers                          | 14.4                            |
| 5. TTL and CMOS                                | 14.4                            |
| 6. 3 digit BCD                                 | 14.4                            |
| 7. Troubleshooting                             | N/A                             |
| <b>I2. SHIFT REGISTERS</b>                     |                                 |
| 1. Serial and Parallel                         | 14.4                            |
| 2. Universal                                   | 14.4                            |
| 3. 74194 IC                                    | 14.4                            |

| DUTY AREAS AND TASKS                                 | NATIONAL SKILL STANDARD-ETA/ECT |
|--|---------------------------------|
| 4. 8 bit CMOS  | 14.4                            |
| 5. Using and troubleshooting                         | 14.4                            |
| <b>J2. ARITHMETIC CIRCUITS</b>                       |                                 |
| 1. Binary addition                                   | 14.4                            |
| 2. Half, full, and three bit adders                  | 14.4                            |
| 3. Binary subtraction                                | 14.4                            |
| 4. Parallel subtractors                              | 14.4                            |
| 5. IC adders   | 14.4                            |
| 6. Binary multiplication                             | 14.4                            |
| 7. 2s complement addition and subtraction            | 14.4                            |
| 8. Troubleshooting                                   | N/A                             |
| <b>K2. MEMORIES</b>                                  |                                 |
| 1. RAM   | 15.4                            |
| 2. SCRAM   | 15.4                            |
| 3. ROM   | 15.4                            |
| 4. PROM  | 15.4                            |
| 5. Nonvolatile read/write                            | 15.4                            |
| 6. Memory packaging                                  | 15.4                            |
| <b>L2. DIGITAL SYSTEMS</b>                           |                                 |
| 1. Elements of a system                              | 15.1                            |
| 2. Calculators, computers, digital signal processing | N/A                             |
| 3. Data transmission                                 | 14.6                            |
| 4. Clocks  | 14.8                            |
| 5. Frequency counters                                | 14.4                            |
| 6. Programmable logic controllers                    | 15.5                            |
| <b>M2. CONNECTING WITH ANALOG DEVICES</b>            |                                 |

| <b>DUTY AREAS AND TASKS</b> | <b>NATIONAL SKILL STANDARD-ETA/ECT</b> |
|-----------------------------|--|
| 1. D/A conversion           | 14.0                                   |
| 2. Operational amplifiers   | 14.0                                   |
| 3. A/D conversion           | 14.0                                   |