Introduction to Electrical Installation Work

Compulsory Units for the 2330 Certificate in Electrotechnical Technology Level 2 (Installation Route)
Introduction to Electrical Installation Work

Second edition

Compulsory Units for the 2330 Certificate in Electrotechnical Technology Level 2 (Installation Route)

Trevor Linsley
Contents

Preface xiii

1 Working Effectively and Safely in an Electrical Environment 1
Laws and Safety Regulations 2
Statutory Laws 4
1. The Health & Safety at Work Act 1974 4
2. Electricity at Work Regulations 1989 5
3. The Electricity Safety, Quality and Continuity Regulations 2002 5
4. The Management of Health & Safety at Work Regulations 1999 5
5. Provision and Use of Work Equipment Regulations 1998 6
6. COSHH Regulations (2002) 6
7. Personal Protective Equipment Regulations (PPE) 6
Non-Statutory Regulations 8
The IEE Wiring Regulations, the requirements for Electrical Installations (BS 7671) 8
Health and Safety Responsibilities 9
Safety Signs 10
Warning Signs (these give safety information) 11
Advisory Signs (these also give safety information) 11
Mandatory Signs (these are ‘MUST DO’ signs) 12
Prohibition Signs (these are 'MUST NOT DO' signs) 13

Accident and Emergency Procedures 13
   Emergency Procedures – Fire Control 14
   Emergency Procedures – Electric Shock 17
   Emergency Procedures – First Aid 19
   Emergency Procedures – Electrical Isolation and Lock Off 23

Organisations having Electrotechnical Activities 27

Services provided by the Electrotechnical Industry 32
   1. Lighting and power installations 32
   2. Emergency lighting and security systems 32
   3. Building management and control systems 32
   4. Instrumentation 33
   5. Electrical maintenance 33
   6. Live cable jointing 33
   7. Highway electrical systems 33
   8. Electrical panel building 33
   9. Electrical machine drive installations 34
  10. Consumer and commercial electronics 34

Roles and Responsibilities of Workers in the Electrotechnical Industry 34
   Design Engineer 35
   Estimator/Cost Engineer 35
   Contracts Manager 35
   Project Manager 35
   Service Manager 36
   Technician 36
   Supervisor/Foreman 36
   Operative 37
3 Health and Safety Application and Electrical Principles 121

Health and Safety Applications 122
Avoiding Accidents in the Workplace 122
Risk Assessment, the Process 125
Safe Manual Handling 128
Safe Working above Ground Level 129
Safe Electrical Isolation and Lock off 136

Electrical Installation Principles 139
A.C. Theory 139
## Contents

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Machines – Basic Operating Principles</td>
<td>147</td>
</tr>
<tr>
<td>Fluorescent Luminaires</td>
<td>147</td>
</tr>
<tr>
<td>Building Regulations for Energy Efficient Lamps</td>
<td>149</td>
</tr>
<tr>
<td>The Electrical Relay</td>
<td>150</td>
</tr>
<tr>
<td>D.C. Motors</td>
<td>151</td>
</tr>
<tr>
<td>A.C. Motors</td>
<td>154</td>
</tr>
<tr>
<td>Transformers</td>
<td>155</td>
</tr>
<tr>
<td>Types of Transformer</td>
<td>158</td>
</tr>
<tr>
<td>Generation, Transmission and Distribution of Electricity</td>
<td>160</td>
</tr>
<tr>
<td>Balancing Single Phase Loads</td>
<td>164</td>
</tr>
<tr>
<td>Protecting Electrical Equipment, Circuits and People</td>
<td>165</td>
</tr>
<tr>
<td>Shock Protection</td>
<td>165</td>
</tr>
<tr>
<td>Basic Protection</td>
<td>165</td>
</tr>
<tr>
<td>Fault Protection</td>
<td>165</td>
</tr>
<tr>
<td>Bonding Safety and other Trades</td>
<td>167</td>
</tr>
<tr>
<td>Overcurrent Protection</td>
<td>168</td>
</tr>
<tr>
<td><strong>Assessment Questions</strong></td>
<td>175</td>
</tr>
<tr>
<td><strong>Multiple Choice Assessment Questions</strong></td>
<td>177</td>
</tr>
</tbody>
</table>

### 4 Installation (Building and Structures) 189

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulations and Responsibilities</td>
<td>190</td>
</tr>
<tr>
<td>Electricity at Work Regulations and Codes of Practice</td>
<td>190</td>
</tr>
<tr>
<td>IEE Regulations (BS 7671)</td>
<td>192</td>
</tr>
<tr>
<td><strong>On-Site Communications</strong></td>
<td>193</td>
</tr>
<tr>
<td>Time Sheets</td>
<td>194</td>
</tr>
<tr>
<td>Job Sheets</td>
<td>194</td>
</tr>
<tr>
<td>Daywork Sheets</td>
<td>196</td>
</tr>
<tr>
<td>Delivery Notes</td>
<td>198</td>
</tr>
<tr>
<td>Reports</td>
<td>198</td>
</tr>
</tbody>
</table>
Electricity Supply Systems 199
Cable Sheath Earth Supplies (TN-S system) 200
Protective Multiple Earthing Supplies (TN-C-S system) 200
No Earth Provided Supplies (TT system) 202
Wiring and Lighting Circuits 203
  Fixing Positions of Switches and Sockets 206
Wiring and Socket Outlet Circuits 207
  Radial Circuits 208
  Ring Circuits 209
  Additional Protection for Socket Outlets 209
  Socket Outlet Numbers 210
Cables and Enclosures 212
New Wiring Colours 213
  Size of Conductor 214
Wiring Systems and Enclosures 215
  PVC Insulated and Sheathed Cable Installations 216
Conduit Installations 219
  Steel Conduit 220
  PVC Conduit 220
  Flexible Conduit 221
Trunking Installations 221
  Metallic Trunking 222
Cable Tray Installations 222
  PVC/SWA Installations 224
  MI Cable Installations 224
  Special Installations 225
Bathroom Installations 225
  Zones for Bath and Shower Rooms 227
  Supplementary Equipotential Bonding 229
Temporary Installations (Construction Sites) 231
Agricultural and Horticultural Installations 234
Hazardous Area Installations 235
Support and Fixing Methods for Electrical Equipment 238
  Cable Clips 239
  Plastic Plugs 240
  Expansion Bolts 241
  Spring Toggle Bolts 242
  Girder Fixings 242
Electrical Installation, Inspection and Testing 244
  1. Continuity of Protective Conductors Including Main and Supplementary Equipotential Bonding 245
  2. Continuity of Ring Final Circuit Conductors 246
  3. Insulation Resistance 246
  4. Polarity 246
Safe Working Environment 248
Correct Disposal of Waste Material 249
Assessment Questions 252
Multiple Choice Assessment Questions 254
Solutions to Assessment Questions 267
Index 273
Preface

The second edition of *Introduction to Electrical Installation Work* is, as the title implies, a first book of electrical installation practice. It is designed to be a simple introduction to electrical theory and practice and, therefore, does not contain any difficult mathematics or complicated electrical theory.

The book will be of assistance to students taking a first year electrical course, particularly those taking the City & Guilds 2330 Level 2 Certificate in Electrotechnical Technology.

*Introduction to Electrical Installation Work* provides a sound basic knowledge of electrical practice which will also be valuable to the other trades in the construction industry who require a knowledge of electrical installation work, particularly those involved in multi-skilling activities.

This book incorporates the requirements of the latest regulations, particularly:

- New Hazardous Waste Regulations 2005
- The New Work at Height Regulations 2005
- The New Part P Building Regulations (Electrical Safety in Dwellings) 2005
- The New (Harmonised) Fixed Cable Core Colours (2006)

The City & Guilds course is in four units which correspond to the four chapters in this book. Each chapter concludes with Assessment Questions in preparation for the City & Guilds On-Line Assessment.
This book features three small cartoon characters that appear in the margin depicting:

- **IMPORTANT INFORMATION** which identifies important safety information
- **FOLLOW THIS MATHS** reminds students to follow each step of a mathematical solution carefully and
- **TRY THIS** is a student activity which readers may like to respond to by making notes in the margin.

I would like to acknowledge the assistance given by the following manufacturers and organisations in the preparation of this book:

- Crabtree Electrical Industries Ltd
- R.S. Components Ltd
- The Institution of Electrical Engineers
- The British Standards Institution
- The City & Guilds of London Institute
- Stocksigns Ltd
- Wylex Electrical Components

I would also like to thank the many college lecturers who returned the questionnaire from Elsevier and the proposal reviewers for their suggestions and advice during the preparation of this book.

I would also like to thank the editorial and production staff at Elsevier for responding to the very short time scale created by the publication of the 17th Edition of the IEE Regulations.

Finally, I would like to thank Joyce, Samantha and Victoria for their support and encouragement.

_Trevor Linsley_

2008