

# **ELECTRICAL WIRING ESTIMATING & COSTING**



**S.L. UPPAL  
G.C. GARG**

**KHANNA PUBLISHERS**

---

# **ELECTRICAL WIRING ESTIMATING AND COSTING**

---

*For*  
*State Diploma Students of Electrical Engineering,*  
*Practising and Installation Engineers, Electrical Supervisors*  
*and I.T.I. Certificate Course Students of Electrician and*  
*Wireman Apprentices*

**Dr. S.L. Uppal**  
**J.M. Lahoria**

*Revised & Enlarged by*  
**G.C. Garg,**  
*FIT, (Electrical), C. Eng. (I), T.T.T.I. (Electrical),*  
*Holland-Collaboration*



**KHANNA PUBLISHERS**

*Operational Office*

B-35/9, G.T. Karnal Road, Industrial Area,  
(Near Telephone Exchange), Delhi-110033  
*Phones*: 011-27224179 • *Mob.* 09811541460  
*email*: [contactus@khannapublishers.in](mailto:contactus@khannapublishers.in)

*Published by :*

Romesh Chander Khanna & Vineet Khanna  
for **KHANNA PUBLISHERS**  
2-B, Nath Market, Nai Sarak  
Delhi- 110 006 (India)

**Website : [www.khannapublishers.in](http://www.khannapublishers.in)**

© 1979 and onward

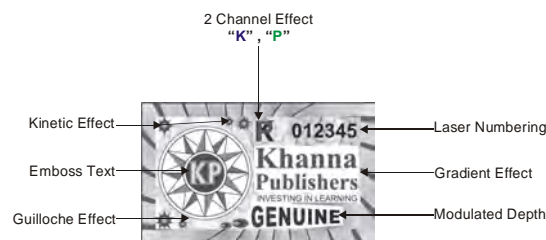
*This book or part thereof cannot be translated or reproduced in any form without the written permission of the Authors and the Publishers. The right to translation, however, reserved with the author alone.*

**Copyright: Author and Publishers Jointly**

Hologram & Description

To all readers of our books, from yourself if being defrauded by pirates to prevent, please make sure that there is an Hologram on the cover of our books with the below specifications. If you find any book without Hologram and Description, please mail us at [contactus@khannapublishers.in](mailto:contactus@khannapublishers.in)

Thanking you



**ISBN No. 978-81-7409-240-3**

***First Edition : 1987***

***Sixth Edition***

***Eighth Reprint : 2018***

## *Preface to Sixth Edition*

---

This popular and well-established book covers the fundamentals of Electrical Wiring, Estimating and Costing. This book has been fully revised by adding the latest in field and sufficient material as per requirement of the students in all the chapters viz., Electrical Symbols, Tools, Wiring and Cables, Types and Installation of Wiring Systems, Lighting Accessories Internal & External Wiring Estimates, Design of Small Transformers and Chokes.

The Sixth Edition has been revised and re-organised to cover the latest developments in electrical wiring, estimating and costing and to reflect modern and latest course structures introduced in technical institutions.

I must thank my publisher, M/s. Khanna Publishers for their encouragement for revision of this book.

The success and popularity of the venture depends upon the liking of the readers, whose valuable suggestions are invariably welcomed to improve the subject matter of book. Errors might have crept in despite utmost care to avoid them and author shall be grateful if these are pointed out along with other suggestions for improvement of the book.

—G.C. Garg



# Contents

---

---

<b>1. Estimating &amp; Costing and Electrical Symbols</b>	<b>1-27</b>
1.1. Introduction	1
1.2. Estimating	1
1.3. Various Steps to Form an Estimate	1
1.4. Purpose of Estimating and Costing	2
1.5. Quantities of a Good Estimator	2
1.6. Essential Elements of Estimating and Costing	2
1.7. Price List	3
1.8. Net Prices	4
1.9. Purchase Organisation	5
1.10. Tender	11
1.11. Tender Notice	11
1.12. Modes of Tendering	11
1.13. Practical Example of Tender Notice	11
1.14. Availability of Tender Form	13
1.15. Opening of Tender Form	13
1.16. Quotation	15
1.17. Practical Example of Tender Notice	15
1.18. International System (SI) of Units	17
1.19. Conventional Electrical Symbols	18
<b>2. Common Hand Tools their uses, Care and Maintenance</b>	<b>28-48</b>
<b>3. Wires, Cables, Wire Splicing and Termination</b>	<b>49-80</b>
3.1. Introduction	49
3.2. Conductor	49
3.3. Properties of a Good Conductor	49
3.4. Classification of Conductors	50
3.5. Common Conductors - Their Properties and Uses	50
3.6. Semi-conductors	52
3.7. Difference Between a Wire and a Cable	52
3.8. Parts of a Cable	53
3.9. Current Rating and Fusing Current of Cable	53
3.10. Stranded Cable	53
3.11. Necessity of Stranding Cables	54

3.12. Core of a Cable	54
3.13. Measurement of Size of Cable	54
3.14. Standard Wire Gauge	55
3.15. Types of Cables	56
3.16. Necessity of Tinning	57
3.17. Voltage Grade of Cable	58
3.18. Selection of Cable for Wiring Installation	58
3.19. Insulation and Protective Covering of Different Cables alongwith their Uses	60
3.20. Soldering	61
3.21. Solder	61
3.22. Necessity of Soldering	61
3.23. Flux	61
3.24. Sizes of Wires	62
3.25. Types of Wires	65
3.26. Wire Splicing and Termination	71
3.27. Western Union Splice or Twist Splice	71
3.28. Married Joint	74
3.29. Single Branch Splice or a Tape Joint	75
3.30. Double Branch Splice	76
3.31. Tap Joint for Stranded Wires	76
3.32. Flexible Cord Splicing	77
3.33. Pigtail Joint	78
3.34. Pigtail Joint of a Solid Conductor & a Flexible Wire	78
3.35. Termination of Wires at Terminal Screws	78
<hr/>	
<b>4. Type and Installation of Wiring Systems</b>	<b>81-122</b>
<hr/>	
4.1. System of Supply	81
4.2. Selection of Wiring	83
4.3. Rules for Wiring	83
4.4. System of Wiring	84
4.5. Separation of Power and Lighting Circuits	111
4.6. Comparison of Various Wiring Systems	111
4.7. Testing of Wiring Installation	113
4.8. Necessity of Earthing	116
4.9. Factors Governing Resistance of Earth Electrode	117
4.10. Systems of Earthing	117
4.11. Rules for Earthing	118
4.12. Double Earthing	120
4.13. Methods of Improving the Earth Resistance	120
4.14. Resistance of Earth Electrode	120
4.15. Size of Earth Continuity Conductor	121

---

**5. General Electrical Accessories and Insulating Materials** **123-159**


---

5.1. Electrical Accessories	123
5.2. Switches	123
5.3. Switches Used for Domestic Purposes	130
5.4. Ceiling Roses	134
5.5. Socket Outlets	135
5.6. Plugs	136
5.7. Terminal Block	136
5.8. Appliance Connector	137
5.9. Main Switch	138
5.10. Splitter Units	140
5.11. Distribution Fuse Boards	141
5.12. Neutral Links	142
5.13. Two-Pin Wall	143
5.14. Plug Tops	145
5.15. Lamp Holder	146
5.16. Wall Bracket	146
5.17. Ceiling Rose	147
5.18. Porcelain Connectors	148
5.19. Adapter Lamp Holder	148
5.20. Iron Connectors or Press Connectors	149
5.21. Reflectors and Shades	149
5.22. Lamp Holder of Fluorescent Tube	149
5.23. Fuses	149
5.24. Iron-Clad Cut-out	150
5.25. Insulator	150
5.26. Qualities of Insulating Materials	151
5.27. Common Insulating Materials: Properties & Uses	151
5.28. Classification of Insulating Materials	154
5.29. Miniature Circuit Breaker (M.C.B.)	155
5.30. Detailed Specification for M.C.B's for Various Purposes	155
5.30. Specifications of Some Electrical Accessories	155

---

**6. Protection Devices and Electric Earthing and Shock** **160-207**


---

6.1. Introduction	160
6.2. Main Features of good Protective Devices	160
6.3. Protective Relays	161
6.4. Description of Relays	162
6.5. Fuses : Introduction and Importance	167

6.6. Melting Points of various Metals	170
6.7. Silver as a Fusing Element	170
6.8. Copper as Fuse Wire	170
6.9. Types of fuses and their Description	172
6.10. Fuse Holders	175
6.11. Terms generally used in Fuses	177
6.11A. Application and Misapplication of Fuses	177
6.12. Electric Earthing and Shock	178
6.13. Neutral Wire	179
6.14. Why Grounding is Required	179
6.15. Comparison between Neutral and Earth Wire	182
6.16. Fire Hazards from Electricity	183
6.17. Why the Fuses is not used in the Neutral	183
6.18. Connection with Earth	184
6.19. Values of Earth Electrode Resistance and Factors on which it is Dependent	185
6.20. Methods of Earthing	185
6.21. Definitions	187
6.22. Earth Leakage Circuit Breaker System	190
6.23. Points to Remember while Providing Earthing	190
6.24. Electric shock	192
6.25. Cure of Shocks	193
6.26. Artificial Respiration	193
6.27. Precautions against Shock	195
6.28. Miniature Circuit Breaker (MCB) Safety Protection	196
6.29. Price List	197
6.30. Over Load Trips	199
6.31. Advantages of using MCB's over Switch Fuses (KitKats)	199
6.32. Availability of MCB's	200
6.33. General Specification of MCB's	200
6.34. MCB Selection Chart for Household Appliances	200
6.35. Earth Leakage Circuit Breakers (ELCB) or Residual Current Circuit Breaker (RCCB)	201
6.36. Types of Closing Mechanism in Circuit Breakers	202
6.37. Trip Mechanism	204
6.38. Trip Coils	205
6.39. Application of ELCB	206

---

**7. Illumination Schemes & Types of I.S.I. Electric Lamps (C.F.L.)** **208-274**

---

7.1. Introduction	208
7.2. Nature of Light	208
7.3. Colour	209

7.4. Relative Sensitivity	210
7.5. Radiant Efficiency	210
7.6. Definitions	210
7.7. Law of Illumination	214
7.8. Design of Lighting Scheme	215
7.9. Illumination Required for Various Purposes	217
7.10. Lamp Fittings and Lighting Systems	219
7.10.1. Amount of Light to be Received	221
7.10.2. Estimation of Lighting Scheme	221
7.10.3. Lighting Schemes : Calculations	229
7.10.4. Planning Lighting Installations	232
7.11. Methods of Lighting Calculations	234
7.12. Consideration Points for Planning a Lighting Installation	236
7.13. Design Considerations of Good Lighting Scheme	236
7.14. Sources of Light	237
7.15. Electrical Sources of Light	238
7.16. Design of Interior Lighting Schemes	246
7.17. Halogen Lamps	248
7.18. Tungsten Halogen Lamps	250
7.19. Compact Fluorescent Lamp (CFL)	252
7.20. Characteristics of Compact Fluorescent Lamps	253
7.21. Applications	254
7.22. Types of CFL Available to Suit for Different Requirements	254
7.23. CFL (Compact Fluorescent Lamps)	254
7.24. Compact Fluorescent Lamps	256
7.25. Illumination Required for Various Applications	257
7.26. Barriers of Efficient Lamps	259
7.27. Long Way to Electric Lamps	259
7.28. Lamp Development	261
7.29. Characteristic of Lamps	261
7.30. Contemporary Lamps and their Problems	262
7.31. Neon Lamp	263
7.32. Neon Tubes	264
7.33. Street Lighting	265
7.34. Lighting Schemes	265
7.35. Illumination Level for Street Lighting and Mountings Height of Lamps	265
7.36. Spacing of Street Lighting	266
7.37. Types of Lamps used for Street Lighting	266
7.38. Control of Street Lights	266
7.39. Flood Lighting	266
7.40. Location and Mounting of Projectors	267

(x)

7.41. Flood Lighting Calculations	267
7.42. Description of Terms used in the above Relation	268
7.43. Neon Tubes	268
7.44. Glow Lamps	269
7.45. Night Lamps	269
7.46. Light Sources and Light Fittings	269
7.47. Recommended Values of Illumination	270
7.48. Power Requirement of Important Household Appliance	272

---

**8. Substations** **275-314**

---

8.1. Introduction	275
8.2. Development of Substations	275
8.3. Classification of Substations	276
8.4. Types of Substations	279
8.5. Components of 11/0.4 kV Pole Mounted Substation	281
8.6. Estimate of Material and Cost for 100 kVA, 11/0.4 kV Pole Mounted Substation	283
8.7. Transformer	286
8.8. Advantages and Disadvantages of Outdoor Substations as Compared to Indoor Substations	288
8.9. Design of Substation	288
8.10. Main Connection Schemes	289
8.11. Graphical Symbols for Various Types of Apparatus and Circuit Elements on Substation Main Connection Diagram	289
8.12. Main Connection Diagrams Showing the Arrangements of Various Typical Connections and of the Simplest Substation Schemes	291
8.12.1. Insulators	293
8.13. Substation Auxiliaries Supply	297
8.14. Complete Bus Bar Arrangements on High and Low Voltage Side for a Substation	298
8.15. Ring Main System	300
8.16. Circuit Breakers	301
8.17. Essential Components of a Circuit Breaker	304
8.18. Connection Diagrams	306

---

**9. Transmission & Distribution of Electrical Energy & House Service Connections** **315-367**

---

9.1. Introduction to Transmission System	315
9.2. Various Definitions	316

9.3. D.C. & A.C. Systems of Supply	317
9.4. Distribution of Electrical Energy	318
9.5. Overhead Lines	319
9.6. Types of Conductors	322
9.8. Line Supports	325
9.9. Arrangements of Conductors	330
9.10. Distribution	333
9.11. Distribution Lines	336
9.12. Insulators : Materials and Types	336
9.12.1. Stay Set and Guy Wire	344
9.12.2. Pole Fittings	346
9.12.3. Lighting Arrestors	346
9.12.4. Miscellaneous Fittings	347
9.13. Earthing of Overhead Lines	348
9.14. Service Lines	348
9.15. Comparison Between Overhead System and Underground System	349
9.16. Tariffs	350
9.17. Protection for Domestic Installations	350
9.18. Erection, Components and Estimation of an L.T. and H.T. Over Head Line	351
9.19. Estimate of Material for 3KM, LLKV, Overhead Line	355
9.20. Components of an Overhead 400/230 Volts (L.T.) Line	359
9.21. Estimate of Material and Cost for 1000 Meter 400/230 Volt Overhead Line With Street Lighting	361
<b>10. Underground Cables and Installation</b>	<b>368-404</b>
10.1. Introduction	368
10.2. Cable Insulation	368
10.3. Material Used for Different Class of Insulating Materials	371
10.4. Characteristics of Some Insulating Materials in Cables	372
10.5. Different Types of Cables and their Applications	373
10.6. Classification of Cables	374
10.7. Requirements of the Cables	374
10.8. Underground Cables	375
10.9. General Information About Cables	375
10.10. Types of Cables (Low Tension & High Tension)	376
10.11. High-Tension (H.T.) Cables	377
10.12. Insulating Materials for Cables	378

10.13. Comparison Between Overhead and Underground System	379
10.14. Cable Laying	380
10.15. Grading of Cables	382
10.16. Measurement of Insulation Resistance of Cables	385
10.17. Cable Jointing	385
10.18. Filling Compound in the Sleeve	388
10.19. Jointing a Multicore Cable	388
10.20. Faults	390
10.21. Location of Faults	391
10.22. Blavier's Test	392
10.23. Murray Loop Test	394
10.24. Varley Loop Test	397
10.25. Location of Line and Cable Fault and Earthing (Grounding)	399
10.26. Grounding (Earthing)	400

---

**11. General Specifications**
**405-417**


---

11.1. Introduction	405
11.2. Generating Sets (Diesel Engine Driven)	405
11.3. Switches and O.C.B.	406
11.4. L.T. O.C.B. Indoor Type with Time Limit Switch	406
11.5. H.T. 11KV Switch with H.R.C. Fuses	406
11.6. Ring Main T. Off Switch	407
11.7. H.T. Feeder Panel	407
11.8. L.T. Feeder Panel	408
11.9. Transformers	409
11.10. Specifications for Items of Overhead Lines	409
11.11. Poles or Struts	409
11.12. Pin Insulators	410
11.13. Shackle Insulators	410
11.14. Disc Type Insulators	410
11.15. Stay Assembly	411
11.16. Stay Wire	411
11.17. Aluminium Conductor Steel Rod	411
11.18. G.I. Wire	412
11.19. Specifications for Items of Internal Wiring	412
11.20. Underground Cables (Low Tension)	416
11.21. Underground Cable (High Tension)	416
11.22. Boxes, Cable Jointing (Low & Medium & High Tension)	416

---

**12. Measurement of Earth Resistance and Testing  
of Installations** **418-426**

---

12.1. Measurement of Earth Resistance	418
12.2. Two Point Method	420
12.3. Three-point Method	420
12.4. Fall of potential Method	421
12.5. Direct measurement of Earth Resistance	422
12.6. Testing of Installations	423

---

**13. Estimating and Conductor Size Calculations for  
Internal Wiring H.T. & L.T. Overhead Lines  
and Under Ground Cables** **427-466**

---

13.1. Estimating	427
13.2. Price Catalogue	427
13.3. Schedule of Labour Rates	428
13.4. Schedule of Rates and Estimating Data	428
13.5. Determination of Conductor Size	428
13.6. Current Carrying Capacity	428
13.7. Voltage Drop	428
13.8. Minimum Permissible Size	428
13.9. Conductor Size Calculation for Internal Domestic Wiring	429
13.10. Conductor Size Calculation for Underground Cable	433
13.11. Conductor Size Calculations for Overhead Lines with A.C.S.R.	463

---

**14. Installation and Estimates for Service Lines** **467-484**

---

14.1. Introduction	467
14.2. Service Line	467
14.3. Overhead Service Mains	469
14.4. Underground Service Main	471

---

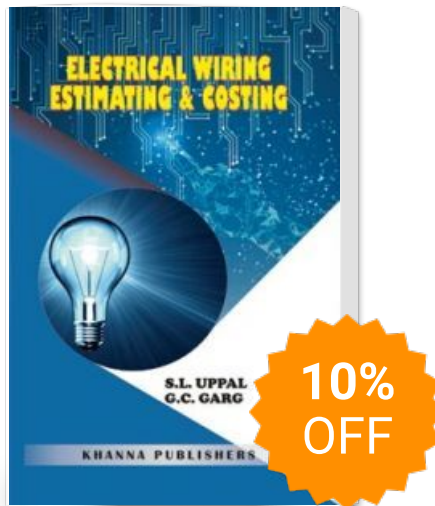
**15. Internal Wiring Systems and Lamp Circuits** **485-518**

---

15.1. Introduction	485
15.2. Wiring System	486
15.3. Looping in System	486
15.4. Wiring of a Building	488
15.5. Tree System	489
15.6. Ring System	489

15.7. Lamp Circuits	490
15.8. Simple Circuits	491
15.9. Series Parallel Circuits	495
15.10. Master Switch Circuit	498
15.11. Pilot Circuits	501
15.12. Circuits Using Special Types of Switches	502
15.14. Lamp Control Circuit from More than Two Points or Alternative Method of Corridor Lighting	510
15.15 Use of Parallel or Series Switch	512
15.16. Use of Reversing Switch	513
15.17. Fluorescent Tube Lighting	513
15.18. Circuit with a Thermal Starter	514
15.19. Tube Circuit with Glow Starting Switch	514
15.20. The Instant Start Circuit of Fluorescent Tube	516
15.21. Flasher for Moving Lights	516
15.22. Suggested Position of Electrical Fittings	518
<hr/>	
<b>16. Estimating and Costing of Material in Electrical Installation for Residential Buildings, Workshops and Halls</b>	<b>519-690</b>
<hr/>	
16.1. Introduction	519
16.2. Procedure while Estimating for Internal Electrification	520
16.3. Points to be Adhered while Preparing the Estimate	520
16.4. Power Wiring Installations	560
16.5. Types of Industrial Wiring	618
<hr/>	
<b>17. Estimates for L.T. Distributors and Street Light Feeders</b>	<b>691-726</b>
<hr/>	
<b>18. Estimates for 11 K.V. Feeders and Substations</b>	<b>727-744</b>
<hr/>	
<b>19. Extracts from Indian Electricity Amendment Rules-1972</b>	<b>745-786</b>
<hr/>	
<b>20. Indian Standard (I.S.) Fundamental Definitions</b>	<b>787-796</b>
<hr/>	
20.1. A.C. Quantities	787
20.2. Machine Characteristics	788
20.3. Electro-Kinetics	789
20.4. Constitution of Matter	789
20.5. Electrostatics	790

# Electrical Wiring Estimating And Costing



Publisher : KHANNA PUBLISHERS

ISBN : 9788174092403

Author : S. L. Uppal , G. C. Garg

Type the URL : <https://www.kopykitab.com/product/40275>



Get this eBook