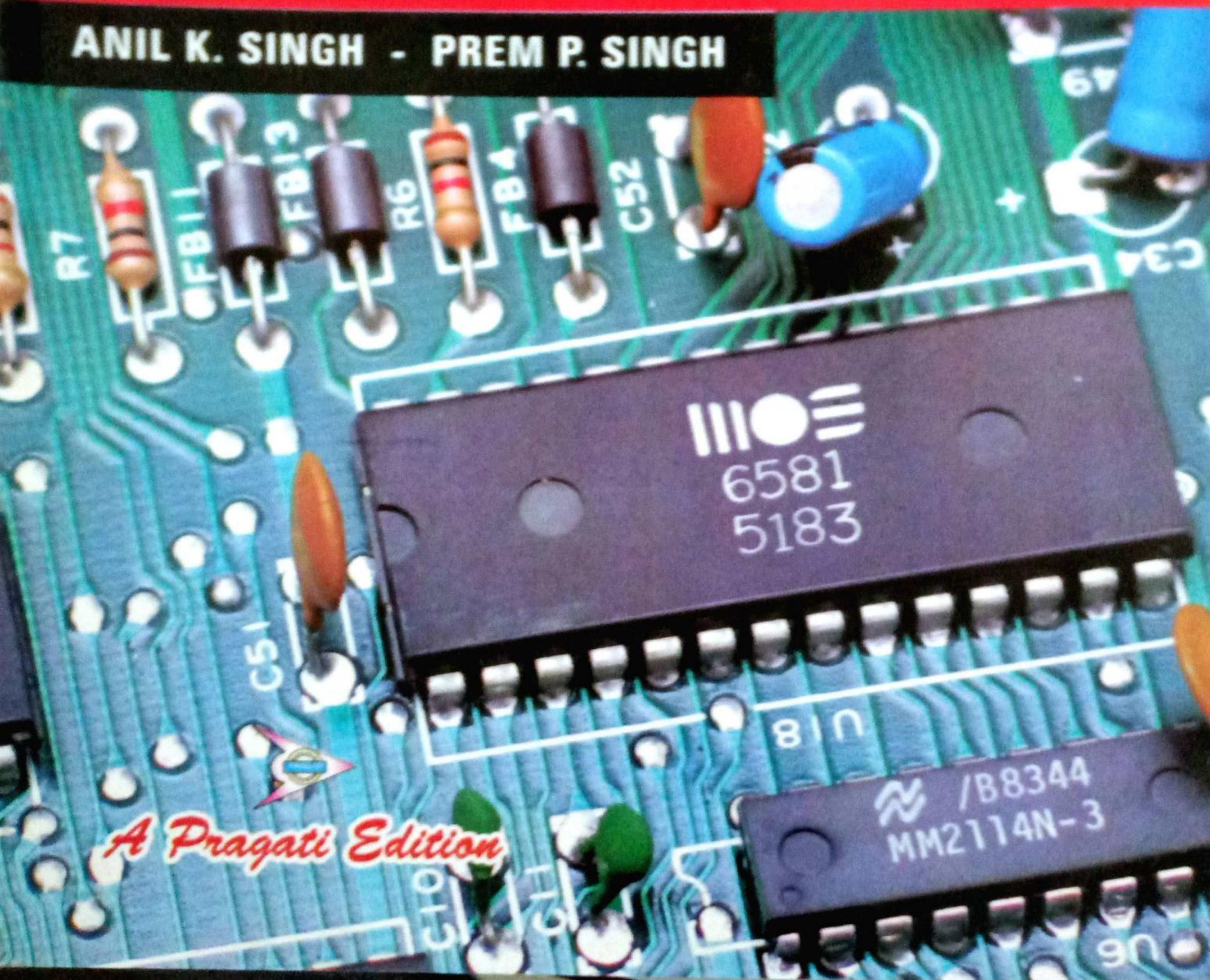


CBCS PATTERN



FOUNDATION OF ELECTRONICS: AN ILLUSTRATION

ANIL K. SINGH - PREM P. SINGH



A Pragati Edition

CONTENTS

1-20

1. ELECTRONS

- 1.1. Schrödinger Equation 3
- 1.2. Tunneling 5
- 1.3. Degeneracy 6
- 1.4. Electrons in the molecules 6
- 1.5. Solids 7
- 1.6. Energy bands in solid 8
- 1.7. Distribution function for electrons 9
- 1.8. Concentration of holes in the valence band of solids 11
- 1.9. Fermi-Energy Level 13
- Questions 19

21-39

2. BASIC CIRCUIT ANALYSIS

- 2.1. The Current Source 21
- 2.2. The Voltage Source 22
- 2.3. Kirchhoff's Law 23
- 2.4. T and π Network 25
- 2.5. Network Theorem 26
- 2.6. Impedance Matching 29
- Questions 38

40-54

3. FOURIER SERIES

- 3.1. Properties of Fourier Series 40
- 3.2. Dirichlet's Conditions for a Fourier Series 40
- 3.3. Useful Integrals 41
- 3.4. Fourier Theorem 41
- 3.5. Comparison of Periodic and Non-Periodic Functions 42
- 3.6. Even Function 43
- 3.7. Odd Function 43

- 3.8. Determination of the Constants 43
- 3.9. Complex Representation of a Fourier Series 45
- 3.10. Fourier Transforms 46
- Questions 53

4. SEMI-CONDUCTOR

- 4.1. Energy Bands in Solids 56
- 4.2. Intrinsic Semiconductor 57
- 4.3. Extrinsic Semi-Conductor 57
- 4.4. Effect of Temperature 62
- Questions 62

5. P-N JUNCTION

- 5.1. Energy Band Configuration 65
- 5.2. P-N Junction Under Bias 67
- 5.3. Forward bias characteristics 68
- 5.4. Diode Model 71
- 5.5. Open Position 71
- 5.6. Temperature Dependence of Diode Characteristics 73
- 5.7. Diode Resistance 76
- 5.8. Diode Capacitance 77
- 5.9. Diffusion Capacitance 79
- 5.10. Reverse Bias 80
- 5.11. Breakdown 81
- 5.12. Block diagram of Power Supply 86
- 5.13. Flow Chart of Rectifier 87
- 5.14. Filter 96
- 5.15. Zener Regulation 100
- 5.16. Switch Mode Power Supply 101
- Questions 108

6. TRANSISTOR

- 6.1. Bipolar Transistor 111
- 6.2. Mode of Operation 116
- 6.3. Base Transport Factor 117

- 6.4. Working of Transistor 118
- 6.5. Early Effect and Punch through 119
- 6.6. Operating Configuration of a BJT 120
- 6.7. Standard Notation for Current and Voltage in Transistor 122
- 6.8. Transistor Amplification Action 122
- 6.9. Common-Emitter Configuration 126
- 6.10. Common-Collector Configuration 128
- Questions 134

7. AMPLIFIER CIRCUIT

- 7.1. D.C. Load Line 137
- 7.2. Application of d.c. load line 140
- 7.3. Transistor Biasing 141
- 7.4. Emitter Follower Configuration 152
- 7.5. BJT-Characteristics 154
- 7.6. PNP Transistor 155
- 7.7. Switching Action in Transistor 157
- 7.8. Hybrid Circuit 159
- 7.9. Ebers Moll Model 168
- 7.10. Generalized Transistor Equation 169
- 7.11. Analytical Treatment of Characteristics of a BJT 174
- 7.12. Early Effect 177
- 7.13. CE-Output Characteristics 178
- 7.14. Switching Characteristics 180
- 7.15. Inverse Mode 181
- 7.16. Cut-off Region 182
- 7.17. Saturation Region 183
- 7.18. Ebers-Moll Model : Saturation Region 184
- 7.19. Range of σ -Value 185
- 7.20. Inverse Mode : Analysis 187
- 7.21. Amplifier 189
- 7.22. Components in the Transistor Amplifier 191
- 7.23. Phase Change in between (I/P) and (O/P) 192
- 7.24. Mathematical Analysis of CE amplifier using hybrid parameters 196
- 7.25. Voltage Gain 126

137-211

- 7.26. Output Resistance 199
- 7.27. Practical Circuit : Single Stage Amplifier 201
- 7.28. R-C Coupled amplifier 202
- 7.29. Frequency Response Curve 203
- 7.30. Function of Stray Capacitance 207
- Questions 209

8. FIELD EFFECT TRANSISTOR

- 8.1. FET-Operation 213
- 8.2. The JFET transfer characteristics 215
- 8.3. Amplifier using FET 216
- 8.4. FET AC Equivalent Circuit 217
- 8.5. Relationship among μ , r_d and g_m 217
- 8.6. MOSFET 219
- 8.7. MOS Switch 222
- 8.8. CMOS 226
- Questions 234

9. MODULATION AND DEMODULATION

- 9.1. Amplitude Modulation 238
- 9.2. Wave Forms 239
- 9.3. Energy in Modulated Signal 241
- 9.4. Collector Modulation Circuit 242
- 9.5. Modulated output voltage 242
- 9.6. Frequency Modulation 243
- 9.7. Phase Modulation 246
- 9.8. Comparison between F.M. and P.M. 248
- 9.9. Production of F.M. Wave by P.M. Process 248
- 9.10. Demodulation
- Questions 252

10. OSCILLATOR

- 10.1. Feedback Oscillator 254
- 10.2. Voltage gain in Feedback Amplifier 256
- 10.3. Increase in Input Impedance 257

254-271

- 10.4. Decrease in output impedance 258
- 10.5. Mechanism of oscillation 258
- 10.6. L.C. Tuned Oscillator 260
- 10.7. Hartley Oscillator 261
- 10.8. Colpitts Oscillator 261
- 10.9. Wien-Bridge Oscillator 262
- 10.10. Phase-Shift Oscillator 263
- 10.11. Crystal Oscillator 265
- Questions 270

11. LIGHT EMITTING DIODE (LED)

272-288

- 11.1. Energy Band Gap 272
- 11.2. Structure of LED 273
- 11.3. Device Structure 275
- 11.4. Multicolour light-emitting Diodes 276
- 11.5. Blue LEDs 279
- 11.6. Challenging Convention 280
- 11.7. Fiat-Lux-LET there be light 280
- 11.8. Creating light in a semiconductor 281
- 11.9. A Bright Revolution 282
- 11.10. Advantages of LEDs 283
- 11.11. Disadvantages of LEDs 283
- 11.12. Application of LEDs 283
- 11.13. Solar Cell 284
- Questions 286

12. DIGITAL CIRCUITS

289-326

- 12.1. Characteristics of Digital Circuits 289
- 12.2. RTL Logic NOT Gate 290
- 12.3. RTL Logic NOR Gate 291
- 12.4. RTL Logic Ex-OR Gate 298
- 12.5. DTL Logic NAND Gate 299
- 12.6. Transistor, Transistor Logic 310
- Questions 325

13. FABRICATION

- 13.1. Moore's law 327
- 13.2. Microelectronics and Semiconductor Industry 328
- 13.3. Microfabrication and Microstructure 328
- 13.4. Substrate for Microfabrication 329
- 13.5. Micromachining Methods 329
- 13.6. Microfabrication Process 331
- 13.7. Process Flow : Fabrication of Transistor 341
- Questions 345

14. CHAPTERWISE PRACTICE PROBLEMS (CPP)

- 14.1. Electron 347
- 14.2. Basic Circuit Analysis 349
- 14.3. Fourier Series 356
- 14.4. Semi-conductor 359
- 14.5. P-N Junction 363
- 14.6. Transistor 373
- 14.7. FET and Digital Circuit 379

15. OPERATIONAL AMPLIFIER

- 15.1. Differential Amplifier 393
- 15.2. Characteristics of OP-AMP 397
- 15.3. Applications 397
- 15.4. 741C and Symbol of OP-AMP 397
- 15.5. Virtual Ground 402
- 15.6. Practical OP-AMP Circuit 403
- 15.7. Offset Voltage 406
- 15.8. Skew Rate 407
- 15.9. Frequency Response 408
- 15.10 Common-Mode Rejection Ratio 409
- Questions 413

16. NUMBER SYSTEM AND LOGIC GATE

- 16.1. Digital Number System 415
- 16.2. Number Conversions 420

- 16.3. Data Representation 426
- 16.4. Binary Arithmetics 432
- 16.5. Boolean Laws 436
- 16.6. Logic Gate 437
- 16.7. Universal Gates or Building Blocks 441
- 16.8. Idempotent Law 446
- Questions 447

7. BINARY CODES AND COMBINATIONAL CIRCUITS

449-500

- 17.1. Classification of Codes 449
- 17.2. Weighted Binary Code 449
- 17.3. Non-Weighted Codes 450
- 17.4. Binary Coded Decimal 450
- 17.5. 1's Complement 453
- 17.6. 10's Complement 455
- 17.7. Excess-3 Code 458
- 17.8. Gray Code 460
- 17.9. Alphanumeric Codes 461
- 17.10. ASCII 462
- 17.11. IBM 464
- 17.12. EBCDIC 465
- 17.13. SOP and POS Representation for Logic Expressions 466
- 17.14. Minterm and Maxterm 469
- 17.15. Simplification Techniques 475
- 17.16. Karnaugh Map Simplification 478
- 17.17. Combinational Logic Circuit 494
- 17.18. Half Subtractor 496
- 17.19. Full Subtractor 497
- Questions 498

8. SEQUENTIAL CIRCUITS

501-520

- 18.1. Basic Latch 502
- 18.2. Flip-Flop 504
- 18.3. Registers 509
- 18.4. Counter 512

- 18.5. Propagation Delay 512
- 18.6. Modulus of the Counter 515
- 18.7. Glitch 516
- 18.8. Synchronous Counter 516
- Questions 519

APPENDICES

- A. Schottky Diode and Schottky Transistor 521**
- B. Hall Effect 524**
- C. Symbols, Abbreviations and Diagrammatic symbols 527**
- D. Unit and Conversion Factor 533**
- E. Modern Periodic Table 536**
- F. Conduction Properties of Common Metals 537**