

# Contents

<i>Preface</i> .....	(vii)
----------------------	-------

## CHAPTER 1

### **Introduction to Electrical Energy and DC Circuits**

1.1 Introduction.....	1
1.1.1 The Role of Electrical Energy in Modern Life.....	1
1.1.2 Electrical Energy vs Computer Science Engineering.....	2
1.2 Over View of Electrical Energy Generation, Transmission and Utilization.....	2
1.3 Electric Circuit.....	4
1.3.1 Circuit Elements.....	5
1.3.2 Electrical Energy Sources .....	8
1.4 Source Transformation .....	13
1.5 Kirchhoff's Laws .....	16
1.6 Problems on Series-Parallel Connections .....	31
1.7 Star/Delta Transformations.....	36
1.8 Superposition Theorem.....	48
1.9 Thevenin's Theorem .....	51
1.10 Time Response of RL and RC Circuits .....	62
1.10.1 Introduction to Transients .....	62
1.10.2 DC Response of an R-L Circuit .....	62
1.10.3 DC Response of an R-C Circuit .....	66
<i>Review Questions</i> .....	70
<i>Short Answer (Two marks) Questions</i> .....	70
<i>Essay (Six marks) Questions</i> .....	71

## CHAPTER 2

### Steady State A.C Circuits

2.1.1 Representation of Sinusoidal Waveforms .....	73
2.1.2 Average and RMS Values .....	80
2.2 Analysis of Single Phase AC Circuits .....	89
2.2.1 A.C through Pure Resistance.....	89
2.2.2 AC through Pure Inductance .....	90
2.2.3 A.C through Pure Capacitance .....	93
2.2.4 AC through Series R-L Circuit.....	96
2.2.5 AC through Series R-C Circuit .....	98
2.2.6 AC through Series R-L-C Circuit.....	100
2.3 Three Phase Balanced Circuits .....	112
2.3.1 Star Connection .....	114
2.3.2 Delta Connection.....	117
<i>Review Questions</i> .....	129
<i>Short Answer (Two marks) Questions</i> .....	129
<i>Essay (Six marks) Questions</i> .....	129

## CHAPTER 3

### Transformers and DC Machines

3.1 Transformers.....	130
3.1.1 Working Principle .....	130
3.1.2 Brief Construction of Transformers .....	132
3.1.3 Emf Equation.....	132
3.1.4 Transformer on No-load.....	137
3.1.5 Ideal Transformer .....	139
3.1.6 Real Transformer or Practical Transformer .....	139
3.1.7 Transformer Equivalent Circuit.....	141
3.1.8 Voltage Regulation.....	144
3.1.9 Losses and Efficiency.....	149
3.2 DC Machines .....	158
3.2.0 Introduction .....	158
3.2.1 DC Generators.....	158
3.2.2 DC Generator Principle.....	159

3.2.3	Simple Loop Generator .....	161
3.2.4	Construction .....	163
3.2.5	Emf Generated or EMF equation .....	166
3.2.6	Classification of DC Generators.....	169
3.3	DC Motors .....	171
3.3.1	DC Motor Principle.....	172
3.3.2	Back Emf.....	173
3.3.3	Classification of DC Motors.....	175
3.3.4	Load Characteristics of a Separately Excited DC Motor .....	178
3.3.5	Speed Control of Separately Excited DC Motor .....	181
	<i>Review Questions</i> .....	184
	<i>Short Answer (Two marks) Questions</i> .....	184
	<i>Essay (Six marks) Questions</i> .....	185

## CHAPTER 4

### Alternating Current Machines

4.1	Three Phase Induction Motors .....	186
4.1.1	Introduction .....	186
4.1.2	Construction .....	186
4.1.3	Principle .....	188
4.1.4	Torque – Slip Characteristics .....	195
4.2	Synchronous Generators .....	197
4.2.1	Principle .....	197
4.3	Stepper Motor .....	199
4.4	Electrical Installations and Batteries.....	200
4.4.1	Basic lay-out of wiring in Domestic Installations .....	200
4.4.2	Types of Wiring Systems .....	201
4.4.3	Fuse .....	204
4.4.4	Switch Fuse Unit (SFU) .....	206
4.4.5	MCB.....	206
4.4.6	MCCB .....	207
4.4.7	Earthing.....	208

4.5	Classification of Batteries.....	211
4.5.1	Lead-Acid battery.....	211
4.6	Elementary Calculations of Energy Consumption.....	214
4.7	Electrical Safety Precautions .....	216
	<i>Review Questions</i> .....	217
	<i>Short Answer (Two marks) Questions</i> .....	217
	<i>Essay (Six marks) Questions</i> .....	217

## CHAPTER 5

### Semi-Conductor Devices

5.1	Introduction.....	219
5.1.1	P-N Junction Diode .....	220
5.1.2	V-I Characteristics of PN Junction Diode .....	223
5.1.3	Diode Applications.....	225
5.2	Bipolar Junction Transistor.....	230
5.2.1	Construction .....	230
5.2.2	Biasing of Transistors.....	231
5.2.3	Types of Transistor Configurations.....	234
5.2.4	Working of a Transistor .....	236
5.2.5	Transistor as an Amplifier.....	236
5.3	Power Converters.....	239
5.3.1	AC to DC Converters .....	240
5.3.2	DC to DC Converters .....	241
5.3.3	DC to AC Converters .....	242
5.4	Uninterruptible Power Supply (UPS) .....	243
	<i>Review Questions</i> .....	244
	<i>Short Answer (Two marks) Questions</i> .....	244
	<i>Essay (Six marks) Questions</i> .....	244

## CHAPTER 6

### Op-Amps, Transducers and Data Acquisition

6.1	Operational Amplifier.....	245
6.1.2	Ideal Operational Amplifier .....	246
6.1.3	Commercial IC 741 Op-Amp .....	246

6.2 Remote Control and Monitoring.....	248
6.2.1 Transducer used to Sense Strain.....	248
6.2.2 Transducer used to sense the Temperature.....	249
6.2.3 Transducer to Sense the Acceleration .....	250
6.2.4 Transducer to Sense the Light .....	251
6.3 A/D and D/A Converters .....	252
6.3.1 Digital to Analog Converter (D/A Converter).....	253
6.3.2 Analog to Digital Converter .....	254
6.4 Data Acquisition and Control .....	255
<i>Review Questions</i> .....	256
<i>Short Answer (Two marks) Questions</i> .....	256
<i>Essay (Six marks) Questions</i> .....	257
<b><i>Index</i></b> .....	<b>259</b>