

SANDIP UNIVERSITY, SIJOUL, MADHUBANI
II SEMESTER DIPLOMA IN ELECTRICAL ENGINEERING
Skill Based Diploma in Engineering Course
TRANSMISSION & DISTRIBUTION OF ELECTRIC POWER

Subject Code EE201T	Theory						Credits
	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	04	—	—	TA	:	10	
—	—	—	CT	:	20		

CONTENTS: THEORY

Chapter	Name of the Topic	Hours	Marks
Unit-01	Basics Of Transmission. Introduction to transmission. Necessity of transmission of electricity. Classification & comparison of different transmission systems.	03	03
Unit-02	Transmission Line Components. Introduction to line components. types of conductors-Copper, Aluminum & state their tradenames. Solid, Stranded & bundled conductors. Line supports – requirements, types, and field of applications. Line insulators – requirements, types, and field of applications. Failure of insulator & reasons of Failure. Distribution of potential over a string of suspension insulators. Concept of string efficiency, Methods of improving string efficiency. Corona – corona formation, advantages & disadvantages, factors affecting corona, important terms related to corona. Spacing between Conductors. Calculation of Span length & sag Calculation (Numerical based on 2.7 , 2.8 & 2.11)	10	12
Unit-03	Transmission Line Parameters R,L & C of 1-ph & 3-ph transmission line & their effects on line. Skin effect, proximity effect & Ferranti effect. Concept of transposition of conductors & necessity.	03	04
Unit-04	Performance Of Transmission Line. Classification of transmission lines. Losses, Efficiency & Regulation of line. Performance of single phase short transmission line(Numerical based on it) Effect of load power factor on performance. Medium transmission lines-End condenser, Nominal T & Nominal π Network with vector diagram. General circuit & Generalised Circuit Constants (A, B, C, D)	10	13
Unit-05	Extra High Voltage Transmission. Introduction & Requirement. EHVAC Transmission, Reasons for adoption & limitations. HVDC Transmission – Advantages, Limitations.	03	06
Unit-06	Components Of Distribution System. Introduction. Classification of distribution system. A.C distribution. Connection schemes of distribution system. Requirements of Distribution systems. Design consideration. A.C. distribution calculations. Methods of solving A.C.-1 phase & 3 \emptyset -phase connected (balanced) distribution system. (Numerical based on 1-ph & 3-ph balanced distribution system)	10	16

Unit-07	Underground Cables. Introduction & requirements. Classification of cables. Cable conductors. Cable construction. Cable insulation, Metallic sheathing & mechanical protection. a. Comparison with overhead lines Cable laying	03	04
Unit-08	Substations. Introduction. Classification of indoor & outdoor sub-stations. Advantages & Disadvantages. Selection & location of site. Main connection schemes. Equipment's circuit element of substations. In coming & outgoing lines, Transformers, CT&PT, Relays, CB's, fuses, Isolators, batteries, lightning arresters. Insulators. Bus bar's material, types in detail. Connection diagram and layout of sub-stations.	06	12
TOTAL		48	70

Text /Reference Books:		
Titles of the Book	Name of Authors	Name of the Publisher
A Course in electrical power	Soni-Gupta- Bhatnagar	Dhanpat Rai
Principals of power system	V. K. Mehta	S. Chand & Company
A Course in electrical power	S. L. Uppal.	S. K. Khanna
Transmission & distribution of electrical energy	J. B. Gupta	S. K. Khanna
Generation & transmission of electrical energy	A. T. Star	Pitman
Transmission & Distribution of Electric Power	Savinder Singh	Foundation Publishing

Unit-05	Special purpose transformer current transformer potential transformer isolation transformer welding transformer	04	08
	Total	48	70

Text /Reference Books:		
Titles of the Book	Name of Authors	Name of the Publisher
Electrical Technology	E. Hughes	Logmans, London
Electrical Technology	H. Cotton	C. B. S. Publisher New Delhi
Electrical Technology Vol. II	B. L. Theraja	S. Chand & CO Delhi
Electrical Machine Design	A. K. Sohawney	Dhanpatrai & Sons, New Delhi
Pradeep Sinha	D.C. Machines & Transformers	Foundation Publishing

NETWORK THEORY

Subject Code EE203T	Theory			Credits		
	No. of Periods Per Week			Full Marks	:	100
	L	T	P/S	ESE	:	70
	03	—	—	TA	:	10
	—	—	—	CT	:	20

CONTENTS: THEORY

—	Name of the Topic	Hours	Marks
Unit-01	<u>BASIC CIRCUIT ELEMENTS & WAVEFORMS:</u>	[07]	
	01.01 Circuit Components		
	01.02 Standard Input Signals		
	01.03 Sinusoidal Signals		
Unit-02	<u>MESH AND NODE ANALYSIS:</u>	[09]	
	02.01 Kirchoff's Laws.		
	02.02 Source Transformation.		
	02.03 Mesh & Node analysis.		
Unit-03	<u>FOURIER SIERIES:</u>	[06]	
	03.01 All forms of Fourier Series including trigonometry, Exponential etc.		
	03.02 Fourier Transform.		
Unit-04	<u>LAPLACE TRANSFORM & THEIR APPLICATION:</u>	[07]	
	04.01 Introduction.		
	04.02 Laplace Transformation.		
	04.03 Application of Laplace Transform in the solution of Linear Differential Equation.		
Unit-05	<u>RESONANCE:</u>	[03]	
	05.01 Series Resonance.		
	05.02 Parallel Resonance		
Unit-06	<u>TWO-PORT NETWORK:</u>	[12]	
	06.01 Introduction.		
	06.02 Open Circuit Impedance Parameters.		
	06.03 Short Circuit Admittance.		
Unit-07	<u>PASSIVE NETWORK SYNTHESIS:</u>	[10]	
	07.01 Introduction.		
	07.02 Positive real function.		
	07.03 Two Terminal R-L Network.		
Unit-08	<u>INTRODUCTION OF FIRST ORDER & SECOND ORDER SYSTEMS WITH EXAMPLES:</u>	[06]	
	Total		

Books Recommended:-

1.	Network & system	-	D. Roy Choudhury
2.	Network & system	-	G.K. Mittal
3.	Network & system	-	Vulkenberg
4.	Network & system	-	Dacsur & Kuo
5.	Network Theory	-	R.N. Pathak

ELECTRICAL ESTIMATION & COSTING

Subject Code EE204T	Theory						Credits
	No. of Periods Per Week			Full Marks	:	100	02
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

CONTENTS: THEORY

	Name of the Topic	Hours	Marks
Unit-01	Drawing and IE rules Classification of Electrical Installation. General requirement of Electrical Installation. Reading and Interpretation of Electrical Engineering Drawings. Various diagrams, plans and layout Important definitions related to Installation IE rules related to Electrical Installation & Testing.	03	06
Unit-02	Service Connection Concept of service connection. Types of service connection & their features. Methods of Installation of service connection. Estimates of under ground & overhead service connections.	04	10
Unit-03	Residential Building Electrification General rules guidelines for wiring of Residential Installation and positioning of equipments. Principles of circuit design in lighting and power circuits. Procedures for designing the circuits and deciding the number of circuits. Method of drawing single line diagram. Selection of type of wiring and rating of wires & cables. Load calculations and selection of size of conductor. Selection of rating of main switch, distributions board, protective switchgear ELCB and MCB and wiring accessories. Earthing of Residential Installation. Sequence to be followed for preparing Estimate Preparation of detailed estimates and costing of Residential Installation.	11	24
Unit-04	Electrification of factory unit Installation Concept of Industrial load. Concept of Motor wiring circuit and single line diagram. Important guidelines about power wiring and Motor wiring. Design consideration of Electrical Installation in small Industry/Factory/workshop. Motor current calculations. Selection and rating of wire, cable size & conduct. 5.4.3 Deciding fuse rating, starter, distribution boards main switch etc. 5.4.4. Deciding the cable route, determination of length of wire, cable, conduit, earth wire, and earthing. Sequence to be followed to prepare estimate. Preparations of detailed estimate and costing of small factory unit/ workshop.	11	24
Unit-05	Testing of Installation Testing of wiring Installation for verification of current; earthing, insulation resistance and continuity as per IS	03	06
	Total	32	70

Text /Reference Books:		
Titles of the Book	Name of Authors	Name of the Publisher
Electrical Design; Estimating and costing	K.B. Raina S.K.Bhattacharya	New Age International (p) Limited, New Delhi
Electrical Estimating and costing	Surjit Singh	Dhanpat Rai and company, New Delhi
Electrical Estimating and costing	N. Alagappan S. Ekambaram	Tata Mc Graw Hill Publication, New Delhi
Electrical wiring Estimating and costing	S.L. Uappal	Khanna Publication.
Electrical wiring, Estimating and costing	B.D.Arora	R.B. Publication, New Delhi
Electrical Estimation & Costing	Savinder Singh	Foundation Publishing

APPLIED ELECTRONICS

Subject Code EE205T	Theory						Credits
	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

CONTENTS: THEORY

Chapter	Name of the Topic	Hours	Marks
Unit-01	<p>AMPLIFIERS Power Amplifiers Introduction, Classification – Class A, ClassB, Class AB & Class C, efficiency of each. Single stage class A power amplifier: Circuit operation, input & output waveforms , graphical Analysis and efficiency of</p> <p>1.1.2.i] Transformer couple resistive load single stage power amplifier 1.1.2. ii] Class A push pull amplifier 1.1.2.iii] Class B push pull amplifier 1.1.2.iv] Class AB push pull amplifier 1.1.3 Concept of cross over distortion 1.1.4. Advantages of push pull amplifier , collector power dissipation requirement & specifications of power transistor, need of heat sink.</p> <p>FET Amplifier Biasing of FET: Source Self Bias, Drain to source Bias Application of FET as VVR Common Source Amplifier: Working & Applications Introduction to MOSFET:Types, Construction, Working & Applications Tuned Amplifiers Introduction & necessity of tuned amplifier. Basic tuned circuits, series & parallel resonance in tuned circuits. Operating principle, circuit working, resonance frequency of single tuned, double tuned amplifiers.</p>	16	24
Unit-02	<p>Feedback Amplifiers & oscillators General theory of feedback: Types of feedback – negative & positive feedback. Types of negative feedback – voltage shunt, voltage series, current shunt & current series. Advantages of negative feedback on voltage gain , bandwidth , input impedance output impedance, stability , noise , distortion in amplifiers. Introduction to oscillator , block diagram of sine wave oscillator , requirement of oscillation – Barkhausen criterion , operating principles of RC & LC oscillators RC oscillators – RC phase shift , Wien bridge LC oscillators – Colpitts , Hartley , Crystal oscillators Circuit diagram, equation for frequency of oscillation & frequency stability.</p>	10	14

Unit-03	Wave shaping circuits Necessity of wave shaping circuits. Linear circuits – RC integrator & differentiator – input / output waveforms & frequency response. Non-linear circuits - Clipper , diode series & shunt ,positive & negative biased & unbiased & combinational clipper. Clampers – positive & negative clampers	06	10
Unit-04	Multivibrators Transistor as switch. Definition & graphical representation of different time periods . Multivibrator classification , circuit working & frequency with specific application . MMV , AMV,BMV & Schmitt trigger	06	10
Unit-05	Time base generator – Voltage time base generator, exponential sweep generator UJT Relaxation Oscillator, negative resistance generator. working principle & operation . Current time base generator , bootstrap & miller sweep generator, applications in TV & CRO	06	08
Unit-06	Trouble shooting & Testing Need for trouble shooting , Important steps for testing Visible testing – Observing circuits for visible faults like broken component, open contacts etc. Active testing – Voltage analysis, Resistance analysis, signal analysis. Trouble shootings of multivibrators, phase shift oscillators, transistorised sweep generator, clipping & clamping circuits.	04	04
	Total	48	70

Text /Reference Books:		
Titles of the Book	Name of Authors	Name of the Publisher
Electronic Principles	Paul Malvino	Tata McGraw-Hill
Applied Electronics	R.S.Sedha	S.Chand & Co.
Electronics Devices & Circuits	Allen ottershed	Prantice Hall India LTD.
Pulse Digital & Switching Waveforms	J.Millman and H.Taub	Tata McGraw-Hill
Pulse & Digital Electronics	G.K.Mittal and R.Vanvasai	Khanna Publication
Applied Electronics	R.S. Sharma	Foundation Publishing

D.C MACHINES & TRANSFORMERS LAB

Subject Code EE206P	Practical						Credits
	No. of Periods Per Week			Full Marks	:	50	01
	L	T	P/S	ESE	:	50	
	—	—	02	Internal	:	15	
—	—	—	External	:	35		

CONTENTS: PRACTICAL

Skills to be developed:

Intellectual Skills:

1. Analytical Skills.
2. Identification

Motor Skills:

1. Measurement Skills.
2. Connection Skills.

List of Practical's:-

- 1) a) To identify the constructional parts of D. C. machine.
b) To plot the O.C.C. of a given d. c. machine and to find critical resistance.
- 2) To find the performance of d. c. series & shunt motor by conducting load test
- 3) a) To control the speed of d. c. shunt motor above and below normal speed.
b) To reverse the direction of rotation of d. c. motor.
- 4) a) To identify the constructional details of 1-phase and 3-phase transformer.
b) Visit to maintenance and repair workshop of a transformer and prepare a report.
- 5) To measure the performance of single phase transformer by direct loading and to find transformation ratio.
- 6) To measure the performance of single phase transformer by conducting O.C. and S.C. test.
- 7) To identify terminal polarity of corresponding phases of 3-phase transformer & to calculate transformation ratio.
- 8) To compare 1-phase auto transformer with two winding transformer by collecting literature from local dealer/manufacturer & compare the data on following points.
Weight of iron, weight of copper, turns ratio, efficiency & percentage regulation.
- 9) To observe the phase difference between primary & secondary voltage of 3-phase transformer for various vector groups.

ELECTRONICS CONSTRUCTION AND REPAIR LAB

Subject Code EE207P	Practical						Credits
	No. of Periods Per Week			Full Marks	:	50	01
	L	T	P/S	ESE	:	50	
	—	—	02	Internal	:	15	
	—	—	—	External	:	35	

CONTENTS: PRACTICAL

	Name of the Topic	Hrs/Week	Marks
Unit-01	Construction of a Battery Eliminator Box, Stabilizer Box, Radio and TV Cabinets.	[]	
Unit-02	Soldering Practice: Connecting circuit components.	[]	
Unit-03	Assembling Battery-Stabilizer, Radio Receiver, Intercoil Circuit.	[]	
Unit-04	Assembling Inverter.	[]	
Unit-05	<ul style="list-style-type: none"> - Location of faults and repair of:- - Battery Eliminator - Voltage stabilizer - Inverter - Radio Receiver 	[]	
Unit-06	Location of faults in different types of Electronics Circuits.	[]	
Unit-07	Tracing fault in a C.H.O and its repair.	[]	
Unit-08	Handling of different types of multimeter: VTVM, Frequency meters, Calculators.	[]	
Unit-09	Fault Location and repair of instruments – Multimeter VTVM, Frequency meters, Calculators.	[]	
Unit-10	Repair of faulty study panels of your laboratory.	[]	
Total			

NOTE:- Three assignments for practical under SL 1 and 2. Two assignments for practical listed under SL 3 and 4, and at least one assignment for each of the practical under SL No. 5 to 10. Altogether eleven assignments to be done by the students in the workshop or laboratory.

APPLIED ELECTRONICS LAB

Subject Code EE208P	Practical						Credits
	No. of Periods Per Week			Full Marks	:	50	01
	L	T	P/S	ESE	:	50	
	—	—	02	Internal	:	15	
—	—	—	External	:	35		

CONTENTS: PRACTICAL

Intellectual Skills:

- 1 To locate faults in circuits.
2. Interpret the waveforms.

Motor Skill:

1. Ability to Sketch circuit/block diagram.
2. Ability to interpret the circuit.

List of Practical's:

1. To Plot Frequency response of FET amplifier.
2. To Plot Frequency response & bandwidth of negative feedback amplifier.
3. To Study the Colpitt's oscillator.
4. To Study RC Phase shift oscillator.
5. To Study RC integrator and differentiator & draw i/p & o/p waveforms.
6. To Study Clipping and clamping circuits.
7. To Study function of Astable Multivibrator.
8. To Study Monostable Multivibrator.
9. To Study Bistable Multivibrator.
10. To Study UJT relaxation oscillator.

ELECTRICAL ESTIMATION & COSTING -TW

Subject Code EE209P	Term Work						Credits
	No. of Periods Per Week			Full Marks	:	25	01
	L	T	P/S	Internal	:	07	
	—	—	02	External	:	18	

CONTENTS: TERM WORK

2. IS/International Codes : IS- 5909, 7733, 2174, 732,4648

List of Assignments / Term Work :-

S.No	Term Work Problems on estimation and	Assignments : Note: Use half imperial drawing sheets
1	<p>1. Electrical Installation scheme for single flat, independent bungalow and small house. Draw wiring diagram and prepare detailed estimate and its costing</p> <p>2. Electrical Installation scheme for commercial buildings. Draw wiring diagram and prepare detailed estimate and its costing.</p> <p>3. Electrical Installation scheme for small factory unit. Draw single line layout and prepare detailed estimate and its costing</p> <p>1) Small factory unit 2) Workshop 3) Agriculture pump and floor mills etc.</p>	<p>1. Design electrical Installation scheme for a flat scheme/ Independent bungalow/House. Draw detail wiring diagrams also prepare material schedule and detailed estimate and costing. Prepare report and Drawing sheets. (Minimum 2 Drawing sheets).</p> <p>2. Design electrical Installation scheme for any one commercial complex having minimum 20KW load requirements. Draw detailed wiring diagram; prepare material schedule and detailed estimate and costing, prepare report and Drawing sheet (one Drawing sheet).</p> <p>3. Design Electrical Installation scheme for agriculture pump/floor mill. Draw wiring diagram, prepare material schedule and detailed estimate and costing. Prepare report and Drawing sheet. (One Drawing sheet).</p> <p>4. Design electrical Installation scheme for any two-factory/small unit/workshop having aggregate load of 30 KW. Draw wiring diagrams prepare material schedule & detail estimate and costing. Prepare report and Drawing sheet. (Two Drawing sheet).</p>

ELECTRICAL DRAWING - TW

Subject Code EE210P	Term Work						Credits
	No. of Periods Per Week			Full Marks	:	25	02
	L	T	P/S	Internal	:	07	
	—	—	03	External	:	18	

Contents : Term Work		Hrs/week
Chapter	Name of the Topic	Hours
01	Study of symbols for representation of machines, Electrical Accessories Equipment switching and protection units as per IS 2032, 8270, 3722	2*
02	Study of various methods of representing circuits/systems through layouts, Block Diagrams, wiring diagrams.	1*
03	Study any Engineering Graphic package (preferably CAD) for preparing layout, Block Diagrams, wiring Diagrams of substations, Machine shop, Illumination systems etc.	1*
04	How to read and interpret, various types of electrical drawings based on the knowledge & Information given while studying the above 3 chapters.	4*

* Eight Clock Hours of practical / drawing will be used for teaching theory

Drawing Sheets: (HALF IMPERIAL)

1. (A) Draw a sheet for symbolic representation of various electrical equipment's/machines
(B) Read the given circuits identify the components & trace the path of flow of current.
2. Draw a sheet of wires & wiring accessories
3. Prepare a drawing sheet showing details of domestic appliances such as Electric iron, electric Geyser, Electric Bell, Hot plate.
4. Draw a sheet of electrical symbols for various electrical devices using CAD.
5. Draw circuit diagrams for Staircase & Godown wiring using CAD.
6. Draw (a) circuit diagram (b) vector diagram for conducting direct loading test on transformer using CAD
7. Draw control and power circuit diagrams for DOL and Star/Delta Starter

Mini Project:

1. Visit electrical Machine lab/workshop & trace the electrical installation. Draw Layout diagram & single line diagram.

Text /Reference Books:

Titles of the Book	Name of Authors	Name of the Publisher
Electrical Engineering Drawing	Dr. S. K. Bhattacharya	New Age International Publishers
Working with Auto CAD	Mr. Ajit Singh	Tata McGraw Hill
Electrical Drawing	Sandeep Verma	Foundation Publishing

List of Assignments :-

1	(A) Draw a sheet for symbolic representation of various electrical equipment's/machines (B) Read the given circuits identify the components & trace the path of flow of current.
2	Draw a sheet of wires & wiring accessories
3	Prepare a drawing sheet showing details of domestic appliances such as Electric iron, electric Geyser, Electric Bell, Hot plate
4	Draw a sheet of electrical symbols for various electrical devices using CAD.
5	Draw circuit diagrams for Staircase & Godown wiring using CAD.
6	Draw (a) circuit diagram (b) vector diagram for conducting direct loading test on transformer using CAD.

LED LIGHT PREPARATION

Subject Code EE211P	Term Work			Credits			
	No. of Periods Per Week			Full Marks	:	25	02
	L	T	P/S	Internal	:	07	
	—	—	03	External	:	18	

Contents : Term Work		Hrs/week
Chapter	Name of the Topic	Hours
01	LED:- Introduction, Indicator lights, Illumination, Low power requirement, Types of LEDs, High power LED, Surface mount LEDs, Bi-colour and multicolor LEDs, Multicolor LEDs, Flashing LEDs, Alphanumeric LED displays.	4
02	LED Raw-materials, Requirement tools need for LED Manufacturing. Applications of LED's, LED Applications. Thermal Decimation Methods:-Aluminum Metal PCB, Aluminum Metal Casing, Thermal paste, Thermal heat sink tape, Teflon wire Teflon sleeve etc.	4
03	LED DRIVE:- Introduction, working principle, components used in driver, LED driver Block diagram explanation, Different types of LED Drivers.	4
04	Types of LED Fittings:- LED Bulb Holder, Lock type B22 Bayonet Cap Indian Lock Type, E27 (Thread type) E27 Indian Screw Type, Adopter B22 to E27 Indian type to Screw type Energy, Adopter B27 to E22 Indian type to Screw type Energy, Adopter E14 to B22 Indian type to Screw type Energy.	4
05	Design of the Metal PCB:- 3W LED Aluminum MCPCBs (Metal Core PCB), 5W LED Metal PCB, 9W Small LED Metal PCB, 9W Medium LED Metal PCB, 7W aluminum small/medium/large metal PCB, 12W LED Metal PCB etc.	4

List of Assignments :-

- 1) 3W LED AC Lamp Manufacturing.
- 2) 5W LED AC Lamp Manufacturing.
- 3) 3W Ceiling down Light Manufacturing.
- 4) 3W Ceiling down Cup Light Manufacturing.
- 5) 10 to 15W Ceiling down Focus Light Manufacturing.
- 6) 3W Spot Light Manufacturing.
- 7) 15 to 20W Focus Light/Flood Light/High Bay Light Manufacturing.
- 8) 12W Street Light Manufacturing.
- 9) 18W Street Light Manufacturing.
- 10) 12 W Solar Street Light DC Manufacturing.
- 11) 10W Two feet Tube Light Diffused Manufacturing.

ALTERNATIVE ENERGY RESOURCES

Subject Code EE212P	Term Work						Credits
	No. of Periods Per Week			Full Marks	:	25	02
	L	T	P/S	Internal	:	07	
	—	—	03	External	:	18	

Contents : Term Work		Hrs/week
Chapter	Name of the Topic	Hours
01	Introduction: Limitations of conventional energy sources, need and growth of alternate energy sources, basic schemes and applications of direct energy conversion. MHD Generators: Basic principles and Hall Effect, different types of MHD generators, applications and economic aspects	4
02	Solar Energy: Photovoltaic effect, characteristics of photovoltaic cells, conversion efficiency, solar batteries and applications. Solar energy in India, solar collectors, solar furnaces & applications. Wind Energy: History of wind power, wind generators, theory of wind power, characteristics of suitable wind power sites, scope in India, advantages and limitations.	4
03	Thermo-electric Generators: Seeback effect, peltier effect, Thomson effect, thermoelectric convertors, brief description of the construction of thermoelectric generators, applications and economic aspects.	4
04	Fuel Cells: Principle of action, gibbs free energy, general description of fuel cells, types, construction, operational characteristics and applications.	4
05	Miscellaneous Sources: Geothermal system, characteristics of geothermal resources, choice of generators, electric equipment and precautions. Low head hydro plants, definition of lowhead hydro power, choice of site and turbines. Tidal energy, idea of tidal energy, tidal electric generator, limitations.	4

Text /Reference Books:		
Titles of the Book	Name of Authors	Name of the Publisher
Non-conventional energy sources	G.D. Rai	Khanna Publishers
Non Conventional EnergyResources	B.H.Khan	Tata McGraw Hill