International Conference on Advances in Materials, Computing and Communication Technologies
In Association withInternational Journal of Scientific Research in Science and Technology
Volume 9 | Issue 1 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)

Energy and Demand Forecasting Control Using Prepaid Energy Metering Technique

Sowndarya R[1], Nivetha N[2], Kashifa Shalini K[2], Shrutha Keerthi K[2], Kesevan K[2]
[1]Assistant Professor, Department of EEE, Narasu's Sarathy Institute of Technology, Tamil Nadu, India
[2]Students, Department of EEE, Narasu's Sarathy Institute of Technology, Tamil Nadu, India

ABSTRACT

The system controls the current level electrical loads to maintain the total electrical power demand during a demand interval within certain predetermined limits. The demand forecaster makes periodic projections of the metered demand to the end of the demand interval based upon the current rate of energy consumption (instantaneous demand) and the accumulated energy consumption during the demand interval. If the projected value indicates that a demand peak will occur, the system signal interrupting the load to prevent the occurrence of the peak. Conversely, if the system detects a projected low value of the demand, a "restore" condition exists whereby the load is turned on to take advantage of the available electrical capacity. Object of the work is to provide a power distribution control system which can provide the solution of 2 hours power cut in Tamil Nadu.

Keywords : Power Demand

I. INTRODUCTION

The present invention relates to a system for controlling the operation of electrical loads. The purpose of the demand controller of this invention is to maintain the total electrical power demand of the load at or below a predetermined peak demand. The concepts of this invention may be used for controlling a single electrical load but are preferably employed in controlling a plurality of electrical loads on a priority basis.An electrical power demand is metered usually on the basis of a predetermined demand interval which may be, for example, a 15 minute, 30 minute or 60 minute demand interval. During this demand interval the consumption of electrical energy is accumulated and averaged. Thus, in this systems have been devised for maintaining the demand below a predetermined peak value during the demand interval thereby limiting this peak demand charge. Some of these techniques, however, such as a zero-order constant rate comparison technique had not been totally satisfactory. Accordingly, one object of the present invention is to provide a demand controller having an improved forecasting technique. Another object of the present invention is to provide a demand control technique that can be implemented relatively simply without the need for excessive complex data processing and logic circuitry. A demand control apparatus connected to a group of loads and adapted to shut off the power supply to loads in accordance with their set priority levels so that the total quantity of working current in the group of loads will be equal to or lower than a set quantity of current. Electricity generation in Tamil Nadu until about 1908 was confined to a few tiny plants in Tea Estates run on water power and to a small hydro electric station at Kattery near Coonoor. The Government Electricity department was created in 1927. Today TNEB has grown into a giant organization having a installed capacity of 10,214 MW and serving a consumer base of about 2 croreconsumers.To satisfy the energy needs of the state, Tamil Nadu Electricity Board has a total installed capacity of 10,214 MW which includes Central share and Independent Power Producers. Other than this, the state has installations in renewable energy sources like windmill up to 4300 MW. Due to the astronomical increase in energy demand in the last few years, the state has a deficit of power and it is estimated to be around 15.4% as on Feb 2010.To meet the ever-increasing energy demand in the coming years, TNEB has proposed new generation projects for the next 5 years. TNEB has fully exploited the hydroelectric potential available in the state. However, to tide over the peak hour shortage, 3 Pumped storage schemes totaling 1200 MW in Kundah (500 MW), Mettur(500 MW) and Vellimalai(200 MW) are available. TNEB has also proposed to establish small hydroelectric projects of capacity less than 25 MW in the run of river scheme with total capacity of 163 MW. Power generation, particularly the coal based power plants have adverse impact on the environment. Presently Tamil Nadu Electricity Board (TNEB) has four major coal based Thermal Power Stations with a total capacity of 2970 MW and four gases based power plants with a total capacity of 516 MW. TNEB realizes its social obligation and is very much conscious of the importance of prevention of degradation of environment due to its various Thermal Stations. Hence TNEB is very much serious in incorporating the environmental safeguards relentlessly in all its Power Plants, right from the inception stage of the Project to the commissioning stage and in the day to day running of the Power Plants. Tamil Nadu Electricity Board is a pioneer among the State Electricity Boards in India in promoting Renewable Energy Programmes. Ta mil Nadu maintains No.1 position in India in Power Generation from Renewable Energy S ources. India is among the top four nations in the deployment of this resource.

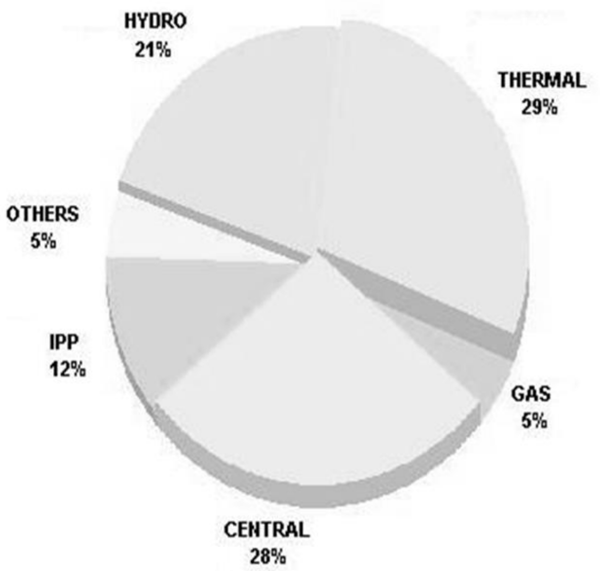

Fig.1. Generation status of TNEB

TNEB has recorded the combined thermal generation during the years 2006-07 and 2007-08 was 21,288 Million Units and 21,355 Million units respectively. Foundation stone was laid for the first super critical thermal power project of capacity 1600 MW under Joint Venture between TNEB and BHEL on 22.02.09.Foundation stone was laid for the thermal power project of capacity 1000 MW under Joint Venture between TNEB and NLC on 28.02.09.The Engineering Procurement Contract (EPC) for ongoing North Chennai TPS Stage-2 of capacity 1200 MW was awarded to M/s BHEL. In principle, REC sanctioned Rupee Term Loan of Rs.2475 Crore for Unit-1.The EPC for ongoing Mettur TPS Stage-3 of capacity 600 MW was awarded to M/s BGR Energy /Chennai on 27.06.08. Loan agreement has been signed with PFC, New Delhi on 19.05.2008 for Rs.2221.80 Crores, for 500 MW capacity, remaining amount being raised internally. In order to bridge the demand-availability gap, TNEB is exploring the possibility of setting up of 2X600 MW coal based Thermal Power Project.The Industries Department, GoTN is agreeable in-principle to allot about 500 acres of in the TIDCO's Multi Product Special Economic Zone in Thriuvallur District.

An additional Gas based thermal project with a capacity of 92 MW had been commissioned on 17.02.09 at Valuthur in Ramanathapuram. Administrative approval has been accorded by the Board for the establishment of Co-generation Plants to generate power using coal of various capacities 7/12/15/18 MW at an estimated cost of Rs.1176.70 Crores, with a totalling of 234 MW in 15 nos.TheGoTN is encouraging the private promotrs for developing Merchant Power Plant (MPP) along the coastal areas. The GoTN has issued facilitation letter to 10 MPP totaling to a capacity of 17,140MW using imported coal as fuel.TamilNadu is one of the states selected by Government of India for the establishment of Ultra mega power project (4000 MW) at Cheyyur.21 Small HEPs of total capacity 118.65 MW are to be allotted to the Private Promoters through Expression of interest route after finalization of terms & conditions on Small hydro development by Private promoters. So far, under Renewable Energy Sources, 8018 WEGS of 4118 MW, 22 Co-generation plants of 466 MW and 16 Biomass plants of 137 MW has been added to the grid.Transmission sector of TNEB consists of the following network infrastructure HT and EHT lines for a total length of 1, 63,883 Kms. A total of 1202 substations 95 Substations in and around Chennai have been provided with SCADA and have been integrated into Chennai Distribution and control center (DCC). TNEB has one State Load Dispatch Centre at Chennai and 3 Sub LDCs at Chennai, Madurai and Erode. The transmission network expansion is aimed at evolving a national power grid to facilitate free flow of power across regional boundaries, raising the transmission voltage from 230 kV to 400 kV level. In order to evacuate bulk power from one region to another region, there is scope for enhancing the transmission capability to 765 KV level. Tamil Nadu Electricity Board has taken up the indigenous erection of 400 KV substations and lines.

Establishment of 765 KV transmission lines is also under investigation. The Government of India has approved nondiscriminatory open access to the transmission system to all generators for injecting power and to any consumer to carry the power from the point of injection to his load. To augment the power supply, the Government of Tamil Nadu has also permitted third party sale of power produced by IPPs, CPPs & other private power producers through short term Intra-State open access to HT consumers within Tamil Nadu as it will provide an incentive to the generators within the State to produce to their full capacity.Transmission and Distribution loss is at 18 % and AT&C loss is at 19.3 %. For reducing those losses, implementation of High Voltage Distribution System and Rural Load Management System are being carried out in addition to the regular measures.Target of AT&C losses (as directed by TNERC) for the year 2008-09, 2009-10, 2010-11 and 2011-12 are 19.3%, 18.9%, 18.5% and 18.1% respectively.During 2007-08, 163883 k.m lengths of EHT & HT lines had been laid. 1202 number of EHT & HT substations was commissioned.Sunguvarchatram will be the fourth 400 KV Substation developed by TNEB and the same is likely to be commissioned on 31.12.09.Smart Power Monitoring System Using Wireless Sensor Networks.Wired sensor networks have already been reached and deployed in many applications over a decade; because of the wireless extension, smart grids have witnessed a tremendous upsurge in interest and activities in recent years. New technologies include cutting-edge advancements in information technology, sensors, metering, transmission, distribution, and electricity storage technology, as well as providing new information and flexibility to both consumers and providers of electricity.The

ZigBee Alliance, the wireless communication platform is presently examining Japan's new smart home wireless system implication by having a new initiative with Japan's Government that will evaluate use of the forthcoming ZigBee Internet Protocol (IP) specification and the IEEE 802.15.4g standard to help Japan create smart homes that improve energy management and efficiency . It is expected that 65 million households will equip with smart meters by 2015 and it is a realistic estimate of the size of the home energy management market.

Smart Grid and wireless sensor networks provides an intelligent functions that advance interactions of agents such as telecommunication, control and optimization to achieve adaptability, self-healing, efficiency, cyber security and reliability of power systems while reducing the cost and providing efficient resource management and utilization. A wide range of smart meter research is being carried during the last decade. Various architectural design and development methods of smart grid utility system for effectively managing and controlling the household appliances for optimal energy harvesting have been presented.Different Information and Communication technologies integrating with smart meter devices have been proposed and tested at different flats in a residential area for optimal power utilization, but individual controlling of the devices are limited to specific houses. Considering performance and cost factors related to design and development of smart meters and also predicting the usage of the power consumption have been demonstrated.

However, low-cost, flexible and robust system to continuously monitor and control based on consumer requirements are at early stages of development.The Costs and Benefits of Smart Meters for Residential Customers.Across the nation, electric utilities are deploying smart meters (technically termed advanced metering infrastructure or AMI) to their residential customers as the basic building block of the Smart Grid. In a few areas of the country, such as California and Texas, smart meters are almost fully deployed. As of June 2011, approximately 20 million smart meters had been deployed in the U.S. and it is likely that the number will rise to approximately 65 million meters by 2015.1 This would represent approximately 50 percent of all U.S. households. By the end of this decade, smart meters may be deployed to almost all U.S. households. Another noteworthy trend is the growing number of home energy management devices. In a recent report, Greentech Media estimated that approximately 6 million U.S. households will have some type of home energy management device by 2015.2 This represents about 10 percent of the expected 65 million households with smart meters and, in our view, is a realistic estimate of the size of the home energy management market.Demand Management and Wireless Sensor Networks in the Smart Grid. In the traditional power grid, energy generation facilities are generally monitored with wired sensors which are limited in amount and located only at a few critical places. This is due to the high cost of installation and maintenance of those sensors. WSNs offer low-cost sensors that can communicate via wireless links hence have flexible deployment opportunities. In fact, the utilization of WSNs becomes even more essential with the increasing number of renewable energy sites in the energy generation cycle. These renewable energy generation facilities can be in remote areas, and operate in harsh environments where fault-tolerance of WSNs makes them an ideal candidate for such applications. Furthermore, the output of the renewable energy resources is closely related with the ambient conditions such as wind velocity for wind power generation and cloudiness for solar panels. These varying ambient conditions cause intermittent power generation which makes renewable resources hard to integrate to the power grid. For instance, at high wind speeds, to avoid damage to the blades and gears inside the hub of the wind turbine, the turbines are shut off. This causes a steep reduction of output that has to be balanced with other resources (Ipakchi&Albuyeh, 2009).

Prediction of such events will give opportunities for preparedness and fast restoration capabilities by the help of backup generators. This emphasizes the importance of ambient data collection. For those reasons, WSNs can offer solutions for renewable energy generation sites, such as solar (PV) farms or wind farms. Furthermore, wireless sensor and actor networks can take part in increasing the efficiency of the equipments. In (Shen et al., 2008), the authors address the challenge of varying wind power output by employing prediction where WSNs are used to collect and communicate the wind speed prediction data to a central location. WSNs can also be used for condition monitoring of the wind turbines. Wind turbines are expensive equipments which may experience break downs in time due to wear. Early detection of malfunctioning components may increase the lifetime of the wind tribunes and reduce the time spared for maintenance which increases the efficiency of production. In (Al-Anbagi et al., 2011), the authors utilize WSNs for monitoring the condition of the bearings within the gearboxes where accelerometers are used to monitor wind turbine vibration. WSNs are used to provide early detection for bearing failures or other related problems.

The authors address the issue of delay-sensitive data transmission in WSNs for a wind turbine by modifying the Medium Access Control (MAC) protocol of IEEE 802.15.4 standard in order to provide service differentiation for critical and non-critical data, and reduce the end-to-end delay for critical data. A WSN-based energy evaluation and planning system for industrial plants have been introduced in (Lu et al., 2010). The authors have discussed the feasibility of using WSNs and the benefits of replacing the conventional wired sensor with WSNs. A similar WSN-based system can also be used for condition monitoring of power plants. Low-cost, ease of deployment, fault-tolerance, flexibility are among the advantages of the WSN-based systems.Development of a Smart Power Metering System with Demand Side Management Tool.

The concept of smart grids which features higher utilization of power grid, demand reduction, and extensive usage of renewable energy source, is accepted and implemented all over the world. Smart grids are used to accomplish an advanced power system with automatic monitoring, diagnosing, and repairing functions. The installation of Advanced Metering Infrastructure (AMI) is looked upon as a bridge to the construction of smart grids. The smart metering system is an integral part of the AMI. The current smart meters on the market can provide the basic functions like power measurement with bi-directional communication, remotely turning off the electricity supply for an apartment and changing the billing plan from flat-rate to multi-stage tariff. However, current smart meter still follows the traditional way of calculating the power consumption, which is based on balanced linear circuit. As the electronic devices and power converter applications are widely used in home appliances, the traditional power consumption calculation is no longer suitable for these non-linear applications.

The current smart meters also cannot satisfy the need of controlling individual home appliances to achieve a better demand side management, based on a more accurate hourly time-varying tariff.The objectives of this project are to improve the accuracy of the non-linear power consumption calculation using IEEE Standard 1459-2000[5], to provide users solutions of optimized power consumption plan based on the hourly time-varying tariff and to help users choose the appliances they want to be controlled by the optimized power consumption plan to reduce their electricity cost. This is achieved through the development of the smart power metering system using Agilent Technology Data Acquisition and VEE Pro programming environment.Efficient Power Management In Home Using Wireless Sensor Networks.

In this section, we briefly discuss the existing works about smart home systems based on wireless communication technology. Various proposals are there to interconnect domestic appliances by wireless networks to monitor and control which are provided in. Also, smart meter systems like have been designed to specific usages particularly related to geographical usages and are limited to specific places. Different information and communication technologies integrating with smart meter devices have been proposed and tested at different flats in a residential area for optimal power utilization, but individual controlling of the devices are limited to specific houses.

There has been design and developments of smart meters predicting the usage of power consumption . However a low-cost, flexible, and robust system to continuously monitor and control based on consumer requirements is at the early stages of development. In this , we have designed and implemented a ZigBee-based intelligent home energy management and control service. We used the ZigBee (the IEEE 802.15.4 standard) technology for networking and communication because it has low-power and low-cost characteristics, which enable it to be widely used in home and building environments. The disadvantage are: the physical wiring from the meter to the house can still be an obstacle for an easy implementation of this solution, particularly for tall or old buildings, due to cost and installation complexity.Han et al proposed a Home Energy Management System (HEMS) using the ZigBee technology to reduce the standby power. The system consists of an automatic standby cutoff outlet, a ZigBee hub and a server. The power outlet with a ZigBee module cuts off the ac power when the energy consumption of the device connected to the power outlet is below a fixed value. The central hub collects information from the power channels and controls these power channels through the ZigBee module.

The central hub sends the present state information to a server and then a user can monitor or control the present energy usage using the HEMS user interface. This facility may create some uneasiness for the users. For example, if the users may want low intensity of light, for some situation but the system will cut the power off leading to darkness.In this paper, wireless sensors are responsible for measuring current illuminations and the lights are controlled by applying the model of user‟s actions and profiles. The above mentioned home monitoring and controlling systems have limitations with respect to home automation such as: 1) energy consumption control mechanism is limited to only certain devices like light illuminations, whereas several household appliances can be controlled; 2) energy control is based on fixed threshold power consumption, which may not be applicable to different consumers; 3) controlling the home appliances through network management functions, in practice inhabitant requirements may vary according to their behavior but not with network characteristics. A low-cost, flexible, and real-time smart power management system, which can easily integrate and operate with the home monitoring systems such as is presented.

II. CONVENTIONAL METHOD

The system principally monitors electrical parameters of household appliances such as voltage and current and subsequently calculates the power consumed.The novelty of this system is the implementation of the controlling mechanism of appliances in different ways. The developed system is a low-cost and flexible in operation and thus can save electricity expense of the consumers.

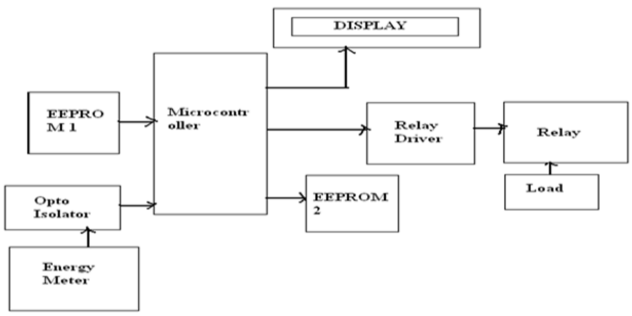

Fig..2.Conventional block diagram

Over the last three years, Tamil Nadu has been facing severe power shortages, with outages lasting 8-10 hours. In rural areas, power cuts can go up to 14 hours. TNEB is now planning to announce 30% demand cut and evening peak hour restriction resulting in 46.7% power shortage and during summer the demand cut might be increased to 40% resulting in 56.7% power shortage.

Equal distribution of power shortage across the consumers (will work to less than 4 hours – 17%) including Chennai

Announce 30% demand/energy cut during evening peak hours (6.00 pm to 10.00 pm) and 20% during other hours – totaling 5.2 hours (21.7%).

Disadvantages: The main drawback of the system is, a protection scheme was done by manually. The operation time of the system is more due to the reason of manual operation.

III. PROPOSED SYSTEM

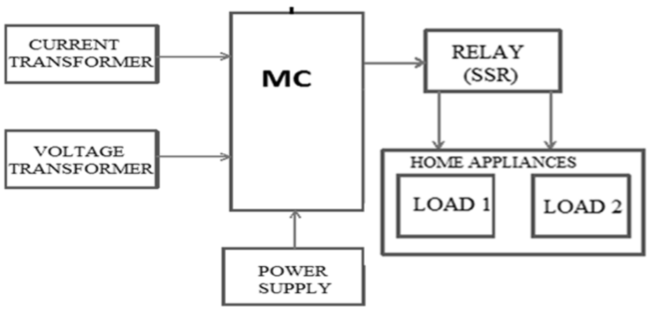

Fig.3. Proposed Block Diagram

Power demand controller is a current controlling device. This is to be kept in each and every house. The power from energy meter is given to the controller and the output of controller is provided into home loads.In a day for normal 22hours maximum power consumed by consumer but for the particular 2hours the power is limited by controller this helps EB to provide minimum power instead of power cut. Thus the excess power cannot be used by consumer.For normal 22hours power from energy meter is directed provided load. For that particular two hours the current flow path is changed by using relay. After that current flow changes the current limiter provided to reduce they current at output.Thus the current flow direction is changes by using timer buffer and comparator in feature current cut may be three hours or four hours which timing is desired in using timer. The time when the power limit made is decided by the buffer and comparator.

When signal from EB comes the comparator compares the signal and it holds the signal for some times after that the timer triggered with indicator now the current flow path is changed to MCB. After timing is finished, the controller will turn off immediately and normal power flow will occur.The concept of triggering is an emerging issue to the modern technology dependent society. Remote control technologies are widely used for controller without walking up to them. Controlling appliances through computer can also be a possible solution. However, it cannot fulfill the current demand which is to control them from remote places. The advantages of cellular communications like GSM technology is a potential solution for such remote controlling activities. GSM-SMS technology can be used to control from remote places. Firstly, appliances are controlled by server mobile which acts as remote control. Secondly, GSM-SMS messaging technology is used to control them from remote places and finally, to provide a multiple agents environment.

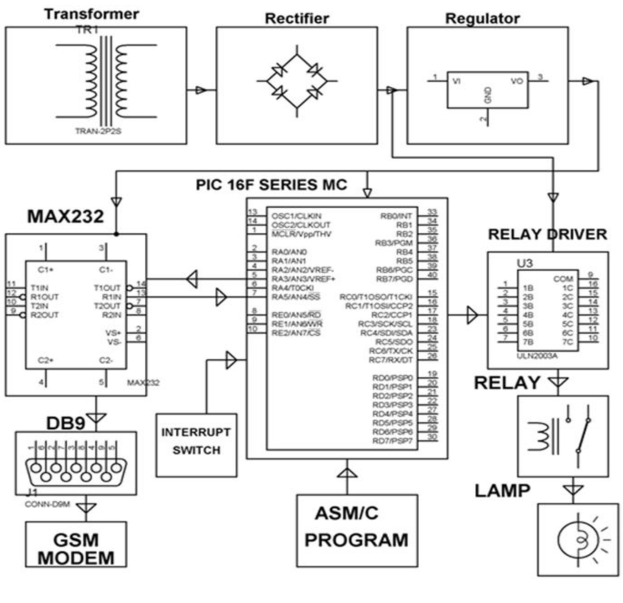

Fig. 4.2. Circuit Diagram

The concept of triggering is an emerging issue to the modern technology dependent society. Remote control technologies are widely used for controller without walking up to them. Controlling appliances through computer can also be a possible solution. However, it cannot fulfill the current demand which is to control them from remote places. The advantages of cellular communications like GSM technology is a potential solution for such remote controlling activities. GSM-SMS technology can be used to control from remote places. Firstly, appliances are controlled by server mobile which acts as remote control. Secondly, GSM-SMS messaging technology is used to control them from remote places and finally, to provide a multiple agents environment.

Advantages: Save money in energy bills, Improves energy generation, Reduction of inductance in transmission lines, It provides efficient power demand management, No power cut due to power shortage

IV. EXPECTED OUTPUT

The present invention relates to a system for controlling the operation of electrical loads. The purpose of the demand controller of this invention is to maintain the total electrical power demand of the load at or below a predetermined peak demand. The concepts of this invention may be used for controlling a single electrical load but are preferably employed in controlling a plurality of electrical loads on a priority basis.

V. CONCLUSION

The demand control apparatus is adapted to compute the quantity of working current in each of the loads from a difference between the total quantities of working current before and after shut-off in that load and to re-start the load within a range defined by a difference between a set quantity of current and the total quantity of working current after shut-off in the load in accordance with its priority level. The power distribution control system provide reliability by absents of 2 hour power cut, also it includes a center communication terminal and a plurality of customer's communication terminals operatively connected to the center communication terminal through transmission lines. The concepts of this invention may be used for controlling a single electrical load but are preferably employed in controlling a multiple of electrical loads on a priority basis.

VI. REFERENCES

[1]. Electrical engineers data books (vol. one) lighting, traction and power distribution. Volume compiled and collated by D.V.Onslow A.M.I.E.E. publishers Ernest Benn ltd, 8 Boveriestreet, London. Published 1925.

[2]. Book one – Electrical and Radio Notes for Wireless Operators Book Two – Foundations of Wireless, printed in 1946 (fourth edition) by M. G. Scroggie . Book Three – The Amateur Radio Handbook printed in 1946 by Sir Joseph Causton& Sons.

[3]. Technical Electricity by Davidge and Hutchinson. A few chapters include: - Electrostatics General principals, - Electrostatics measuring instruments, - Magnetic units and theory, - magnetic measurements, Dynamos, - Indoor wiring,….. Published in 1922 (fourth edition) by University Tutorial Press.