Load Modeling - A Case Study

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ABSTRACT:
This paper presents a case study of an electric load modeling of 11kv feeder of an engineering college line that result into a simplified mathematical model. The variation of load on the feeders is studied on hourly basis, weekly basis and monthly basis for developing the mathematical equations. The databases are investigated to assess and adjudge the mathematical modeling of load curves. Validation is performed on comparing the load curves in between measured data and proposed Gaussian model. Once the model is validated then it can be turned into a good prediction tool useful for planning studies.

KEYWORDS: Gaussian equation, load modeling, database, feeder etc.

I. INTRODUCTION:
The load on the distribution system varies with time. The distribution utilities require an accurate load data for power production, operation planning, distribution network planning, load management planning, tariff planning and finally billing. The utilities objective is to supply quality of power at optimum cost. This is advised that load modeling is to be done based on the collection of load data at regular intervals for the betterment service of distribution utilities. The load modeling depends on the various factors such as type of load whether it is domestic or industry, time duration of load, weather conditions, previous load pattern etc. Load information mostly needed is how a customer or a group of customers uses the electricity at different hours of day, different days of week and seasons of year. Load data is also needed for defining the network capacity and approximating transmission losses.
Usually the measurements of customers load are electricity bill reflecting the consumption on hourly basis for large load, weekly basis for medium load and monthly basis for small load.
The mathematical load modeling developed for the forecasting purposes are usually complicated. This is due to the fact that the load is a randomly distributed variable. Literatures [1-6] illustrated the wide variation of modeling depending on the nature of load, type of load, time duration i.e. hourly, weekly, monthly, yearly basis.This paper presents a case study on the mathematical modeling of load distribution from the data obtained from the distribution network of our 11 kV feeder line.
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The everyday data are taken for a month June 2014 on hourly basis. These data are adjudged for the goodness of fit of measured value. This is found that Gaussian mathematical equation is best goodness of fit satisfying the load curves obtained from database. Validation is performed on comparing the load curves with proposed Gaussian equation using MATLAB.

II.   GAUSSIAN POLYNOMIAL:
The Gaussian model fits peak [7], and is given by

$$f(x) = \sum_{i=1}^{n} a_i e^{-\left(\frac{x-b_i}{c_i}\right)^2}$$

Where a is amplitude, b is centroid or location, c is related to peak width and n is number of peaks to fit lies in between $1 \leq n \leq 8$. In this paper the value of n is taken either 2 or 3. Gaussian peaks are encountered frequently in science and engineering.

III. RESULTS AND DISCUSSION:

The weekly data on hourly basis data for a month June 2014 are plotted i.e. from June 1-6, June 7-12, June 13-18, June 19-24 and June 25-30 are shown in Fig.1-5.
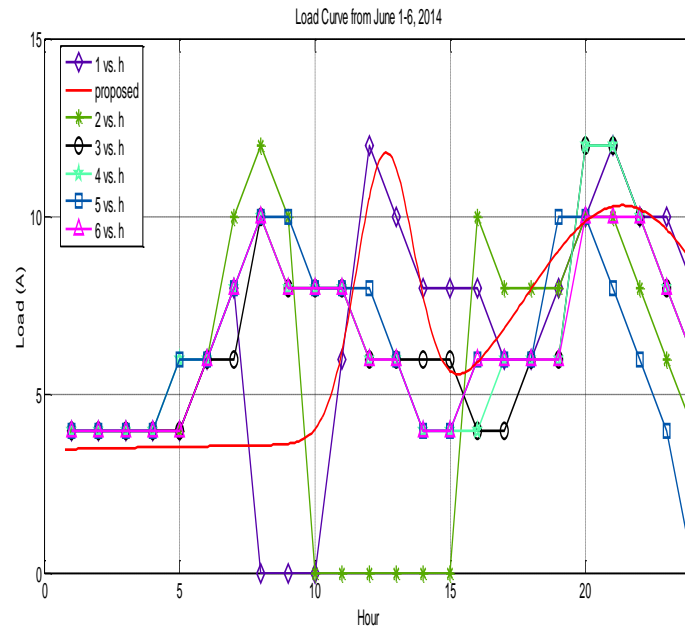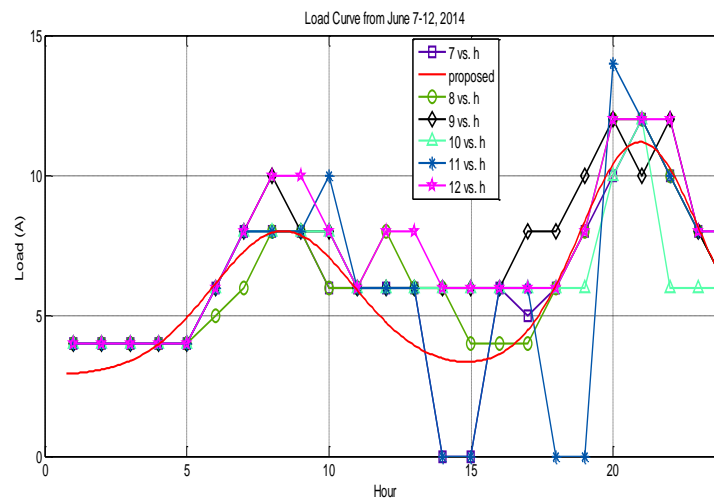

Fig1: Load curve from June 1-6, 2014
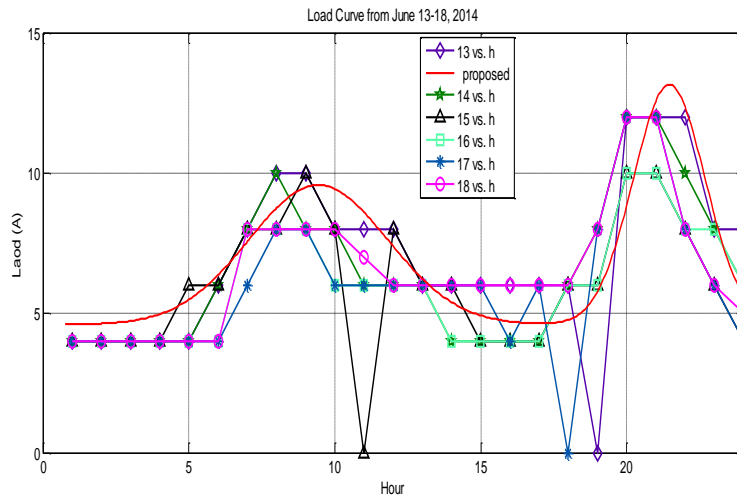

Fig2: Load curve from June 7-12, 2014

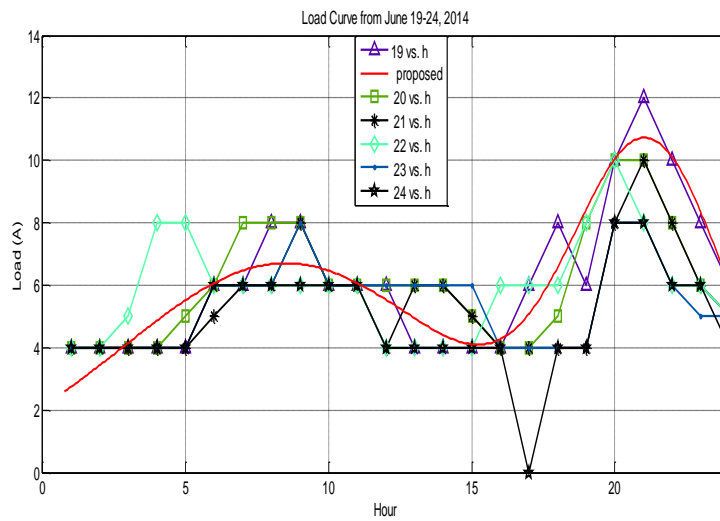**Fig3: Load curve from June 13-18, 2014**

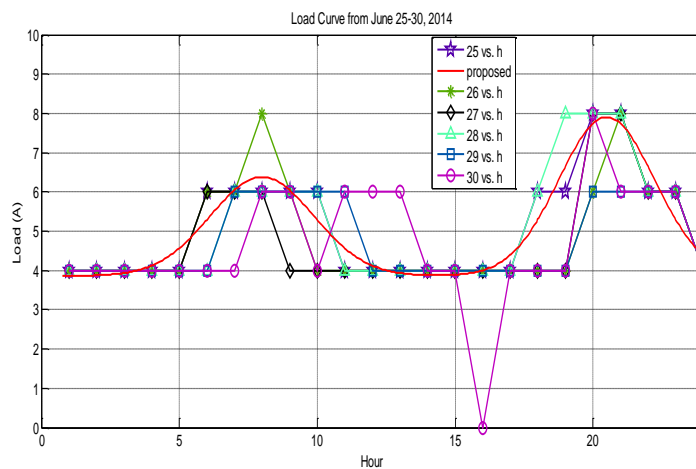**Fig4: Load curve from June 19-24, 2014**

Fig5: Load curve from June 25-30, 2014

In all above figures, the red line curve represents the proposed load curve using Gaussian mathematical equation that resembles the load curves obtained from database. The zero loads at specific hours appearing

in above figures indicating the tripping of 11 kV feeders. This is to be noted that this zero load is not taken into account in developing the mathematical modelling.
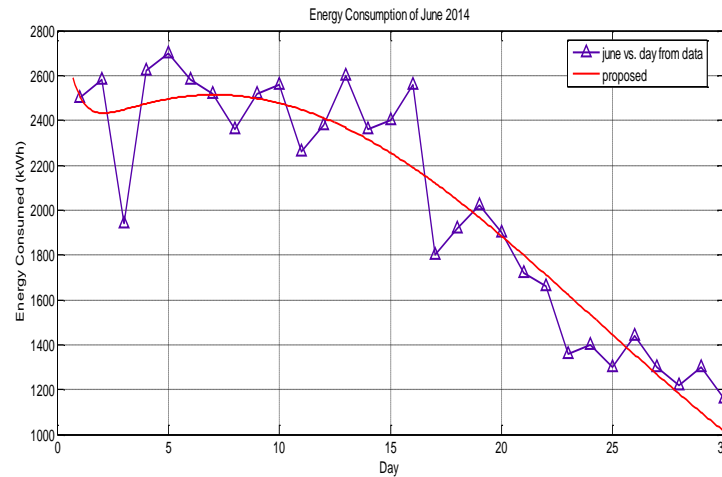

Fig6: Energy consumption per day for June 2014

The per day energy consumption comparison for the month of June 2014 is also made and shown in Fig.6. Red line represents the proposed one validating the load modelling.

IV. CONCLUSION:

On hourly basis data are collected for a month June 2014 and plotted. The appropriate mathematical equations validating the data are proposed i.e. 'Gaussian Equation' using MATLAB curve fitting technique. Load modelling is also validated using per day energy consumption for the month June 2014.

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