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Application of AI techniques to Optimize the Performance of CI Engine Fuelled With Cotton Seed Oil- A Review.

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Abstract:-
The agenda of this paper is to seek out and elaborate the most effective AI techniques for locating the potency of bio fuel in internal-combustion engine. This study deals with the appliance of AI techniques to optimise the performance of internal-combustion engine. Since the AI techniques is extremely abundant in style during this space. it's far more necessary to seek out that is that the best and economical techniques, which may provide the decent output.
Keywords:- *Biodiesel, AI techniques, Fuzzy logic, Genetic algorithm, Artificial neural networks.*

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I. INTRODUCTION:-

1. a. Biodiesel

The world is as of now confronting a vitality emergency due to huge anthropogenic exercises. The consuming of fossil energizes has prompted height of climactic temperatures and environmental change. Biodiesel is a biodegradable and sustainable power source. Biodiesel can act naturally used in present IC motors with a decreased outflow to the condition. Microalgae can aggregate high sums of lipids with a quick development rate making them a planned feedstock for biodiesel creation. Unique photo bioreactor arrangements are used for mass

Development of microalgae.[1]Biodiesel can be obtain from natural sources, among them liqid materials, for example, fats and oils have gotten expanding consideration. Various procedures for biodiesel creation utilizing fats what's more, oils as a feedstock yields powers with various synthesis and properties. Biodiesel which is characterized as the mono-alkyl esters of vegetable oils or creature fats, acquired by transesterifying oil or fat with a liquor. Biodiesel is being produced from many of vegetable oils and animal fats. If it is produced from high quality edible oil and fats, it will resulted in high prices of raw material and biodiesel is more expensive than petroleum diesel fuel also shortage of edible oil for food purpose. Transesterification and emulsification are two main solutions that have appeared as effective methods for using animal fats and vegetables oil in diesel engine.[2]

The elective energizes must be in fact adequate, monetarily serious, ecologically worthy and effectively accessible. Research on biodiesel got from vegetable oils and creature fats are being kept up to exchange this sort of energizes to oil based diesel fuel

1. b. Introduction to AI techniques:

Artificial intelligence (Computer based intelligence) methods may assume a significant job in displaying and forecast of the exhibition and control of burning procedure. The paper plots a comprehension of how AI frameworks work by method for introducing various issues in the various controls of ignition designing. The different utilizations of AI are introduced in a topical as opposed to a sequential or some other request. From the portrayal of the different applications introduced in this paper, one can see that Man-made intelligence procedures have been applied in a wide scope of fields for displaying, forecast and control in burning procedures. What is required for setting up such a framework is information that speaks to the previous history what's more, execution of the genuine framework and a choice of an appropriate model. The choice of this model is finished observationally and subsequent to testing different other option arrangements. The presentation of the chose models is tried with the information of the previous history of the genuine framework.
We have been researching on three AI techniques which is widely used in the field of biotechnology or we can say biodiesel.

A. Fuzzy Logic:-

The fuzzy logic approach has the potential to produce a simplified control for various chemical engineering applications. The rule-based features of fuzzy models allow for a model interpretation in a way that is similar to the one humans use for describing reality. Conventional methods for statistical validation based on numerical data can be complemented by human knowledge which usually involves heuristic knowledge and intuition. A multi-input single output (MISO) fuzzy model of batch reactor for transesterification has been developed using ANFIS by considering two input

Parameters and one output variable in order to predict the product concentration. This technique provides a method for the fuzzy modelling method to understand information about a data set, in order to evaluate the membership function parameters that best provide the corresponding FIS to track the given input/output data. This learning process works similarly to that of neural networks. The parameters associated with the membership functions will change through the learning process. This method is based on the Surgeon-type fuzzy interface system and can simulate and analyse the

Mapping relation between the input and output data through hybrid learning to determine the optimal allocation of membership functions. The ANFIS
Architecture of the type from Takagi and Surgeon has been shown in Figure **1.**

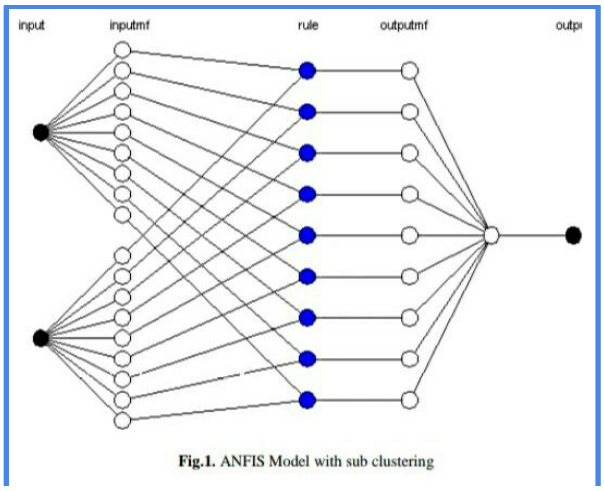

Fig.1. ANFIS Model with sub clustering

This interference system is composed of five layers. Each layer involves several nodes, which are described by the node function. The output signals from the nodes in the previous layers will be accepted as the input signals in the present layer. After manipulation by the node function in the present layer, the output will serve as the input signal for the next layer. To simply explain the mechanism of the ANFIS, we consider two inputs, x and y, and one output f in the FIS. Hence, the base rules will be fuzzy "if-then" rules as follows:
Rule 1: If x is A1 and y is B1, then f = p1x + q1y +r1
Rule 2: If x is A2 and y is B2, then f = p2x + q2y +r2 [3]

- ***Fuzzy Interference System (FIS)***

The core of a fuzzy logic controller/modelling is the inference engine, which contains information of the control strategy in the form of "if-then" rules. Since the fuzzy logic, rules require linguistic variables. Inputs and outputs of a process are generally continuous crisp values, therefore the conversion of crisp values into fuzzy values and vice versa are required. The initial step of the fuzzy modelling approach is to determine the input and output variables of the fuzzy logic controller. Surgeon type FIS is used for this purpose. A typical direct fuzzy logic control system is shown in Fig. 2. The ANFIS editor is used to create, train, and assess the Surgeon fuzzy logic. This FIS system is designed for the MISO system. The MISO system includes two inputs and one output.[3]

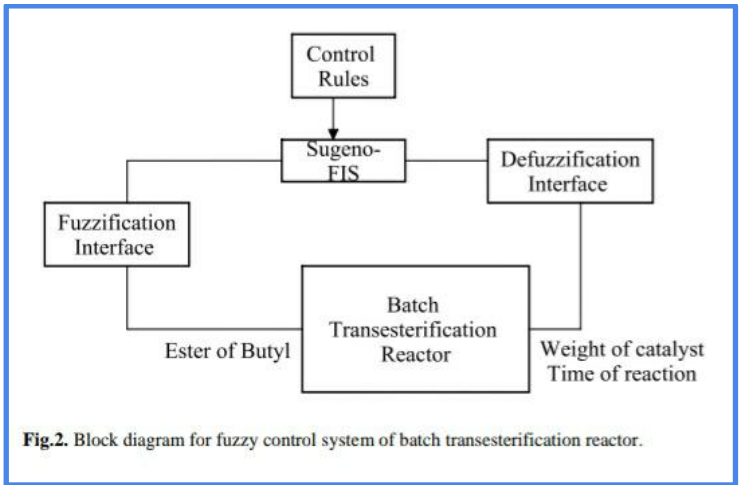

Fig.2. Block diagram for fuzzy control system of batch transesterification reactor.

B. Genetic Algorithm

Genetic algorithm are search and improvement calculations dependent on the standards of characteristic advancement, which were first presented by john Holland in 1970. Genetic algorithm likewise execute the streamlining procedures by reproducing advancement of species through normal choices. Genetic algorithm is commonly made out of two procedures. First procedure is determination of individual for the creation of people to come and second procedure is control of the chosen individual to frame the cutting edge by hybrid what's more, change strategies. The choice system figures out which individual are picked for generation and what number of posterity each chose singular produce. The fundamental standard of choice technique is the better is an individual; the higher is its opportunity of being guardian.

Genetic algorithms abstract the problem space as a population of individuals, and try to explore the fittest individual by producing generations iteratively. GA evolves a population of initial individuals to a population of high quality individuals, where each individual represents a solution of the problem to be solved. The quality of each rule is measured by a fitness function as the quantitative representation of each rule's adaptation to a certain environment. The procedure starts from an initial population of randomly generated individuals.[4]

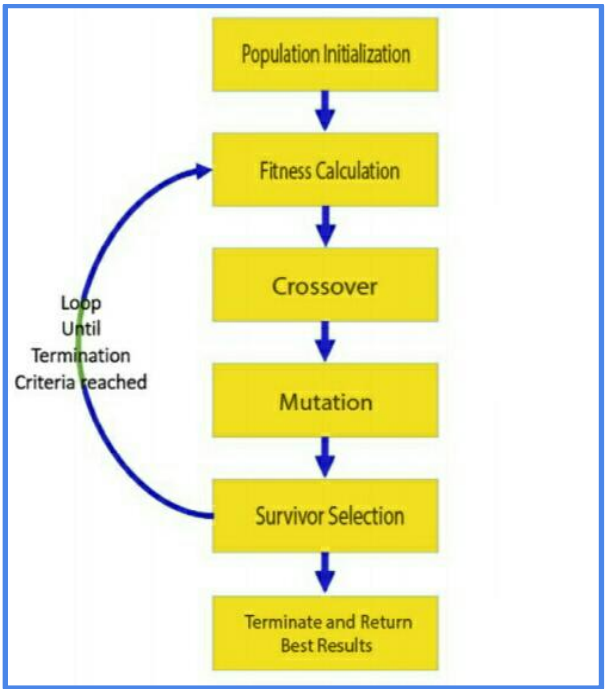

Figure 3:- Flow Chart of GA System.

During each generation, three basic genetic operators are sequentially applied to each individual with certain probabilities, i.e. selection, crossover and mutation. The GAs is computer program that simulate the heredity and evolution of living organisms [3]. An optimum solution is possible even for multi modal objective functions utilizing GAs because they are multi-point search methods. Also, GAs is applicable to discrete search space problems. Thus, GA is not only very easy to use but also a very powerful optimization tool. In GA, the search space consists of strings, each of which representing a candidate solution to the problem and are termed as chromosomes. The objective function value of each chromosome is called its fitness value. Population is a set of chromosomes along with their associated fitness. Generations are populations generated in an iteration of the GA.[3]

In ***Selection Operation*** GA searches for better solutions by genetic operations, including selection operation, crossover operation and mutation operation is to choose elitist people as guardians in current populace, which can produce posterity. Wellness values are utilized as rules to decide whether people are elitist. There are numerous techniques how to choose the best chromosomes, for instance roulette wheel determination, Boltzmann determination, competition choice, position choice, consistent state. The age of replacements in a GA is dictated by a set of administrators that recombine and change chosen individuals of the present populace. The two most regular administrators are ***crossover*** and transformation. The crossover administrator produces two new posterity from two parent strings, by duplicating chosen bits from each parent. The bit at position I in each posterity is duplicated from the bit at position I in one of the two guardians. The decision of which parent contributes the bit for position I is controlled by an extra string called the crossover cover administrator quickly. There are three sorts of crossover administrators, in particular as single-point, two-point and uniform crossover.

In addition to recombination operators that produce offspring by combining parts of two parents, a second type of operator produces offspring from a single parent. In particular, the ***mutation operator*** produces small random changes to the bit string by choosing a single bit at random, then changing its value.[3]

C. Artificial Neural Network (ANN):-

An artificial neural network is an interconnected group of nodes, inspired by a simplification of neurons in a brain. Here, each circular node represents an artificial neuron and an arrow represents a connection from the output of one artificial neuron to the input of another.

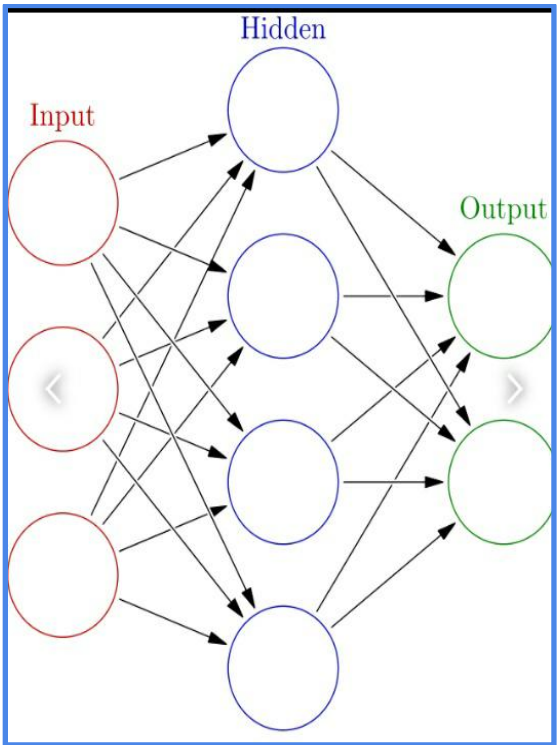

Figure 4.:- Simplified diagram of Artificial Neural network

Figure 4 show the simplest diagram of ANN. Artificial neural networks (ANN) or connectionist systems are computing systems vaguely inspired by the biological neural networks that constitute animal brains. Such systems "learn" to perform tasks by considering examples, generally without being programmed with task-specific rules.

Neural networks obviate the need to use complex mathematically explicit formulas, computer models, and impractical and costly physical models. Some of the characteristics that support the success of ANNs and distinguish them from the conventional computational techniques are:

- The direct manner in which ANNs acquire information and knowledge about a given problem domain (learning interesting and possibly non-linear relationships) through the „training" phase.
- Neural networks can work with numerical or analogue data that would be difficult to deal with by other means because of the form of the data or because there are so many variables.
- Neural network analysis can be conceived of as a „black box" approach and the user does not require sophisticated mathematical knowledge.
- The compact form in which the acquired information and knowledge is stored within the trained network and the ease with which it can be accessed and used.
- Neural network solutions can be robust even in the presence of „noise" in the input data.
- The high degree of accuracy reported when ANN are used to generalize over a set of previously unseen data (not used in the „training" process) from the problem domain[5]

Especially the ANN has wide application in IC engine combustion, monitoring and controlling. This system has ability to represent the non linear system and self learning capability advanced engine system required accurate dynamic models, which are substantially non linear and does not required knowledge of the governing equation of engine. These neuro-models are then integrated into an upper level emission optimization tool, which calculates a cost function for exhaust verses consumption/torque and determining optimal engine settings. Shivakumar et.al. uses the ANN to predict the performance and emission parameter of CI engine. Mean Relative error and the regression analysis was carried out for the trained as well as the test data are considered to be within the acceptable limits. The emission of smoke and CO shows slightly higher values. Hence ANN approach can be used for the prediction of engine performance and emission characteristics of I.C engines by performing a limited number of tests instead of detailed experimental study thus saving both engineering effort and funds . Gholamhassan Najafi et. al. has been conducted combustion analysis with ANN technique. An artificial neural network (ANN) was developed based on the collected data of this work. The backpropagation algorithm was utilized in training of all ANN models. This algorithm uses the supervised training technique where the network weights and biases are initialized randomly at the beginning of the training phase. The error minimization process is achieved using gradient descent rule. It was found that the R (the coefficient of correlation) values are 0.99994, 1, 1 and 0.99998 for the engine torque, specific fuel consumption, CO and HC emissions, respectively.[4]

The technique of Artificial neural network is generally inspired by the biological neural networks.The human cerebrum no uncertainty is a profoundly perplexing structure saw as a huge, exceptionally interconnected system of straightforward preparing components called Neurons. Each part of the model bears an immediate similarity to the real segments of an organic neuron and consequently is named as Artificial Neuron. It is this model which structures the premise of the Artificial Networks as appeared in fig.5

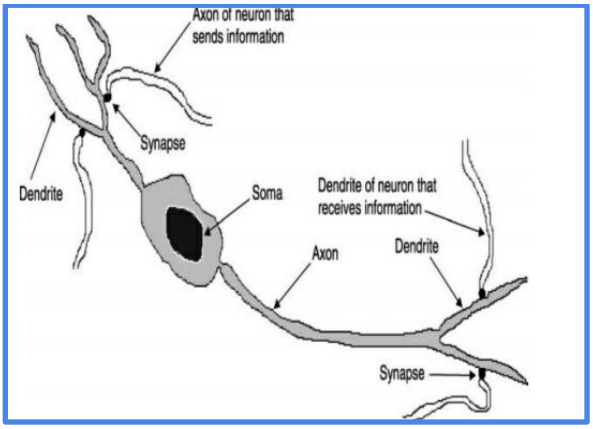

Figure 5:- Biological neural networks

While most scholars are concerned with the techniques to define ANN architecture, practitioners want to apply the ANN architecture to the model and obtain quick results. The neural network architecture refers to the arrangement of neurons into layers and the connection patterns between layers, activation functions and learning methods. The neural network model and the architecture of a neural network determine how a network transforms its input into an output. This transformation is in fact a computation. Often the success depends upon

a clear understanding of the problem regardless of the network architecture. However, in determining which neural network architecture provides the best prediction it is necessary to build a good model. It is essential to be able to identify the most important variables in a process and generate best-fit models. How to identify and define the best model it is very controversial.[4]

Neural systems forestall the need to utilize complex numerically express recipes, computer models, and unreasonable and expensive physical models.They can gain from models, and can bargain with non-straight issues. Besides, they display heartiness and adaptation to non-critical failure. The errands that ANNs can't deal with successfully are those requiring high exactness and accuracy as in rationale and number-crunching. ANNs have been applied effectively in a different fields of science, building, medication, financial aspects, meteorology, brain science, nervous system science, and numerous others.

II. LITERATURE SURVEY

2.1-Optimization of the one step transesterification process for the biodiesel production from Chlorella sp. MJ 11/11 Supratim Ghosh, Aayushman Srivastava,Debabrata Das:

The major agenda of this paper is to deliver the quality of production of biodiesel. A tweaked 20 L carrier photo bioreactor was used for the development of Chlorella sp. MJ 11/11. The biomass acquired was additionally utilized for creation of biodiesel. A one step transesterification process was used for the creation of biodiesel from algal lipids. The lipid substance of Chlorella sp. MJ 11/11 was resolved to be 58% w/w. The biomass acquired was flocculated utilizing chitosan (supply of 10 mg L-1) what's more, the flocculation effectiveness was seen as 97%. HCl was seen as the most reasonable impetus for the transesterification response. The most reasonable conditions required for transesterification were resolved. Using these conditions, the transformation of algal lipids to biodiesel was seen to be 84.2%. The unsaturated fats substance of biodiesel from the lipids of the microalgae proposed its probability as a promising fuel for what's to come.[1]

The consistently expanding fuel requests and the impediments of oil saves have persuaded research of inexhaustible and economical vitality assets to supplant, even mostly, petroleum derivatives, which are having a genuine natural effect on a dangerous atmospheric devotion and environmental change, over the top nursery discharges and deforestation. Thus, another option, inexhaustible and biodegradable ignitable like biodiesel is important. Direct transesterification of vegetable oils was embraced to integrate the biodiesel. A few factors controlled the procedure. The soluble impetus that is utilized, ordinarily sodium hydroxide (NaOH) or potassium hydroxide (KOH), builds the solvency and accelerates the response. Along these lines, the approach that this investigation proposes for improving the biodiesel creation depends on processing procedures for expectation and enhancement of these procedure measurements. The technique fabricates and chooses a gathering of relapse models that foresee a few properties of biodiesel tests (consistency turbidity, thickness, high warming worth furthermore, yield) in view of different qualities of the transesterification procedure (dose of impetus, molar proportion, blending speed, blending time, temperature, moistness and polluting influences).

In this research paper the results is also discussed perfectly as transesterification process is use for the production of biodiesel. The persuasive parameters for transesterification viz impetus fixation, Ethanol sum, response temperature and response time were streamlined to improve the biodiesel yield.

2.2Optimization of alkali catalyst for transesterification of jatropha curcus using adaptive neuro-fuzzy modeling,Vipan K Sohpal1*, Amarpal Singh2

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As the title describes the utilization of another AI technique for identifying the properties of biodiesel. This research paper deals with the proper way to utilise the Fuzzy logic for the research purpose in biotechnology. Fuzzy logic is the another alternative technology of an Artificial intelligence used for delectation of many of the properties.

In this research paper Transesterification of Jatropha curcas for biodiesel production is a kinetic control process, which is complex in nature and controlled by temperature, the molar ratio, mixing intensity and catalyst process parameters. A precise choice of catalyst is required to improve the rate of transesterification and to simulate the kinetic study in a batch reactor. The present paper uses an Adaptive Neuro-Fuzzy Inference System (ANFIS) approach to model and simulate the butyl ester production using alkaline catalyst (NaOH). The amounts of catalyst and time for reaction have been used as the model's input parameters. The model is a combination of fuzzy inference and artificial neural network, including a set of fuzzy rules which have been developed directly from experimental data. The proposed modeling approach has been verified by comparing the expected results with the practical results which were observed and obtained through a batch reactor operation. The application of the ANFIS test shows which amount of catalyst predicted by the proposed model

is suitable and in compliance with the experimental values at 0.5% level of significance. This paper deals with the application of the fuzzy logic for predicting the production rate of the ester of butyl in the batch transesterification reactor. In this article, the MISO fuzzy model is developed using ANFIS and validated through experimental results for given conditions. With more than 99% average accuracy, it has been found that the results generated by the designed fuzzy models are close to the experimental results. From statistical analysis, it has been concluded that the maximum differences between the cumulative distributions (D) is in the range of 0.1591 to 0.1818 in comparison to the experimental data obtained using FIS. With this low deviation, the accuracy of the model can be used by the process engineer who would like to get quick answers for online intelligent control and/or optimization. The optimum amount of catalysts required in this particular reaction is 28.5-30 gm, and in its current state, the model is limited to the amount of catalyst and reaction time. This study supports the idea that the fuzzy logic technique can be used as a viable alternative for carrying out analysis. Moreover, the Fuzzy logic allows for the modelling and control problem to be treated simultaneously.[2]

2.3-A Study on Genetic Algorithm and its Applications

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Genetic algorithm (GAs) are a class of stochastic hunt calculations, which reproduce the biologic advancement in nature. Genetic calculations incorporate basic hereditary calculation (SGA) furthermore, a portion of its varieties. Not the same as customary single spot based hunt calculations, hereditary calculations embrace a pursuit methodology dependent on populace. Utilizing hereditary activity of determination, hybrid and change, people in populace will trade and aggregate the information on the issue to be settled. In this way, genetic algorithm are truly appropriate to handle muddled issues that conventional hunt calculations cannot settle, in any event, when the angle data of the issue is inaccessible, or no precise target work is accessible. Genetic algorithm can perform worldwide hunt consummately, in any case, their neighbourhood search ability is poor.

The target for Genetic algorithm calculation is all people of a province and the genetic calculation employments randomization innovation direction to successfully search the coded parameter space. Determination, hybrid and variety make out of genetic activity of genetic calculation and five components, including parameter coding, essential province setting, wellness work structure, hereditary activity plan and control parameter setting make up of focal substance of hereditary calculation. The genetic administrator is the central administrator in view of entire looking through capacity.

This paper elaborates that how Genetic Algorithms end up being better in discovering territories of mind boggling and certifiable issues. Genetic Algorithms are versatile to their surroundings, as this kind of technique is a stage showing up in the evolving condition. In Present these calculations are increasingly material. A few enhancements must be made all together that GAs could be all the more by and large pertinent.

In order to obtain best solutions, elaboration was done in mentioned research paper for measuring and differentiating best solutions from worst solutions. The measure could be an objective one that is a statistical model or a simulation, or it can be a subjective one where we choose better solutions over worst ones. Apart from this the fitness function determines a best solution for a given problem, which is subsequently used by the GA to guide the evolution of best solutions. This paper shows how GA is combined with various other methods and technique to derive optimal solution, increase the computation time of retrieval system the applications of genetic algorithms in various fields. [3]

2.4Application of ANN to Optimize the Performance of CI Engine Fuelled With Cotton Seed Oil- A Review

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ANN can gain from model, are issue open minded as in this can deal with boisterous and inadequate information and ready to manage non-direct issue. This is especially helpful in framework demonstrating, for example, in executing complex mapping and framework recognizable proof. The significant goal of this paper is to outline how ANN procedure may assume a significant job in displaying and advancement of the presentation of CI motor fuelled with cotton seed oil. And furthermore to comprehend the impact of cotton seed oil properties on CI motor execution. This papers also elaborates that Artificial Neural Network is inspired from Biological neural networks system and also how much exactness the ANN has.

Artificial neural network (ANN) displaying has been effectively utilized in later a long time to increase new information in different orders. Biodiesel feedstock's, creation forms, compound pieces, norms, physio-substance properties and being used execution are talked about. Restrictions of current biodiesel feedstock's over group of people yet to come biodiesel feedstock have been recognized. The utilization of ANN in

displaying key biodiesel quality parameters and ignition execution in vehicle motors is likewise talked about. The world wide survey has verified that ANN demonstrating has a high potential to add to the advancement of sustainable power source frameworks by quickening biodiesel inquire about.

ANN is collection of small individually interconnected processing units. Information is passed between these units with the help of interconnection weights. ANN requires some past data to train with respect to that data set until the learning of network. Once ANN trained then it will predict new pattern of data. From this it is clear that ANN technique is very useful to predict and optimize the performance of CI engine. The use of cotton seed oil as biodiesel reduces the CO, PM and smoke emission but there is slight increase in NOX emission when compared to neat diesel fuel. Thermal efficiency with cotton seed oil was slightly lower than that of neat diesel fuel due to lower heating value of cotton seed oil.[4]

Utilization of ANN is been approved by many researchers worldwide. There are many methods of utilisation of ANN software's. There are many software's for using ANN setup. The top ANN software are neural network, GMDH shell, Neutrophil, Darknet, and Neurosolutions. Most of the research paper elaborates the best use of using the ANN software's in various fields.

III. CONCLUSIONS:-

The following conclusions are drawn based on the theoretically results of the diesel engine with cottonseed biodiesel blends as compared to base diesel. Cottonseed biodiesel can be used in blended form as an alternative fuel in any diesel engine without any modification.

Related to AI technique we conclude that the three AI technique mentioned in this paper are widely used and found the best technique by the researchers.

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Biodiesel Production From Animal Fats And Its Impact On The Diesel Engine With Ethanol-Diesel Blends: A Review Darunde Dhiraj S.1, Prof. Deshmukh Mangesh M.Tech (Thermal engineering) Student, GCOE Amravati 2 Associate Professor, Department of Mechanical Engineering, GCOE Amravati.

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1 Department of Mechanical Engineering, University of La Rioja, 26004 Logroño, La Rioja, Spain; ruben.lostado@unirioja.es (R.L.L.); fatima.somovilla@unirioja.es (F.S.G.)
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3 Department of Mining Exploitation and Prospecting, University of Oviedo, 33004 Oviedo, Asturias, Spain; vergaraeliseo@uniovi.es* Correspondence: marina.corral@unirioja.es; Tel.: +34-941-299-527 6)A simplified fuzzy logic approach for materials selection in mechanical engineering design R. Sarfaraz Khabbaz a , B. Dehghan Manshadi a, A. Abedian a,*, R. Mahmudi B. Department of Aerospace Engineering, Sharif University of Technology, Tehran, P.O. Box 11365-4563, Tehran.

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