Energy application from the sun to heat water is well known. Solar water heater is a device which is used for heating the water for domestic and industrial purposes by utilizing the solar energy. Solar energy is the energy which is coming from sun in the form of solar radiations in infinite amount, when these solar radiations fall on absorbing surface, then they gets converted into heat. This heat is used for heating the water.

This paper presents the study based on three procedure theory. Exergy analysis is conducted with the aim of providing some methods to save cost and keep the efficiency of solar water heater to desired extent and at the same time figuring out related exergy losses. In the Exergy analysis of solar water heater systems, the conversion of solar radiation is typically included within the analysis. Exergy analysis has been widely used for the optimisation and allocation of losses in energy systems. Exergy is the expression for loss of available energy due to the creation of entropy in irreversible systems or processes. The exergy loss in a system or component is determined by multiplying the absolute temperature of the surroundings by the entropy increase. Exergy is also a measure of the maximum useful work that can be done by a system interacting with an environment. It has been widely used in the design, simulation and performance evaluation of energy systems.

**Keywords:** Solar water heater, Laws of Thermodynamics, Exergy Analysis, Three procedure theory.

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**GREEN VEHICLE: POLLUTION CONTROL THROUGH CATALYTIC CONVERTER AND PERFORMANCE ANALYSIS OF THE SAME**

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Regardless of how perfect engine is operating, there will always be some harmful byproducts of combustion. When the combustion of fuel takes place in an engine of an automobile in the presence of air, following reaction takes place:

\[
\text{Hydrocarbons} \xrightarrow{\text{Heat}} x\text{CO}_2 + y\text{H}_2\text{O} + \text{Heat}
\]

Fumes of un-burnt hydrocarbons produce a number of petrochemical oxidants & photochemical smog with O₂ & N₂ which causes adverse effects on physiological activities of living beings. Emissions from gasoline powered vehicles are generally the hydrocarbons like CO, NOₓ, SO₂, etc.

Catalytic converter is a device which treats the exhaust emission and converts them into the less harmful substances. This device is located in-line with the exhaust system and is used to cause a desirable chemical reaction to take place in the exhaust flow. In this paper the various aspects of design, construction, working and performance analysis of a catalytic converter are discussed. The converter performance is simulated by considering chemical reactions and heat transfer phenomena as the exhaust gases flow through the catalyst.

**Keywords:** Green Vehicle, Pollution control
PERFORMANCE INVESTIGATION OF A COMPACT TRI-GENERATION SYSTEM BASED ON RENEWABLE ENERGY POWER PLANT EXHAUST GAS WASTE HEAT UTILIZATION

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This paper presents a compact tri-generation system in order to cover the electric and thermal power demand of small rural areas using the renewable energy. The gasifier generator coupled power plants are being widely used in rural communities where electric network doesn't exist. The recovery of the exhaust gases makes the system very attractive. Apart from it, there is the performance study of a compact power plant and a tri-generation plant. The stack gases from internal combustion engine are directed to a 25 kW ammonia-water absorption refrigeration chiller. In the power plant, 31.25% is the electric power generation of the total fuel gas input and same amount of stack gases at temperature 400°C just at outlet of engine is used to operate absorption chiller machine which is having COP of 0.517. The temperature of cold storage was between 0°C-5°C at 15kW cooling capacity. The engine water jacket was used for heating purpose and the temperature gain was between 60°C-63.5°C.

**Keywords:** Tri-generation, renewable energy, exhaust gas waste.

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DECOMPOSITION OF ENERGY CONSUMPTION IN INDIA: A DISCUSSION IN THE CONTEXT OF INDEX DECOMPOSITION ANALYSIS (IDA)

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India is a developing country with enormous growth in the Industrial sector. A major concern however lies in the limited energy resources which are the driving force of any industry or country as a whole. Hence, it becomes important to focus on the energy consumption pattern of the country and to identify where optimization is needed. Energy consumption is also related to the environment i.e. CHG emissions and therefore CHG monitoring is also important to check the emissions. Index Decomposition Analysis (IDA) is an analytical tool based on the Index Number Theory used in Economics and Statistics. It is at present a much sought after research area to analyse the energy consumption pattern or to decompose energy indicators. IDA is widely used to disentangle and separate changes in energy consumption, energy intensity and CHG emissions in energy and environmental field. In the present work an attempt has been made to review the energy consumption in India and discuss IDA.

**Keywords:** IDA, CHG

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THERMO-ECONOMIC OPTIMIZATION OF WORK CONSUMING DEVICES

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The finite-time and finite size are considered to be the major constraints in the optimization of the real systems. In classical thermodynamic analysis, these constraints are not considered because of the inherent assumption of reversibility. Finite Time Thermodynamics provide a fundamental starting point for the optimization of real systems. The optimization studies of refrigeration and heat pump systems that consider various objective functions based on Finite Time Thermodynamics and thermo-economics are reviewed here.

**Keywords:** FTT, Endo-reversible, Refrigerator, Heat Pump, Heat Reservoir
CLEAN COAL TECHNOLOGIES FOR POWER GENERATION IN INDIA
A NEAR ZERO EMISSION PLANT APPROACH

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Coal is chemically and physically a complex and heterogeneous material, consisting of organic and inorganic constituents from its origin. Concerted efforts are needed to reduce “ash-forming” inorganic elements and to develop clean methods of using coal. A combined-cycle gas turbine power plant consists of one or more gas turbine generators equipped with heat recovery steam generators to capture heat from the gas turbine exhaust. Steam produced in the heat recovery steam generators powers a steam turbine generator to produce additional electric power. Gas-fired combined-cycle plants produce less carbon dioxide per unit energy output than other fossil fuel technologies because of the relatively high thermal efficiency of the technology. Grate firing was the first combustion system used for solid fuels followed by pulverized and fluidized bed firing. The concept of burning coal that has been pulverized into a fine powder stems from the belief that if the coal is made fine enough, it will burn almost as easily and efficiently as gas. Various scrubbing processes have been proposed to remove carbon dioxide from air or flue gases. In contrast to wet scrubbers which apply energy directly to the flowing fluid medium, an ESP applies energy only to the particulate matter being collected and therefore is very efficient in its consumption of energy (in the form of electricity). Most FGD systems employ two stages: one for fly ash removal and the other for SO2 removal. However, these systems experienced severe maintenance problems and low removal efficiency. In wet scrubbing systems, the flue gases normally passes first through a fly ash removal device, either an electrostatic precipitator or a wet scrubber, and then into the SO2-absorber. However, in dry injection or spray drying operations, the SO2 is first reacted with the sorbent, and then the flue gas passes through a particulate control device. Another important design consideration associated with wet FGD systems is that the flue gas exiting the absorber is saturated with water and still contains some SO2. These gases are highly corrosive to any downstream equipment such as fans, ducts, and stacks. Usage of supercritical and ultrasupercritical pulverised coal technologies along with Circulating Fluidised Bed Combustion besides IGCC has been discussed as Clean Coal Technologies for power generation. Hence the paper Clean Coal Technologies for Power Generation in India: A Near Zero Emission Plant Approach is limited to the study of various technologies to reduce emissions/greenhouse gases by coal combustion.

Keywords: Coal Beneficiation, Coal Gasification, Fluidised Bed Combustion, Integrated Gasification Combined Cycle, Flue Gas Desulphurisation, Electrostatic Precipitator, Carbon Capture and Storage.

LIMITATIONS OF ENERGY UTILIZATION OF SOLID WASTE DUE TO IT'S POOR QUALITY

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The increasing problem of continuous population growth in the metro cities and subsequent increase in solid waste disposal has created a severe problem as well as its hazardous effects may not be overlooked. The major utilization of this solid waste in India is limited to composting only. The amount of solid waste in Delhi alone is nearly 9000 MT / day. The quality of compost is not appropriate because of mixed solid waste and its poor quality. The compost thus produced is not salable in the market. In domestic solid waste if the organic content is collected separately the food stuff waste content can be utilized for compost which shall be of good quality. Again the content in the form of Plastic and paper is suitable for the purpose of energy.

Keywords: Sanitary Land Fills (SLF), Waste to Energy Generation (WTE), Municipal Solid Waste (MSW)
A FEASIBILITY STUDY ON WASTE HEAT RECOVERY IN AN IC ENGINE USING ELECTRO TURBO GENERATION

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In a conventional IC engine a considerable heat is carried away by exhaust gases. To recover the waste heat, various methods are being adopted. One of them is turbo charging. In this project an attempt has been made to explore the various possibilities of waste heat / energy recovery methods in conventional commercial two wheeler and four wheelers. In this context, a new concept of hybrid engine has also been discussed. The heat energy contained in the exhaust gases are recovered in three different methodologies.

Firstly, by introducing an auxiliary combustion chamber and injecting an additional suitable fuel and then allowing it to expand in a turbine which forms the part of turbo charger unit. Thus the waste heat energy is utilized to burn an additional amount of fuel. The second stage contains a thermoelectric generator which produces electrical energy by utilizing the high heat of exhaust gases. The third stage energy recovery is done by coupling a compressor and an alternator. Both being coupled to the turbine shaft, produces electrical energy and compressed air which can be accumulated and used effectively for running any auto auxiliaries. Thus the principle of electro turbo generation has been adopted for waste heat recovery. In order to use the aforesaid combination of waste energy recovery systems a matrix has also been suggested.

REDUCING BATTERY DISCHARGING RATE USING PHOTO-ELECTRIC EFFECT

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To make the battery work longer once charged the electrons can be made to get over the negative terminal of the battery using the photon energy by the use of a low wave length ultra violet lamp [1]. In process forms a circuit that acts as the charging circuit of the battery. Thus the rate of discharge of the battery reduces and battery life increases. Such an arrangement if used with the battery will tend to recharge the battery when it's being used. Thus the net discharging rate of the battery is reduced.

**Keywords:** Electrons, photons, photo-electric effect, Work function, Ultra Violet Lamp.

THERMODYNAMIC MODELLING OF GROUND SOURCE HEAT PUMP FOR SPACE HEATING

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Fossil fuels are depleting day by day due to rapid industrialization and urbanization, so there are lot of effort made all over the world to use alternative energy resources. Ground Source Heat Pump is considered as one of the renewable energy resources used for heating and cooling purposes. In the present work, conservation equation for mass and energy are derived for a GSHP system with simple U Tube Ground heat exchanger. The performance characteristics of GSHP are computed in terms of COP and energetic aspect. After successful validation of the equation and procedure, the analysis has been performed for the application of GSHP for space heating load of 5KW for R 22 and R 134 a (Tetra fluoro ethane) refrigerants.
It has been seen that R 134 a have high COP than R 22. R134 a have no chlorine content and it can be considered as eco-friendly.

Keyword – Ground Source Heat Pump, Energy Analysis, Mass flow rate, Coefficient of Performance

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ALTERNATIVES TO R134A (CF3CHF) REFRIGERANT- A REVIEW

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R134a (Hydrofluorocarbon refrigerant) is used in domestic refrigeration and other vapour compression system. R134a is having zero ozone depletion potential (ODP) and almost same thermodynamic properties as R12 (Chlorofluorocarbon refrigerant), but it has 1300 global warming potential (GWP) per year which is very high. So, there is a need to find out the alternatives to R134a from toxicity, flammability, thermodynamic, thermo-economic and environment point of view. This review paper also represents the recent development done on alternatives to R134a.

Keywords: Global warming, Ozone depletion, Alternative refrigerant, Flammability

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A REVIEW OF COMBINED CYCLE POWER PLANT THERMODYNAMIC CYCLES

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Simple cycle gas turbine engines suffer from limited efficiencies and consequential dominance of fuel prices on generation costs. Combined cycles, however, exploit the waste heat from exhaust gases to boost power output, resulting in overall efficiencies around 50%, which are significantly above those of steam power plants. This paper reviews various types of combined cycles, including repowering, integrated gasification and other advanced systems.

Keywords: Combined cycle power plant, gas turbine, HRSG

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A REVIEW ON PARABOLIC TROUGH TYPE SOLAR COLLECTORS: INNOVATION, APPLICATIONS AND THERMAL ENERGY STORAGE

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The global demand for energy is growing and conventional energy sources like coal and petroleum are depleting, and renewable resources will play a crucial role in the future. This paper presents an overview about the parabolic trough solar collector which is one of the renewable source. Parabolic trough collector can supply the thermal energy up to 4000°C, mainly in steam power plant for electricity generation. Many applications of Parabolic Trough Collector, it’s innovations and thermal energy storage materials has been discussed keeping in mind the environmental benefits. In India, the states of Rajasthan and Gujarat have the potential for widespread application of PTC to harness the solar energy. The launch of The
Jawaharlal Nehru National Solar Mission (JNNSM) in 2008 by the Indian Government and its initiatives, complemented by state solar policy passed by the states of Rajasthan and Gujarat, will go a long way based on deployment of both solar PV projects and solar thermal projects in a ratio of 50:50, in MW terms to fulfilling India's upcoming energy needs.

**Keywords:** - Parabolic Trough Collector (PTC), concentrated solar power (CSP), heat transfer fluid (HTF), Thermal energy storage.

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**STUDY OF FLOW AND HEAT TRANSFER IN PLATE FIN HEAT EXCHANGER AT VARYING REYNOLD'S NUMBER**

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Heat transfer characteristics and flow structure in laminar and turbulent flows through a rectangular channel containing built in vortex generators have been analyzed by means of solutions of the full Navier-Stokes and energy equations. The effects of two different shaped LGVs, rectangular winglet pair (RWP) and delta winglet pair (DWP) with two different configurations, common-flow-down (CFD) and common-flow-up (CFU), are studied. The numerical results indicate that the application of LGVs effectively enhances heat transfer of the channel. According to the performance evaluation parameter \( \frac{(Nu/Nu_0)/(f/f_0)} \), the channel with DWP has better overall performance than RWP; the CFD and CFU configurations of DWP have almost the same overall performance; the CFD configuration has a better overall performance than the CFU configuration for RWP. The basic mechanism of heat transfer enhancement by LGVs can be well described by the field synergy principle. The main purpose of this study is to show the performance of delta winglet type vortex generators in improving heat transfer.

**Keywords:** Vortex generator; Common flow up; Heat transfer enhancement; Plate-fin & tube heat.

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**PERFORMANCE IMPROVEMENT OF A CONTROL VALVE USING COMPUTATIONAL FLUID DYNAMICS**

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This article describes the design and performance improvements of a high pressure turbine bypass valve Zick Twist trim (multi stage, multi path). For effective control of velocity, pressure and temperature, a trim designed to have a tortuous path was designed. Computational fluid dynamics and FEM analyses were used in the design process. The valve, which was installed with the designed trim, was tested. To evaluate its performance in the field, the valve was installed at a 225MW combined power plant system for two months. The results showed that the pressure letdown was successfully controlled by the designed trim, and the noise level was reduced below 85dB. The main objective of the work is to find the pressure drop, velocity variation, temperature distribution in the different stages of the turbine bypass valve using computational fluid dynamics. This is done to increase the performance of the valve.

**Keywords:** Zick Twist trim (multi stage, multi path, tortuous path trim), turbine bypass valve, pressure control, velocity control, temperature control, disc stacks, computational fluid dynamics exchanger.

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CFD APPLICATION IN PASSIVE BUILDING DESIGNS

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The main factors which govern physical conditions and comfort are air temperature and air movement. These factors will assist the designer to know or to reach the suitable thermal comfort to attain the primitive knowledge, it used in passive building design. Thus, in this paper, simulation study has been performed to estimate the distribution of air temperature inside the common room with the direction of velocity and the indoor environment by using ANSYS Fluent 12.1. The simulation results show that radiation model assist better to understand the mixed convection, force convection with temperature in ventilated spaces.

Keywords: CFD, Passive, Radiation, Building Design

ENERGY AUDIT OF 250 MW THERMAL POWER STATIONS PTPS, PANIPAT

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Energy conservation means, the need is to use energy efficiently and effectively. Energy Audit is a technical survey of a plant in which the machine/section wise/department wise pattern of energy consumption studied and attempts to balance the total energy input correlating with production. As a result of the study the areas where the energy is wastefully used and the improvements are felt, are identified and corrective measures are recommended so that the overall plant efficiency could be improved. Fundamental understanding of the process is essential if we are to improve the overall efficiency of the system. In this work an energy audit of 250MW Power Plant (Coal – based) is presented at different loads. In thermal power station approximately 90% of the fuel i.e. Coal alone. In my work the overall plant efficiency observed 33.67% (210MW), 35.89% (232MW) and 36.74% (250MW). The component efficiencies found 85.23% (Boiler), 41.19% (Turbo-Gen.) and 53.33% (condenser) at full load.

THERMODYNAMIC ANALYSIS OF GROUND SOURCE HEAT PUMP FOR SPACE HEATING USING R-22

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In the coming decades, global environmental issues will significantly affect the patterns of energy used around the world. Any future efforts to limit carbon emission likely to alter the composition of total energy–related carbon emissions by energy sources. Air pollutions are becoming an important environmental concern.
EFFECT OF ROUGHNESS ON SECONDARY FLOW IN A RECTILINEAR TURBINE CASCADE

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Three dimensional geometry of rectilinear cascade of four reaction blades is created in the Gambit® 2.2.3 software and flow behavior has been studied using FLUENT 6.2. Air with an inlet velocity of 102 m/s is passed through the cascade. The cascade is open to atmosphere at the exit. Initially, both surfaces of the blade of the cascade are kept as smooth and secondary loss is analyzed. This secondary flow loss is then compared with the blades on which a roughness of 500 µm is applied on suction surface and pressure surface individually as well as on both the surfaces together. It is observed that in a smooth blade average total loss is 14.7% whereas in case of blades having both the surfaces rough this loss gets almost doubled and becomes 27.7%. When roughness is applied to all the suction surfaces only then average total loss is 24.7% and if roughness is present only on the pressure surfaces then average total loss is 18.2%. But the corresponding average secondary loss decreases from 1.7% in case of smooth blades to 1.5% for rough blades. This average secondary loss is 1.9% for the blades on which roughness is present on all the pressure and 1.3% in case when roughness is applied to only suction surfaces of the blades.

Keywords: CFD, cascade, energy loss, roughness.

AN OVERALL EVALUATION OF FLOW CHARACTERISTICS AND PERFORMANCE PARAMETERS OF Y-SHAPED DIFFUSING DUCT WITH SAME ANGLE OF TURN AND DIFFERENT CENTERLINE LENGTH & RADIUS OF CURVATURE

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The several set of experiments have been carried out to compare the flow and performance characteristics of both Y-ducts made of epoxy resin having centerline length (300 mm & 600 mm) and radius of curvature (382 mm & 764 mm) for both sets of Y-ducts area ratio and aspect ratio keep constant i.e. 2 with turning angle 22.50/22.50°. The inlet shape of both limbs of Y duct is rectangular while the outlet is circular. All the experiments have been carried out for a fixed velocity ratio 1.2 (suction to free stream velocity). The maximum average inlet velocity at the inlet of duct is 15.06 m/s. The flow in duct is created by suction with the help of pipeline network which directly connected at the inlet of centrifugal blower with the help of control valve followed by a sliding door. All the parameters are measured with the help of a calibrated five hole probe. The results are presented in the form of 3-D plots for longitudinal velocity at inlet, contour plots for velocity and pressure as well as vector plots for secondary velocity along with wall pressure and mass averaged pressure recovery coefficients and loss coefficients. The Surfer graphic package based on finite volume method is used for all plots.

Keywords: Y-Shaped Diffusing Duct, turning angle, Centerline length, Radius of curvature, CP and CLoss.

REVIEW OF DIFFERENT TECHNOLOGIES IN THE SOLAR ABSORPTION AIR-CONDITIONING SYSTEMS

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The aim of this article is to review the currently available solar air-conditioning technologies, their energy saving potential and technical limitations. The scope of this article is to brief the processes and to consolidate the commercially available...
Solar cooling technologies for comparison. Although a large potential market exists for this technology, existing solar cooling systems are not yet competitive with conventional electricity-driven or gas-fired air-conditioning systems because of their high initial costs. In this paper, the technologies working only on liquid absorption cycle are discussed in brief. The paper looks at ways of improving the performance of the solar air-conditioning (chiller) subsystems by using the different technology.

**Keywords:** Solar Air-conditioning; Absorption chiller; Lithium bromide and water; Generator Temperature.

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ENERGY METHOD FOR PERFORMANCE EVALUATION OF A BOILER IN A COAL FIRED THERMAL POWER PLANT: A REVIEW

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Boiler is one of the most important components for any power generation system. Performance of a boiler, like efficiency and evaporation ratio directly affects the overall performance of the electricity generation process and it reduces with time, due to poor combustion, heat transfer fouling and poor operation and maintenance. The easiest and most cost effective method [1] is to estimate the efficiency value on five broad elements: (1) Boiler stack temperature (2) Heat content of fuel (3) Fuel specification (4) Excess air levels (5) Ambient air temperature and relative humidity. The current study puts forward an effective methodology for the performance evaluation of a boiler based on the work done by some of the experts in the field of thermal/energy studies and enlists some of the factors that affect the performance of a boiler.

**Keywords:** Thermal power plant, performance analysis

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SHELL SIDE CFD ANALYSIS OF A SMALL SHELL-AND-TUBE HEAT EXCHANGER CONSIDERING THE EFFECTS OF BAFFLE INCLINATION ON FLUID FLOW

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The shell side design of a shell-and-tube heat exchanger; in particular the baffle cut and baffles inclination dependencies of the heat transfer coefficient and the pressure drop are investigated by numerically modeling a small heat exchanger. The flow and temperature fields inside the shell are resolved using a commercial CFD software tool STAR CCM+ v6.06. In this present work, attempts were made to investigate the impacts of various baffle inclination angles on fluid flow and the heat transfer characteristics of a shell-and-tube heat exchanger for three different baffles inclination angles namely 0°, 10° and 20°. The simulation results for various shell and tube heat exchangers, one with segmental baffles perpendicular to fluid flow and two with segmental baffles inclined to the direction of fluid flow are compared for their performance. The results are observed to be sensitive to the turbulence model selection. For a given baffle cut of 36 %, the heat exchanger performance is investigated by varying mass flow rate and baffle inclination angle. From the CFD simulation results, the shell side outlet temperature, pressure drop, recirculation near the baffles, heat transfer, optimal mass flow rate and the optimum baffle inclination angle for the given heat exchanger geometry are determined.

**Keywords:** Shell-and-tube heat exchanger, CFD, Conjugate Heat Transfer, Pressure drop, Baffle inclination angle, turbulence models.

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PERFORMANCE BASED COMPARATIVE ANALYSIS OF THERMAL POWER PLANT: A REVIEW

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Coal based thermal power stations are the leaders in electricity generation in India. In this paper, the author attempts to investigate the gap between demand & supply and cost reduction in order to make the existing power plants more efficient. Efficient power generation is expected to make more power available at a lower cost for economic and other activities, which in turn shall make the country more competitive. The focus of the study is on the coal fired thermal power plants in the country. The performance calculation and rectification measures are essential for performance evaluation and efficiency enhancement.

Keywords - Thermal Power Plant, Performance Evaluation, Efficiencies, Energy

EXERGETIC ANALYSIS OF COMBUSTION CHAMBER OF A COMBINED HEAT AND POWER SYSTEM

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In the present analysis mathematical modeling for a 30MW cogeneration cycle is done and effect of cycle pressure ratio, inlet air temperature and turbine inlet temperature (TIT) is studied for the combustion chamber. Cogeneration is the production of electrical energy and useful thermal energy from the same energy source that is why it is called combined heat and power (CHP) system. From the results it is being found that there is an increase of exergy destruction by 31.30% when the inlet air temperature is increased from 5°C to 50°C. Increased exergy destruction shows that performance of combustion chamber deteriorates with the increase in inlet air temperature. A different pattern for the exergy destruction is observed when compressor pressure ratio is increased. From a compression ratio of 5 to 15 there is a decrease of exergy destruction in combustion chamber and after that it increases. After a compression ratio of 26, performance of system starts deteriorate and regenerator is no longer useful. That is why in the present analysis exergy destruction in the combustion chamber is studied only upto a pressure ratio of 26.

Keywords: Cogeneration; compressor; inlet air temperature; pressure ratio; TIT.

APPLICATIONS OF ARTIFICIAL NEURAL NETWORK IN SOLAR THERMAL SYSTEMS: A REVIEW

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Artificial intelligence (AI) techniques offer an alternative way to tackle complex and ill-defined problems to conventional techniques. They have biologically inspired computer programs design to simulate in such a way as human brain processes information. They can congregate acquaintance by identifying the patterns and relationships in data and learn through experience and able to handle noisy, incomplete data, non linear problems and prediction of data. ANNs have been the potential of combining and incorporating both literature-based and experimental data to solve complicated practical problems. They have been found application in various areas like control, forecasting, medicine, pattern recognition,
manufacturing, optimization, signal processing and social/psychological sciences and are becoming more and more popular nowadays. The current review work throw light on the application of the AI-techniques in solar energy systems; for modelling and design of mainly solar air heater, solar water heater and solar radiation estimation. Published literature incorporated in this review work shows the potential of ANNs as a design tool for the optimal solar energy systems.

**Keywords:** Artificial Intelligence; Solar Energy Systems; Solar Air Heater; Solar Water Heater; Photovoltaic Systems.

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**THERMODYNAMIC ANALYSIS FOR IMPROVEMENT IN THERMAL PERFORMANCE OF A SIMPLE GAS TURBINE CYCLE THROUGH RETROFITTING TECHNIQUES (INLET AIR EVAPORATIVE COOLING, STEAM INJECTION & COMBINED IAC AND STIG)**

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Retrofitting technologies [inlet evaporative cooling system and steam injected gas turbine] have been applied on simple gas turbine cycle for performance improvement followed by parametric analysis. The performance improvement has been thermodynamically analysed and discussed for retrofitted techniques followed by performance studies. The parametric study predicts that retrofitting techniques (FCS and STIG) improves net power output, thermal efficiency, power generation efficiency, first law efficiency and exergetic efficiency (second law efficiency) while heat rate falls with a considerable increment in fuel consumption. Exergy analysis showed that combustion chamber and turbine are most sensitive components of retrofitted system. The results show that the power output, thermal efficiency, exergetic efficiency and fuel-air ratio have been enhanced 3.1%, 0.18%, 0.2% and 1.0% respectively while heat rate falls 0.6% by FCS technology. The power output, thermal efficiency, exergetic efficiency and fuel-air ratio have been improved 27.4%, 3.5%, 25.8% and 14.4% respectively while heat rate falls 10.2% by STIG technology. The analysis shows that STIG technology is better than FCS and the combined FCS & STIG technology enhance the power output, thermal efficiency, exergetic efficiency and fuel-air ratio 30.5%, 3.5%, 25.7% and 15.2% respectively and reduces the heat rate 10.4%.

**Keywords:** Gas turbine, Retrofitting, FCS, STIG, Exergy

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**TIME DEPENDENT ANALYSIS OF COOLING LOAD USING FDM APPROACH**

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The present work analyses the variation of cooling load with time of a system having single entity with the use of Finite Difference Method. Cooling load calculation is the major work performed in the air-conditioning system design. This should be performed as accurately as possible to reduce over design or under design of the system. Earlier work of analyzing cooling load with time involves Conduction Transfer Function (CTF) Method. Finite difference method is used for computation of transient heat conduction through the wall and roof. Implicit finite difference method is chosen for its stability. Heat gain through window is calculated by taking solar heat gain coefficients (SHGC). Infiltration effect in the total cooling load is also discussed. The components of heat gain are finally categorized under convective and radiant portion. The convective portions are taken as cooling load. The radiant portions are changed to cooling load by multiplying them with radiant time factors. Finally an example of an auditorium is taken & cooling load is calculated at different instant of time which ultimately helps in the design of an air conditioning system.

**Keywords:** Cooling Load, Finite Difference Method, Solar Heat Gain Coefficient.
USE OF BIOGAS FOR COOKING PURPOSE IN A TECHNICAL INSTITUTE: A VIEW POINT

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Energy crisis in world is increasing. There are limited resources of crude available on the earth. Price of LPG increasing day by day. There is a lot off waste generated which have a problem of disposal. Bio gas production condition in India is very high. The temperature conditions for the production of bio gas are very favorable throughout the year and the availability of the bio degradable waste is in bulk. There is great need for the development of the plants which should be based on the Kitchen waste, industrial waste and municipality waste treatment. So author feel, there is a lot of potential to produce biogas from kitchen waste. SLIET is spreading in 451 acre area. More than four thousand students are staying in 13 boys and girls hostels and five hundred families are also staying in residential area of SLIET campus. A survey is conducted at SLIET Longowal and kitchen waste data collected from different mess, residential areas, shopping complex and restaurant. Survey revealed that 600 kg/day of kitchen waste collected from residential area of faculty, staff, students mess and other location. Biogas of more than 32 kg/day (2 LPG Cylinder/day) can be produced by using the biogas plant. There is an expenditure of Rs 2.50 lacs in constructing a bio gas plant. Produced biogases have a potential to replace a LPG already utilized for a cooking purpose of 250 student capacity in a hostel. The payback period is around 1 year and 3 months approximately.

Keywords: Kitchen Waste, Biogas Plant, Anaerobic Di.

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CFD MODELING FOR PNEUMATIC CONVEYING

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CFD simulation is used to investigate the pressure drop prediction capabilities of CFD techniques for a 900 pipe bend in horizontal plane for an extended range of conveying conditions in a pneumatic pipe line system. The conveyed material was cement with a mean particle size (d50) of 25 micron. In Test Rig, the 900 bend of 52mm internal diameter and D/d of 6 was configured horizontally. The computational grids for the horizontal pipe bend similar to that used in experiment. There is broad qualitative agreement in trends and flow patterns of pneumatic conveying through pipeline system. For the high solids loading ratio the Eulerian solver and transient analysis and at lower solids loading ratios the mixture model and steady-state analysis were more appropriate.

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ELECTRONIC WASTE MANAGEMENT IN INDIA

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The electrical and electronic waste (e-waste) is one of the fastest growing waste streams in the world. The increasing “market penetration” in developing countries, “replacement market” in developed countries and “high obsolescence rate” make e-waste as one of the fastest growing waste streams. Environmental issues and trade associated with e-waste at local, transboundary and international level has driven many countries to introduce interventions.
**ALTERNATIVES OF FREONS**

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Ozone layer depletion by CFCs occurs by breakdown of chlorine atoms from refrigerants by UV radiation and reaction with ozone in stratosphere. Chloro fluoro-carbons are responsible for the depletion of ozone layer. Hence all the CFCs like R11, R12, R113, R115, R502 are being phased out. So we need some alternatives.

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**WASTE TO ENERGY: USING MSW OF KATRA TOWN FOR ELECTRICITY GENERATION**

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India's energy demands have increased very rapidly with the ever increasing population. The process of urbanization and industrialization also add to this demand. Movement of India’s growth and economy in the last 30 years averaging growth of 7% per year since 2000. Today India rank forth in world energy consumption. The IEPR report has estimated by 2030 energy requirement would go high by 5-6 % of current level. There is deficit in energy production and is equivalent to 16.8% of its peak demand as recorded on June 2011. For sustaining the growth India is presently recording this gap to be narrowed. So an urgent challenge for mankind to develop low cost, non polluting energy production technology. Another problem of India is rising population and the waste generated by them. With the rate of urbanization 2.8% annual rate of change waste generation is only going to rise. Overwhelming 90% of waste produced in India is disposed in land filling leading to innumerable health and environmental hazards. This report aims to address both aforesaid issues taking case study of Katra town. Katra has a high floating population that will touch 10.5 million footfalls by the end of December 2012. Report is focussing on converting “waste to energy” and need for better management of waste generated.

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