1. **Mr. MohdIshaq Patel et al (2018)**, Shell and tube heat exchangers result in high shell-side pressure drop and formation of recirculation zones near the baffles. Most of the researches now a day are carried on helical baffles, which give better performance than single segmental baffles but they involve high manufacturing cost, installation cost and maintenance cost. The effectiveness and cost are two important parameters in heat exchanger design. So, In order to improve the thermal performance at a reasonable cost of the Shell and tube heat exchanger, baffles in the present study are provided with some inclination in order to maintain a reasonable pressure drop across the exchanger.

2. **V. Salamon et al (2017)**, The use of nanoparticle dispersed coolants in automobile radiators improves the heat transfer rate and facilitates overall reduction in size of the radiators. In this study, the heat transfer characteristics of water/propylene glycol based TiO2nanofluid was analyzed experimentally and compared with pure water and water/propylene glycol mixture. Two different concentrations of nanofluids were prepared by adding 0.1 vol. % and 0.3 vol. % of TiO2 nanoparticles into water/propylene glycol mixture (70:30). The experiments were conducted by varying the coolant flow rate between 3 to 6 lit/min for various coolant temperatures (50°C, 60°C, 70°C, and 80°C) to understand the effect of coolant flow rate on heat transfer. The results showed that the Nusselt number of the nanofluid coolant increases with increase in flow rate. At low inlet coolant temperature the water/propylene glycol mixture showed higher heat transfer rate when compared with nanofluid coolant. However at higher operating temperature and higher coolant flow rate, 0.3 vol. % of TiO2nanofluid enhances the heat transfer rate by 8.5% when compared to base fluids.

3. **Mukkera Hemanth and Sandeep Mulabagal(2017)** Heat exchanger is a device used to transfer heat between one or more fluids. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact. In this work, different NANO fluids mixed with base fluid water are analysed for their performance in the shell and tube heat exchanger without baffle and with baffle(900,300 and helical type baffle). The NANO fluids are Aluminium Oxide and Titanium carbide for two volume fractions 0.4, 0.5. Theoretical calculations are done determine the properties for NANO fluids and those properties are used as inputs for analysis. 3D model of the shell and elliptical tube heat exchanger is modelling in CREO parametric software. CFD analysis is done by ANSYS software.

4. **Jami Paparao et al (2017)** deals with performance of vapor absorption refrigeration system is used to produce refrigeration effect by using the recovery of thermal energy available at exhaust gases of internal combustion engine. The Net heat transfer in the generator from hot flue gases to aqua ammonia strong solution is purely depends upon the heat transfer surface contact area, these surface contact areas basically depends upon
the shape of the device. The COP of the vapor absorption refrigeration system mainly depends upon the heat extracted at refrigeration cabin to the heat supplied at the generator. So if available heat from engine emissions is high in generator contact surfaces then the net heat supplied to the refrigerant will be more there by COP may increase.

5. **Maysam Molana (2017)** Low efficiency heat exchangers used in automotive as radiator may cause to serious dangers for the engine. Hence, thermal scientists and engineers always pursue modern methods to enhance the heat removal of the engine. It seems nanofluids implementation in automotive cooling system promises to achieve high efficiency radiators. This paper reviews almost all performed studies in this area that are available in the literature. Author collects details about nanoparticles materials and size, base fluid, volume, concentration, flow regime and Reynolds number used in studies. Usually, maximum heat transfer enhancement and maximum need to pumping power occurs at the highest volume concentration of nanoparticles, simultaneously. On the other hand, using nanofluids, due to the enhanced heat carrying capacity of the nanofluids; the pumping power required will also be reduced.

6. **Kumar Sai Tejes, P et al (2017)** At present, the need for improvement in the efficiency of the IC engines has been increased rapidly, hence need a effective cooling system. Radiators are heat exchange devices in automobiles, responsible for carrying out the heat from the engines. In this work, car radiator was tested by the Nano fluids to increase its heat transfer capacity and new experimental results were reported. Zinc Oxide Nano fluids were prepared and tested by adding their nanoparticles in water and propylene glycol (60:40) with different volume fractions (0.15, 0.25 and 0.4) %. Experimentally, the effect of these concentrations were observed by varying a fluid flow rate from 6 to 16 liter per minute and the inlet temperature of fluid entering in radiator from 50 0 C to 80 0 C . The increase in heat transfer rate was observed as 46% by using ZnO Nano fluid with volumetric concentration 0.4%. Also, increase in volumetric concentration has shown the improvement in the heat transfer.

7. **Nakka Sita Rama Raju and V Jaya Prasad (2017)** consists of a simplified model of shell and tube type heat exchanger having both interacting mediums as water and steam. In this paper we have first designed a shell and tube heat exchanger to heat water from 40° to 70° by steam at 140° temperature. study it is clear that if we assign copper to the whole assembly then we shall get the best possible Hence it will be a good deal to assign combination of Steel 1008 and Copper as heat exchanger material. Steel is also a moderate conductor of heat and can be employed, in case greater material economy and corrosion resistance is desired.

8. **Vishal H Acharya (2017)** A heat exchanger is a device that is used to transfer thermal energy (enthalpy) between two or more fluids, at different temperatures and in thermal contact. The tube diameter, tube length, shell types etc. are all standardized and are
available only in certain sizes and geometry. And so the design of a shell-and-tube heat
exchanger usually involves a trial and error procedure where for a certain combination of
the design variables the heat transfer area is calculated and then another combination is
tried to check if there is any possibility of reducing the heat transfer area.

9. Kamlesh S. Shelke1 et al, (2017) This study focuses on the various experimental
research analyses on performance of tubular heat exchangers the tubular heat exchanger
is used throughout various industries because of its inexpensive cost and handiness when
it comes to maintenance. In this paper we discuss about tubular heat exchanger there are
several thermal design factors that are to be taken into account when designing the tubes
in the tubular heat exchangers. They are tube diameter, tube length, number of tubes,
number of baffles,& baffles inclination etc. The characteristics of flow and heat transfer
within the shell are not simple.

10. Raj Kumar Yadav and Veena Nayak Jain, (2016) wise twisted tape provides higher
heat transfer than the other. The effects of twisted tapes with four different clearance
ratio and two different twist ratio on heat transfer were numerically discussed studied
heat transfer enhancement through using wire coils at different experimentally and
numerically investigated heat transfer and friction loss using butterfly, classic and
jagged twisted tapes. Numerical results were in good agreement with experimental
results.

11. Dr. Mohammad Tariq (2016) Engineering are continually being asked to improve
processes and increase efficiency. This request may arise as a result of the need to
increase process throughout, increase profitability, or accommodate capital limitations
whereas outlet temperature was less effective factors. An optimum parameter
combination for the maximum heat transfer was obtained by using the analysis of S/N
ratio.

12. Viraj Gada and Swapnali Chaudhari, (2016) Heat transfer is a thermal energy which
occurs in transits due to temperature difference. The modes of heat transfer are
conduction, convection and radiation. Fin is a thin component or appendage attached to
larger body or structure. Based upon the cross sectional area type, straight fins are of
different types such as rectangular fin, triangular fin, trapezoidal fin parabolic fin or
cylindrical fin. Fin performance can be measured by using the effectiveness of fin,
thermal resistance and efficiency. Triangular fins have applications on cylinders of air
cooled cylinders and compressors, outer space radiators and air conditioned systems in
space craft. Several authors paid attention in analyzing the performance of fins.

13. Shewale Omkar M et al. (2015) conducted an experimental investigation of double-
pipe heat exchanger with helical fins on the inner rotating tube. In this work, to improve
the heat transfer characteristic of the double pipe heat exchanger with the helical fins
were installed on the outer surface of the inner tube and the level of turbulence increased by the rotating the inner tube. The length of heat exchanger was 1m. The convective heat transfer coefficients were obtained for the stationary as well as rotating inner tube for the counter flow mode using water as cold fluid in the tube side and Glycerol as hot fluid in the shell side. Indhe et al. has conducted an experimental and analytical study to optimize longitudinal fin profile for double pipe heat exchanger. In this present study, the performance of the heat transfer process in a given heat exchanger is determined for longitudinal fin profiles (rectangular). The performance of a double pipe heat exchanger is analyzed in two parts that is optimization and experimentation. In the part of optimization, numerical analysis was performed by MATLAB program. This program serves to optimize the fin height so as to obtain maximum possible heat transfer without any wastage of material at a given length and inlet conditions. Also, all the performance parameters such as efficiency, pressure drop, effectiveness, heat transfer coefficient, outlet temperature of both fluids, overall heat transfer coefficient were studied simultaneously for all possible fin height. In second part, experimentation is carried out in a counter flow double pipe heat exchanger for varied mass flow rate which ranges from 0.0168 kg/s to 0.0126 kg/s. Experimental results and analytical result shows that for optimum height, effectiveness is increased up to 23% and heat transfer is enhanced by 26% than unfinned pipe.

14. A.A. Walunj et al, (2015) Fin arrays on horizontal and vertical surfaces are used in variety of engineering applications to dissipate heat to the surroundings. Studies of heat transfer and fluid flow associated with such arrays are therefore of considerable engineering significance. The main controlling variables generally available to the designer are the orientation and the geometry of the fin arrays. In case of short horizontal arrays, it is observed that the air entering symmetrically from both the ends gets heated as it moves towards the Centre of the fin channel, as well as it rises due to decrease in density.

15. Sunil S. Shinde et al. (2015) has studied about the performance Improvement in Single phase Tubular Heat Exchanger using continuous Helical Baffles and investigated that that the performance of tubular heat exchanger can be improved by helical baffles instead of conventional segmental baffles. The use of helical baffles in heat exchanger reduces shell side pressure drop, pumping cost, size, weight, fouling etc. as compare to segmental baffle for new installations. The helix changer type heat exchangers can save capital cost as well as operating and maintenance cost and thus improves the reliability and availability of process plant in a cost effective way. For the helical baffle heat exchangers, the ratios of heat transfer coefficient to pressure drop are higher than those of a conventional segmental heat exchanger.

16. S.S. Pawar et al. [2015] carried out experimental investigation in this, material from fin array stagnant portion is removed in the shape of triangular notch from the central
bottom portion of fin and added on top side to modify its geometry for analysis. The fin weight remains same. Three types of fin arrays have been analyzed that are fin array with 0%, 20% and 40% notch. The results are compared that heat transfer coefficient, Nusselt no. and effect of notch. With increase in heat input, heat transfer coefficient (h) also increases for all types of fin arrays whether it is notched or without notch fin array. Nusselt number increases with increases with increase in heat input as well as increases in notch area.

17. **Abdul Rahim et al,** *(2014)* In their paper analysed heat transfer through a wall containing triangular fins partially embedded in its volume, Coupled heat diffusion equations governing each constituent are solved numerically using an iterative finite volume method. Numerical and the analytical results are attained in their paper. It is found that the fin-root can act simultaneously as a heat sink and heat source for the wall. The heat transfer rate through the combined system is clearly seen to be maximized at a specific fin-root length. The maximum reported heat transfer rate through the triangular rooted-finned wall is recommended to utilize the triangular rooted-fin as a heat transfer enhancer for high mechanical strength structures exposed to highly convective fluid streams.

18. **Gaurav Kumar and Kamal Raj Sharma,** *(2014)* In their article provided experimental investigation to predict the performance of heated triangular fin array within a vertically oriented and air filled rectangular enclosure to analyze the effects of several influencing parameters for their wide ranges; Rayleigh number $295214 \leq Ra \leq 773410$, fin spacing, $25 \text{ mm} \leq S \leq 100 \text{ mm}$ and fin height $12.5 \text{ mm} \leq L \leq 37.5 \text{ mm}$ for constant heat flux boundary conditions at the heated and cooled walls of the enclosure. They developed an empirical correlation relating Nusselt number to several influencing parameters.

19. **Nishank Kumar Pandey et al,** *(2014)* possesses analysed to improve the heat exchanger effectiveness & advised increasing heat exchanger performance via a logical number of steps. The initial step considers when the exchanger can be initially working correctly. The 2nd step looks at increasing pressure drop if easily obtainable in exchangers with single-phase heat transfer. Increased velocity leads to higher heat transfer coefficients, which can be sufficient to enhance performance. Next, a crucial evaluation in the estimated fouling factors might be of interest. Heat exchanger performance could be increased using periodic cleaning & fewer conservative fouling factors. Finally, for several conditions, it might be feasible to contemplate enhanced heat transfer by using finned tubes, inserts, twisted tubes, or maybe modified baffles.

20. **G.P. Lohar et al.** *(2014)* worked out on horizontal rectangular fin array under natural and forced convection it is observed that, the values of average heat transfer coefficient ha increases as the distance between the fin increases but this trend does not remain same and later heat transfer coefficient decreases after the fin spacing of 16 mm .
average heat transfer coefficient is maximum when the spacing between the fin is 14 mm to 16 mm. Later the average heat transfer coefficient decreases as the fin spacing increases. But in case of the forced convection the maximum heat transfer coefficient is obtained between the fin spacing of 12 mm to 14 mm and near about 36 % heat transfer is increased in case of the forced convection

21. **N.G.Narve and N.K.Sane, (2013)** this paper deals with study of heat transfer characteristics of natural convection heat flow through vertical symmetrical triangular fin arrays. It was studied experimentally and its results were compared with equivalent rectangular fin arrays. In the experimental arrangement, spacing between fins was varied Many proposed applications of electronic and thermo electric devices depend upon the feasibility of rejecting waste heat by economical, trouble free methods. For these applications better utilization of the available heat rejection area may be realized by the proper application of outstanding fins.

22. **S.R. Dixit, Dr. D.P. Mishra, (2013)** their study had carried investigated total heat flux as well as the heat transfer coefficient increase as the notch depth increases. The performance of inverted notched fin arrays is 30 to 50% superior to corresponding un-notched arrays, in terms of average heat transfer coefficient.

23. **N.G.Narve, N.K.Sane, R.T.Jadhav, (2013)** in their paper studied heat transfer characteristics of natural convection heat flow through vertical symmetrical triangular fin arrays. They studied experimentally and results are compared with equivalent rectangular fin arrays. Average and base Nusselt numbers and Grashoff number are calculated. They observed that with increase in Grashoff number, average and base Nusselt number increases, Similarly average Nusselt number increases with spacing whereas base Nusselt number increases to maximum value.

24. **S.D. Wankhede et al. (2013)** discusses about inverted notched Fin configurations and notched configurations yield 50–55% higher values of heat transfer and coefficient of heat transfer compared with the un-notched fin for natural convection. For force convection, the notched configurations yield 60–65% higher values predicted for heat transfer and coefficient of heat transfer compared with the un-notched fin.

25. **Yogesh Dhote [2013]** discussed about geometric parameters of fin array i.e. fin height, fin spacing, fin length, fin thickness, number of fins affects convective heat transfer rate. Rectangular fins with vertical base vertically orientation has maximum heat transfer rate. Optimum fin spacing which maximizes heat transfer is a function of fin height and fin length. Fin thickness has not significant effect over heat dissipation.

26. **RajagapalThundilKaruppa Raj, (2012)** in this present study, 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 baffle
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 shell side design has been investigated numerically by modeling a small shell-and-tube heat exchanger. The study is concerned with a single shell and single side pass parallel flow heat exchanger.

27. Hamidou Benzenine and Rachid Saim (2012) provides the comparison associated with experimental data with estimations of regular correlations for that overall heat transfer characteristics of an double pipe heat exchanger and concluded that when heat comes to this inner tube stream by means of an immersion heaters. The overall heat transfer coefficients are usually inferred in the measured data. The heat transfer coefficient from the inner tube flow (circular cross section) will be calculated while using the standard correlations. The heat transfer coefficient from the outer tube flow (annular cross section) is usually then deduced. Higher heat transfer coefficients tend to be reported within the laminar flow regime compared to the forecasts of standard correlations intended for straight and also smooth tubes.

28. Sunil S. Shinde et al. (2012) offers studied concerning the performance Progress in Single phase Tubular Heat Exchanger utilizing continuous Helical Baffles as well as investigated that how the performance connected with tubular heat exchanger could be improved by helical baffles rather than conventional segmental baffles. The application of helical baffles in heat exchanger minimizes shell side pressure drop, pumping price, size, weight, fouling etc. as evaluate to segmental baffle intended for new installations. The helix changer type heat exchangers may save capital cost along with operating and also maintenance cost and so improves this reliability and availability of process plant in an inexpensive way. For that helical baffle heat exchangers, the ratios of heat transfer coefficient to help pressure drop are higher than those of a conventional segmental heat exchanger. Because of this the heat exchangers using helical baffles can have a greater heat transfer coefficient while consuming identical pumping power. It could be concluded that proper baffle inclination angle provides an optimum performance of heat exchangers.

29. A. Gopi chand and V. N. L. Sharma (2012) In this paper, a simplified model for the study of thermal analysis of shell-and-tubes heat exchangers of water and oil type is proposed. Shell and Tube heat exchangers are having special importance in boilers, oil coolers, condensers, pre-heaters. They are also widely used in process applications as well as the refrigeration and air conditioning industry. The robustness and medium weighted shape of Shell and Tube heat exchangers make them well suited for high pressure operations. The thermal analysis and we compared the both results and we are getting an error of 0.02 3in effectiveness .By using above process we can do the thermal analysis in less time and our analysis report also most accurate.
30. **C. Prakash and S. V. Patankar (2011)** presented a two-dimensional analysis for the flow and heat transfer in an interrupted plate passage which is an idealization of the OSF heat exchanger. The main aim of the study is investigating the effect of plate thickness in a non-dimensional form t/H on heat transfer and pressure drop in OSF channels because the impingement region resulting from thick plate on the leading edge and recirculating region behind the trailing edge are absent if the plate thickness is neglected. Their calculation method was based on the periodically fully developed flow through one periodic module since the flow in OSF channels attains a periodic fully developed behaviour after a short entrance region, which may extend to about 5 (at the most 10) ranks of plates. Steady and laminar flow was assumed by them between Reynolds numbers 100 to 2000.

31. **Apu Roy and D. H. Das (2011)** the existing work have been carried out using a view to predicting this performance of a shell and also finned tube heat exchanger in the light connected with waste heat recovery application. Energy obtainable in the exit streams of much energy the conversion devices such as I.C engine gas turbine and so on goes because waste, if not utilized correctly. The performances of the heat exchanger have been evaluated by utilizing the CFD package fluent 6.3.16 and the available values are compared with experimental values. By thinking about different heat transfer fluids the performance in the above heat exchanger may also be predict. The effectiveness parameters of heat exchanger such as effectiveness, overall heat transfer coefficient, energy extraction rate etc, are already taken in this particular work.

32. **Usman Ur Rehman (2011)** had investigated an un-baffled shell-and-tube heat exchanger design with respect to heat transfer coefficient and pressure drop by numerically modelling. The heat exchanger contained 19 tubes inside a 5.85m long and 108mm diameter shell. The flow and temperature fields are resolved using a commercial CFD package and it is performed for a single shell and tube bundle and is compared with the experimental results.

33. **Dan Wang et al., (2011)** The advantages and disadvantages of numerical simulation models for shell-and-tube heat exchanger were compared, and the experiments for small-sized shell-and-tube heat exchanger are carried out. The calculational results of whole entity model were compared with the experimental results, and the calculational results of periodic whole section model were compared with the periodic sections of the whole entity model, and the validity of the periodic whole section model was verified.

34. **T. Wessapan et al, (2010)** In the present energy crisis situation, maximization utilization of energy use is vital matter, especially an air conditioning unit which is one of the largest energy use in the home. The objectives of this paper are to: i) design and development of a portable air conditioning: heat pump unit using helical coil heat exchanger, ii) improve the cooling performance of a portable air-conditioning heat pump
unit, iii) enhance the heat recovery performance of the heat recovery system, and iv) improve the energy efficiency of the portable water-cooled air conditioning unit.

35. **Qiuwang Wang et al, (2010)** carried out an experimental system for investigation on performance of shell-and-tube heat exchangers, and limited experimental data is obtained. The ANN is applied to predict temperature differences and heat transfer rate for heat exchangers. BP algorithm is used to train and test the network. It is shown that the predicted results are close to experimental data by ANN approach. Comparison with correlation for prediction heat transfer rate shows ANN is superior to correlation, indicating that ANN technique is a suitable tool for use in the prediction of heat transfer rates than empirical correlations. It is recommended that ANNs can be applied to simulate thermal systems, especially for engineers to model the complicated heat exchangers in engineering application.

36. **Une Kee Min and Ji Hwan Jeong (2009)** Growing demand for environmentally friendly aero gas-turbine engines with lower emissions and improved specific fuel consumption can be met by incorporating heat exchangers into gas turbines. Relevant researches in such areas as the design of a heat exchanger matrix, materials selection, manufacturing technology, and optimization by a variety of researchers have been reviewed in this paper. Based on results reported in previous studies, potential heat exchanger designs for an aero gas turbine recuperator, intercooler, and cooling-air cooler are suggested.

37. **Zhengguo Zhang and Dabin (2008)** In order to make good use of helical baffles, serial improvements have been made by many researchers. In this paper, a general review is provided of developments and improvements on helix changers, which includes the discontinuous helical baffles, continuous or combined helical baffles, and the combined multiple shell-pass helix changers. Extensive results from experiments and numerical simulations indicate that these helix changers have better flow and heat transfer performance than the conventional segmental baffled heat exchangers. Based on these new improvements, the conventional heat exchangers with segmental baffles might be replaced by helix changers in industrial applications to save energy, reduce cost, and prolong the service life and operation time.

38. **Yusuf Ali Kara and Ozbilin Guraras, (2004)** Computer codes for design are organized to vary systematically the exchanger parameters such as, shell diameter, baffle spacing, number of tube-side pass to identify configurations that satisfy the specified heat transfer and pressure drops. A computer-based design model was made for preliminary design of shell-and-tube heat exchangers with single-phase fluid flow both on shell and tube side. The program covers segmentally baffled U-tube, and fixed tube sheet heat exchangers one-pass and two-pass for tube-side flow. The program determines the overall dimensions of the shell, the tube bundle, and optimum heat transfer surface area required.
to meet the specified heat transfer duty by calculating minimum or allowable shell-side pressure drop.

39. E. Salehi and S. NoieBaghban, (2000) evaluate the shell-side stream of STHX utilizing experimental as well as theoretical techniques. Experimental as well as numerical results are compared over a wide range of Reynolds numbers (1,000 to 1,000,000). The most crucial results of this research are the following: Comparison associated with temperature profile of exchanger, along with and without baffles, shows that baffles possess the vital role in heat transfer rate. The outcomes also show how the effect associated with changing the quantity of baffles will be more crucial than various the heights of baffles with regard to heat transfer rate in the shell.