Review of Related Literature
A study of relevant literature is an essential step to get a full picture of what is done with regard to the problem under study. Such a review brings about a deep and clear perspective of the overall field.

The literature in any field forms the foundations upon which all future work will be built (Agarwal, 1975).

Now-a-days, the educational programme of any type is characterised by reforms and innovative ideas. It seems to be necessary to formulate review of various research studies already completed.

Circuit training can provide vigorous activity in a number of selected fitness and motor ability activities and is aimed at developing all the physical fitness components performed in an interesting and imaginative fashion (Parry, 1968).

The general purpose of the circuit training is to develop muscular strength, muscular endurance and cardio vascular endurance (Annarco, 1973).

In circuit training, the athlete can increase her strength endurance by (1) doing great number of exercises at each station (2) doing the exercises in a shorter length of time or combining (1) and (2). This method of training emphasises time rather than the resistance and is based on the theory that athlete can increase her strength and endurance by working harder in a
given length of time by exerting the same amount of energy in less time (Pasty, 1969).

Circuit training is based on the promise that the athlete must do the same amount of work in a shorter period of time or must do considerably more work within the limits on an assigned training period (Kalfs and Arnheim, 1969).

Circuit training can provide vigorous activity in a number of selected fitness and motor ability activities and is aimed at developing all the basic physical fitness components, performed in an interesting and imaginative fashion. The individual works on each activity within the circuit and in his individual capacity attempts to complete the present circuit within a specified time limit (Johnson and Stolberg, 1971).

Circuit training is designed to stimulate the cardio respiratory organs and as a result the endurance aspect is stressed (Muthiah, 1973).

Circuit training is designed to develop cardio vascular respiratory endurance as well as flexibility, strength and muscular endurance in essential muscle groups (Miller, 1974).

Circuit training can become an excellent addition to well balanced programme of sports and physical fitness. In general, it is a form of high intensity training to provide allround development (Gatchell, 1976).

Circuit training has been adopted throughout the world as a simple but effective method of improving the performance factors (Nicholis, 1978).
The circuit training is a very effective and popular form of doing physical exercises. It is mostly done for the development of strength and endurance abilities especially strength endurance (Hardayal Singh, 1997).

The findings of the influence of a physical education programme for fifth grade girls which included a ten minute circuit programme indicated improvement in physical fitness as measured by AAHPER youth fitness test (Brown, 1961).

An experimental study with different periods of circuit concluded that circuit training would develop large muscle groups and improve agility and endurance (Kula, 1963).

The effects of circuit training on cardio vascular endurance was studied with the experimental group making three circuits thrice a week, against time using primarily weight training exercises and running between stations. The control group used a traditional training method of calisthenics, weight lifting and play. The experimental group gained significantly in cardiovascular endurance (Richard Roman, 1954).

In a study conducted to determine the effects of different lengths of practice period of learning motor skills, three groups of junior high school boys were selected and the practice period varied suitably as two circuits for the first group, five circuits for the second group and eight circuits for the third group, on each practice day. All groups practised two days per week for five weeks. After the third practice period, however, it was observed that groups using longer periods improved in all items and their total physical
fitness improved significantly at the 0.01 level of confidence (Harmon and Oxendine, 1961).

In a study, a group of twenty one subjects was subjected to a developmental course of exercises at the university of Oregon. A second group of seventeen subjects went through a developmental course in which circuit training was used. The subjects were tested in pull ups, 30 yards shuttle run and 60 seconds sit up in test before and after the course. It was found that significant gains in the physical fitness in the low fitness students were achieved through both programmes. It was concluded that improvement in the performance of the cardio respiratory test can be increased significantly by the regular developmental course exercises or by circuit training (Watt, 1962).

In a study on the effect of circuit training on the physical fitness on grade five girls, two classes were tested using AAHPER fitness test before and after eight weeks of regular physical education classes. The experimental class, chosen by chance, had a supplemented ten minute circuit training programme before each class. It was found that the mean difference between groups were not significant, but the experimental class made greater gain except in the shuttle run. The supplemented circuit training produced generally better but not significantly better results than the regular programme (Brown, 1962).

In a study on forty two businessmen from Vancor Y.M.C.A., the subjects were equated into three groups, one group underwent a programme of calisthenic, another a circuit training programme and the third acted as a control group. All subjects were given the Larson muscular
strength and the Harvard step test at the beginning and at the end of eighth week of experimental period. Both experimental groups showed gains in performance with statistically significant difference between them. It was concluded that both the calisthenics and circuit training programmes were the effective methods of improving the cardio vascular and muscular states of businessmen (Taylor, 1963).

Two groups of 17 subjects each were equated on the basis of modified Harvard step test. The experimental group participated in circuit training twice a week for four weeks. The control group took part in the regular service programme consisting of badminton and volleyball. At the conclusion of the experimental period, all subjects were retested on the modified Harvard step test. The experimental group showed a statistically significant improvement whereas the control group did not show statistically significant improvement over the 4 week period. The final test between groups showed no significant difference (Maxwell L. Howell et al., 1963).

In a study to find out the influence of circuit training programme, an experimental group of eleven volunteers was compared to nine students who participated in scheduled physical education class. The two groups were considered to be equivalent in anthropometrical and functional steps. The experimental group (N-11) participated in a circuit training programme (10 exercises) in addition to a regular physical education program for a period of six weeks. In the study, maximum O2 intake was increased; pulse rate adaptations was more efficient and heart volume was enlarged. Muscular development was observed especially in the chest and thigh. The effect upon ventilation was minor (Jacques Urizens, 1969).
A conditioning programme was adopted that worked well for wrestlers, with six exercise stations set up in a circuit fashion. The objective of the programme was to develop both muscular strength and muscular endurance by having the wrestlers work continuously at each of the six stations for a period of ten minutes. The programme was found to be quite beneficial in conditioning the wrestlers for the tough schedule ahead. The programme was flexible enough so that a coach might set up a station to meet his particular needs. It also had good response from wrestlers who actually looked forward to working on the circuit at the beginning of each wrestling season (Welss, 1969).

In a study using circuit training, girls moved as rapidly as possible from one station to the next one. The requirement at a specific station was to run specific distance in a given time or to perform a certain number of push-ups, lift a specific weight prescribed for number of times and chin herself on in a predetermined number of times. New requirements and new goals were established as desired when using this method. Participation in this circuit training programme should have caused the girls to improve progressively. The performance was improved and girls were motivated totally to complete three circuits. Circuit training became an important device in conditioning girls for participating in track and field activities as well as in other sports activities (Dorothy, Harkins and Cooper, 1970).

An experiment was performed with progressive loading which led to circuit training with the boys 14 to 15 who were in two balanced groups which had three physical education periods per week. The experimental group had an additional overload programme amounting to thirty minutes per week for one month. Gains of the experimental group over the control
group indicated that a relatively small amount of intensive overload training using the apparatus normally found in schools produced significant increases in strength efficiency and fitness indices (Morgan and Adamson, 1973).

In a study on the effects of circuit training on the modified Harvard step test, the experimental group participated in circuit training twice a week for four weeks. The circuit training programme consisted of twelve exercises. The control group participated in the regular service programme of volley ball and badminton for about thirty minutes twice a week. At the end of the experimental period, the groups were again tested using the Harvard step test. The results showed statistically significant improvement in performance in the circuit training group (Howell, Hodyson and Sorenson, 1973).

In a study to find out the effects of circuit training on the performance skills of beginner-swimmers and advance swimmers, 52 male and female students at North Carolina Central University acted as the subjects. The variables measured for beginner-swimmers were breath holding, prone glide, arm stroke and crawl stroke and for advance swimmers, treading water front crawl and back stroke. Students were randomly divided into two equal groups. The experimental group was engaged in six weeks circuit training and swimming, while the control group engaged in six weeks swimming only. Experimental students had circuit training on a ten stations universal gym, 3 days per week, 30 minutes per day. Completing the entire circuit twice in each training session, they swim for a remaining 20 minutes of the class period concentrating on the pre-test skills. It was found that the circuit training had a significant effect on the performance skills of the
experimental beginners based on the red cross progressive swimming test for beginner swimmers, but there was no significant difference between the experimental and control beginner swimmers (Smith, 1980).

In a study to find out the changes in cardiovascular endurance, muscular strength and endurance and flexibility in males and females after three months of variable resistance training and circuit training within the scope, limitations and programme of the study, the following conclusions appeared justified.

1. High intensity training was better than low intensity training for improving VO₂ max on treadmill.
2. No difference existed between the circuit training and variable resistance training groups on muscular strength, muscular endurance and flexibility (Kenney, 1986).

In a study to analyse the effects of circuit training on selected physical and physiological variables, seventy physically fit and untrained boys were selected among 240 of ninth standard. Experimental and control groups consisted of 35 boys in each group. Circuit training was given to the experimental group five days a week for a period of 12 weeks. Except routine physical education classes, the control group was restricted participation in any of the training programmes. The result of the study indicated that practice of circuit training after twelve weeks had significant effect for increasing muscular strength, muscular endurance and cardio respiratory endurance. Through circuit training, significant improvement in first six week time and still better improvement after the end of twelve weeks were observed (Vaidhiyanathan, 1988).
The purpose of the study was to assess the effects of a 12 week circuit training programme on cardio-respiratory endurance and muscular strength in adolescent males. The training programme consisted of 30 different activities in five stations. The results of the study showed significant increases in maximum oxygen consumption, resting cardiac output and muscular strength (Masher, 1990).

In a study to find out the effect of simultaneous training for strength and endurance during a thirteen week, three days a week program of hydraulic resistive circuit training and running, eighteen college males were placed into low resistance (LR; n=10) or high resistance (HR; n=8) groups and ten college males were controls and did not train. LR and HR performed two circuits with a work rest ratio of 20:40s during the forty minutes account. LR trained at too low resistance while HR trained at higher resistance. Following the work out, subjects ran two miles. Pre and post tests included strength, physical fitness and anthropometry. The result showed that there were not significant changes in body composition or interactions between the fitness test measures among the two training groups. The change in overall strength average was 6.5 per cent compared to 16 per cent in a prior study that used hydraulic resistive training without concomitant running. They concluded that gains in strength were somewhat compromised by the simultaneous run training, and that improvements in strength and run performance were independent of LR and HR training intensity (Hortobagyi, 1991).

In a study to find out the comparative effectiveness of specific circuit training and combination of training on selected skills among basket ball players, ninety six male students from 14 to 16 years in Kendriya Vidyalaya,
Gwalior were selected as subjects and divided into 4 groups each comprising of 24 students. Group I was treated which specific circuit training, Group II with weight training, Group III with combination of training and Group IV acted as a control group. The training period was 12 weeks. The three experimental groups were found to be significantly better than the control groups in the enhancement of skill performance. The combination training method was superior to the other two training methods in improving the Basket Ball performance (Singh, 1991).

In a study to determine the effects of continuous running, interval running and their combined effects on cardio respiratory endurance, forty five untrained boys were selected as subjects and 15 subjects for each group were randomly assigned. ANOVA was adopted for the comparison of the training effects. It was found that (1) all kinds of endurance training caused a significant improvement in developing cardio respiratory endurance due to six weeks of endurance workout and (ii) though there was no significant difference among the training groups, a trend towards the interval running group was shown (Dhayanithi, 1991).

In a study to find out the influence of high-intensity variation of circuit training programme, forty college football players were randomized into experimental and control groups. The experimental group (N=20) participated three days per week on alternate days utilizing a very brief, high-intensity variation of circuit training. The conventional circuit training programme made significant improvement in power, endurance and strength. However, the high-intensity programme of circuit training produced significantly greater improvement than did the conventional programme (Fincher, 1998).
In a study to find out the comparative effects of an interval training and a continuous training programme, one group (N=7) performed interval training and other group (N=7) participated in continuous training programme. In this study, both the training programmes significantly improved the maximum oxygen consumption and decreased the resting heart rate of the subjects. (May, 1999)

In a study on the effects of circuit training on speed, endurance and striking ability of footballers, the experimental group made three circuits, thrice a week, against time using primarily weight training exercises and running between stations. The control group used a traditional training method of calisthenics, weight lifting and play. The experimental group gained significantly in endurance (Ramon, 1961).

In a study on four groups of 14 to 16 year old boys in North Vancouver Junior High school, the subjects were closely matched on the basis of their scores and their indices. In one out of their weekly (four) physical education periods, they took different training programmes as indicated below.

1. Interval circuit training emphasising endurance and strength training.
2. Conventional circuit training with endurance running.
3. Conventional circuit training with game activity.
4. Playing games only.

The effect of inducing these programme in a typical weekly school programme was studied. Gains were made by all the groups, with interval
circuit training group particularly improving in strength index (Banister, 1975).

The above research study by Banister supports the present study involving parcours training.

In a study using endurance training, it was found that efficiency of an individual in performing physical activities depends basically on circulo-respiratory efficiency. It was concluded that by endurance training the efficiency of the circulatory and respiratory system is improved, maximal O₂ uptake is increased, stroke volume and cardiac output are increased; ventilatory efficiency is improved; lung volume becomes longer and diffusion capacities are increased (Uppal, 1982).

The above study using endurance training to find out the influence on circulo-respiratory efficiency supports the study of the investigator using parcours training which is a continuous running circuit.

Continuous training, as the name implies, involves continuous activity without rest intervals. This type of training became extremely popular during the latter past of the 1960's. Dr. Ernest Van Aaker's work in this area started in the 1920's but has received widespread support only in the last 20 years. This training is probably the most widely used form of endurance conditioning for the joggers who want to stay in condition for health related purposes. The athlete, who participates in team sports and endurance, trains only for general conditioning and wants to maintain endurance conditioning during off-season. The training appears to be an
excellent approach to general endurance conditioning since it has been shown to be effective and can be performed at a comfortable level of work (Jack, 1988).

The above concept of continuous training is closely related to parcours training where the athlete is involved in different type of exercises at stations of a circuit.