

**VOCATIONAL HIGHER SECONDARY  
TEACHERS' SOURCE BOOK**

**MAINTENANCE AND REPAIR  
OF AUTOMOBILE  
SECOND YEAR**



**Government of Kerala  
Department of Education**

**2006**

**STATE COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING (SCERT)**

**Vidyabhavan, Poojappura, Thiruvananthapuram-12**

***Prepared by:***  
**State Council of Educational Research & Training (SCERT)**  
**Vidyabhavan, Poojappura, Thiruvananthapuram -12**  
**Kerala**  
***E-mail:scertkerala@asianetindia.com***

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## Foreword

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Dear Teachers,

**T**his Teacher's Sourcebook on **Maintenance and Repair of Automobile** introduces the teacher to the main principles and practices of the revised pedagogy which is activity-based, process-oriented and learner-centred.

The realisation that learning is not mere storing information in memory and that real learning is construction of knowledge through observation, comparison, classification and analysis has led us to give a new thrust to the teaching-learning process at Vocational Higher Secondary level to make it more meaningful and learner-friendly.

This sourcebook has been developed primarily for the benefit of teachers who teach **Maintenance and Repair of Automobile** at Vocational Higher Secondary level. The subject matter has been dealt with utmost care, in tune with the revised curriculum and pedagogic principles. It is hoped that this book will enable the teacher to provide suitable learning activities for effective learning.

The success of the approach depends upon the vision and commitment of the teacher. They are expected to make use of this sourcebook at all stages of their teaching process. It is also expected that the teacher would seek help and guidance from other sources like libraries and websites.

Hope that this sourcebook will help the teacher to develop the skills and experience required for effective classroom transaction.

Creative criticism and suggestions for improvement are most welcome.

With regards,

Thiruvananthapuram  
July, 2006

**Dr E. Valsala Kumar**  
**Director**  
SCERT, Kerala

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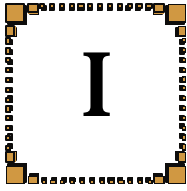
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# Part I



# GENERAL APPROACH

## SIGNIFICANCE OF VOCATIONAL EDUCATION

*The ultimate aim of education is human refinement. Education should enable the learner to formulate a positive outlook towards life and to accept a stand which suits the well being of the society and the individual as well.*

The attitude and potential to work has determined the destiny, progress and cultural development of the human race. As we all are aware, the objective of education is to form a society and individuals having a positive work culture. The educational process expected in and outside our formal schools should concentrate upon inculcating concepts, abilities, attitudes and values in tune with these work culture. Hence vocationalised education cannot be isolated from the main stream of education. In another sense, every educational process should be vocationalised. However due to our inability to utilize the resources wisely, scarcity of job opportunities is a severe issue of the present society. For overcoming this deep crisis, emergent techniques have to be sorted out and appropriate researches have to be seriously carried out. It is in this sense that the content and methodology of Vocational Higher Secondary Education have to be approached. The need for meaningful linkages between the world of work and world of education is well recognized. The essence of the recommendations made by various commissions and committees is that the vocationalisation should be the main feature of the future system of education at the higher secondary stage, it can be extended to school level also.

Vocational education is a system of education which intends to prepare students for identified occupations, spanning several areas of activities.

The Vocational Higher Secondary course is envisaged as a part of the National Policy on Education with the noble idea of securing a job along with education. The relevance of vocational education is very great in this age of unemployment. This education system, which ensures a job along with higher education stands aloof from other systems of education.

This education imparts the life skills required by the youth to enter the world of work and assuming the responsibilities of adulthood. As per the expert meeting report (2001) of UNESCO, the life skills are grouped under four

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categories. They are

1. skills for personal fulfilment
2. skills for living in society
3. skills for dealing with changing economies
4. skills for dealing with changing work patterns.

Vocational Education ensures fulfilment of manpower requirement for national development and social security for the citizens through self-employment. It also helps to reduce the migration of rural youth to urban areas and thus helps in rural development.

The learners of Vocational Education get an opportunity to avail one year apprenticeship training in industries to improve their practical skill. During the course of study, on the job training (OJT) for 10 days in a year is arranged to improve the skill and efficiency of the learner. This education system motivates the attitude towards self-employment through Production/ Service Cum Training Centres. (PTC)

### **Objectives of Vocational Education**

The National policy on education has accorded very high priority to the programme of vocationalisation of education, considering the following objectives.

1. To fulfil national goals of development and the removal of unemployment and poverty.
2. To impart education relevant to increased production and productivity, economic development and individual prosperity.
3. To make available skilled work force at all levels to alleviate the rural unemployment and for the development of nation.
4. To develop environmental awareness to ensure sustainable development.
5. To develop vocational aptitude, work culture, values and attitudes of the learners so as to enrich the productivity of the nation.
6. To develop entrepreneurial competencies and skills of learners for self reliance and to undertake gainful self employment.
7. To facilitate the expansion of higher education and explore future opportunities through innovative guidance and programmes.
8. To develop vocational competencies, creative thinking in the related areas and facilitate training.
9. To create awareness on mental, physical and social health.
10. To acquire awareness about different job areas and to provide backgrounds for acquiring higher level training in subjects concerned.

## **Learning**

Learning is construction of knowledge through a continuous mental process. It is an advancement through adding and correcting in the light of comparing the new issue with the previously learned concepts. It is an intellectual process rather than the mere memorisation of facts. It is a conglomeration of a variety of activities like problem solving, finding out co-relations, prediction, arriving at conclusions, rational as well as critical thinking, finding applications, grouping for other possibilities and extracting the crux. When opportunities are provided for intellectual processes learning will become effective and intellectual ability will get strengthened.

## **Theoretical foundations of learning**

Education is the best device that can be adopted for creation of a new society. It should be democratic in content and process and should acknowledge the rights of the learner. It should also provide opportunity for better citizenship training. The concept of equality at all areas should get recognition in theory and practice. There should be conscious programme of action to develop nationality, humanness and love against the encroachment of sectarianism of caste and religion. The learner should become cognisant of the implications of privatisation, liberalisation, globalisation etc.

They should develop a discrimination to use the acquired learning as a liberative weapon.

They should be able to view education and life with the perspective of social well being. They should get opportunity to recognise that co-operation is better than competition and that co-operation is the key to social life and culture.

A basic awareness of all the subjects needed for life is essential for all students.

The remnants of perspectives formed in us during the colonial period still influence our educational philosophy. The solution to the present day perplexities of the society which approaches education on the basis of competitions and marketisation is only a comprehensive view of life.

It is high time that education was recognized on the basis of the philosophy of human education. The human approach to education has to reflect in its content, learning process and outlook. The perspective of 'learning to be' and 'learning to live together' as expressed by the UNESCO and the concepts of existential, intrapersonal and interpersonal intelligence.

The basis of new approaches on curriculum and teaching- learning process are derived from the developments tookplace in the east and west of the world.

When we begin to see the learner at the centre of the learning process, the teaching process has to be changed timely. It is the result of the rapid growth and development of Science and Technology and Pedagogy. If we want to undergo the changing process, we have to imbibe the modern hypothesis regarding

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learner that they have

- Great curiosity
- Good imagination
- Numerous other qualities and interests
- Independent individuality
- Interest in free thinking and working in a fearless atmosphere.
- Interest in enquiring and questioning.
- Ability to reach conclusions after logical thinking.
- Ability for manifest and establish freely the conclusions arrived at.
- Interest for recognition in the society.
- Determination to face the interference of society and make components which is a part of social life.

When we consider the learning system, the domains to be stressed in education according to the modern development becomes relevant.

The *knowledge* domain consists of

- Facts
- Ideas
- Laws
- The temporary conclusions and principles used presently by scientists.

Learning is a process. The continuous procedures we undergo to reach a particular goal is process. The skills which are parts of the process to analyze the collected ideas and proofs and come to a conclusion is called *process skills*. Some important ***process skills*** are

- To observe
- To collect data and record
- To classify
- To measure and prepare charts
- To experiment
- To predict
- To recognize and control the variables
- To raise questions
- To generalize
- To form a hypothesis and check.
- To conclude

- To communicate
- To predict arid infer
- To use tools.

In addition to this, consider the skills related to *creative domain* also, they are skills:

- To visualize
- To connect facts and ideas in new ways.
- To find out new and uncommon uses of objects
- To fantasize
- To dream
- To develop creative isolated thoughts

Again, the following factors consisting in the **Attitudinal domain** are also important as;

- Self confidence
- Love for scientific knowledge
- Attitude to know and value history
- Respect human emotions
- Decide with reasonable present problems
- Take logical decisions regarding personal values

As regards the **application domain** the important factors are the ability to:

- observe in daily life examples of ideas acquired.
- take the help of scientific process to solve the problems of daily life.
- choose a scientific life style
- connect the ideas acquired with other subjects.
- integrate the subjects with other subjects.

Some basic stands have to be taken on the new scientific knowledge about intelligence learning and teaching. When such basic concepts are accepted changes are required in the following factors.

- The vision, approach, structure and content of the curriculum.
- The vision, approach, structure and content of the textbooks.
- Role of the teacher and the learner.
- Learner atmosphere, learning materials and learning techniques.

Some scientific perspectives accepted by modern world in Educational Psychology are given below.

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## **Constructivism**

This approach puts forward the concept that the learner constructs knowledge. New knowledge is constructed when ideas are examined and practiced in new situations relating them with the previously acquired knowledge and experience. That is assimilated into the cognitive structure of one's knowledge. This method which gives priority to critical thinking and problem solving provides opportunity for self motivated learning.

## **Social Constructivism**

Social constructivism is a branch of constructivism. Knowledge is formed, spread and imbibed and it becomes relevant in a social environment. Interactive learning, group learning, co-operative participatory learning, all these are concepts put forward by social constructivism.

The main propounders of constructivism are Piaget, Vygotsky and Bruner.

Discovery learning and interactive learning have prime importance. Learning takes place as a part of the attempt for problem solving. The activities of a learner who confronts cognitive disequilibrium in a learning situation when he tries to overcome it leads to the renewal of cognitive structure. It is through this process construction of new knowledge and the assimilation of them take place. Observation and enquiry are unavoidable factors. The learner advances towards new areas of acquisition of knowledge where he tries to compare his new findings with the existing concepts.

Learning is a live mental process. Rather than the ability for memorization of facts cognitive process has to be given emphasis. The process of problem analysis, elucidation, critical thinking, rational thinking, finding out corelation, prediction, hypothesis formation, application, probing for other possibilities, extracting the crux and other processes are of critical importance in learning.

Constructivism gives greater predominance to co-operative learning. Social and cultural factors influence learning. Sharing of knowledge and experience among learners, collective enquiry, assessment and improvement, group activity and collaborative learning by sharing responsibilities with the objective of public activity, provide opportunity for effective learning.

In learning internal motivation is more important than external motivation. The learner should have interest and initiative in learning. Learning situation should be capable of forming a sense of ownership in the learner regarding the learning process.

Learning is not a linear process. It progresses in a spiralled way advancing deeper and wider.

## **NEW CONCEPTS OF LEARNING**

### **1. Discovery Learning**

The teacher has to create a motivating atmosphere for the learner to discover concepts and facts, instead of listening always. Creating occasion to progress

towards discovery is preferred. Instead of telling everything before and compelling to imitate the models, situations are to be created to help the children act models as themselves.

## **2. Learning by discussion**

Discussion leads to learning is Burner's theory. Here discussion is not opposing each other. It is a sharing on the plane of ideas. New ideas are arrived at by seeking explanations, by mutual giving and taking of ideas and by problem solving.

## **3. Problem solving and learning**

Only when the learner feels that some thing is a problem to be solved that he takes the responsibility of learning it. It is an inborn tendency to act to solve a problem that causes cognitive disequilibrium in a particular area. It is also needed to have confidence that one is capable of doing it. The problems are to be presented in consideration of the ability and level of attainment of the learner.

## **4. Collaborative learning**

This is the learning in which the responsibilities are distributed among the members of the group keeping common learning objectives. The common responsibility of the group will be successful only if each member discharges his duties. All the members will reach a stage of sharing the result of learning, equally through the activity with mutual understanding. The teachers who arrange collaborative learning will have to make clear the responsibilities to be discharged. This is possible through the discussion with the learners. Collaborative learning will help to avoid the situations of one person working for the whole group.

## **5. Co-operative learning**

This is the learning in which the learners help one another. Those who have more knowledge, experience and competency, will help others. By this exchange of resources the learners develop a plane of social system in learning also. As there are no high ups and low ones according to status among the learners they can ask the fellow students doubts and for helps without any hesitation or in hesitation. Care should be taken not to lead this seeking of help to mechanical copying. It should be on the basis of actual needs. So even while encouraging this exchange of ideas, among the members of the group cautious acceptance is to be observed as a convention. There should be an understanding that satisfactory responses should come from each member and that the achievement of the group will be assessed on the basis of the achievement of all the members

## **6. Zone of Proximal Development**

Vygotsky observes that there is a stage of achievement where a learner can reach by himself and another higher zone where he can reach with the help of his teachers, peers and elders. Even though some of them can fulfil the

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learning activity by themselves there is the possibility of a higher excellence. If appropriate help is provided every learner can better himself.

### **7. Scaffolding**

It is natural that the learner may not be able to complete his work if he does not get support at the proper time. The learner may require the help of the teacher in several learning activities. Here helping means to make the learner complete the activity taking responsibility by himself. The teacher has to keep in mind the objective of enabling the learner to take the responsibility and to make it successful.

### **8. Learning - An active mental process**

Learning being a cognitive process, the teacher needs to know cognitive processes to facilitate the creation of learning opportunities. Learning can be made effective by providing learning experiences involving mental processes like

- Retrieves/recollects/retells information
- Readily makes connections to new information based on past experiences and formulates initial ideas /concepts.
- Detects similarities and differences
- Classifies/categorises/organises information appropriately.
- Translates/transfers knowledge or understanding and applies them in a new situation.
- Establishes cause-effect relationships
- Makes connections/relates prior knowledge to new information/applies reasoning and draw inferences
- Communicates knowledge/understanding through different media.
- Imagines/fantasises/designs/predicts based on received information
- Judges /appraises/evaluates the merits or demerits of an idea/develops own solutions to a problem.

### **9. Intrinsic Motivation**

Intrinsic motivation is given more importance than extrinsic motivation. The teacher has to arouse the internal motivation of the learner. A person internally motivated alone can immerse in learning and own its responsibility.

### **10. Multiple intelligence**

The Theory of Multiple Intelligence put forward by Howard Gardener has created a turning point in the field of education. The National curriculum documents has recommended that the curriculum is to be designed taking into consideration of this theory.

## **Main Factors of the Intellect**

### **1. Verbal/linguistic Intelligence**

Ability to read and write, making linguistic creations, ability to lecture, competency to effective communication, all these come under this. This can be developed by engaging in language games and by teaching others.

### **2. Logical/mathematical Intelligence**

Thinking rationally with causes and effect relation and finding out patterns and relations come under this area. Finding out relations, explaining things, sequential and arithmetical calculations etc. are capable of developing this area of intelligence.

### **3. Visual/spatial Intelligence**

In those who are able to visualize models and bringing what is in the imagination into visual form and in philosophers, designers and sculptors this area of intelligence is developed. The activities like modelling using clay and pulp, making of art equipments, sculpture, and giving illustrations to stories can help the development of this ability.

### **4. Bodily Kinesthetic Intelligence**

The activities using body language come under this. This area of intelligence is more developed in dancers and actors who are able to express ideas through body movements and in experts in sports, gymnastics etc.

### **5. Musical Intelligence**

This is an area of intelligence which is highly developed in those who are able to recognise the different elements of music, in musicians and in those who can hear and enjoy songs. Playing musical instruments, imitating the songs of musicians, listening silently to the rhythms and activities like this are capable of developing this area of intelligence.

### **6. Interpersonal Intelligence**

Those in whom this area of intelligence is developed show qualities of leadership and behave with others in a noble manner. They are capable of understanding the thought of others and carrying on activities like discussion successfully.

### **7. Intrapersonal Intelligence**

This is the ability to understand oneself. These people can recognise their own abilities and disabilities. Writing diaries truthfully and in an analysing way and assessing the ideas and activities of others will help developing this areas of intelligence

## **8. Naturalistic Intelligence**

A great interest in the flora and fauna of the nature, love towards fellow beings interest in spiritual and natural factors will be capable of developing this area.

## **9. Existential Intelligence**

The ability to see and distinguish our own existence as a part of the universe, ability to distinguish the meaning and meaninglessness of life, the ability to realise the ultimate nature of mental and physical existences, all these are the peculiarities of this faculty of intelligence.

## **EMOTIONAL QUOTIENT**

The concept of emotional intelligence put forward by Daniel Golman is used in framing the new curriculum. The fact that one's Emotional Quotient (E.Q) is the greatest factor affecting success in life is now widely accepted. The teacher who aims to focus on improving the emotional intelligence of students need to concentrate on the following.

### **i) Ability to take decisions**

Rather than imposing decision on students while planning and executing activities, the students may be allowed to take part in the decision making process. Taking decisions through open discussion in the class, inviting students suggestions on common problems etc. are habits to be cultivated.

### **ii) Ability to reach consensus**

- When different opinions, ideas and positions arise, the students may be given the responsibility to reach a consensus.
- Imagining what would be the course of action in some situations, allowing to intervene in a healthy way in problems between individuals.

### **iii) Problem solving**

- Developing the idea that there is reason and solution to any problem.
- Training in finding reasons for problems.
- Suggesting solutions through individual or group efforts.
- Discussing social problems.
- Analysing the shortcomings in methods to solve problems.

Whether plastic can be banned within school premises can be given as a problem. Group discussion will provide reasons and solutions. Problems, which can influence classroom learning and for which the learner can actively contribute solution need to be posed

- Self criticism, evaluation

- Ability to face problem-situation in life
- Thinking what one would do if placed in the situation of others, how one would respond to certain experiences of others - All these foster the growth of emotional intelligence.

#### **iv) Life skills**

Life skills need to be given a prominent place in education. W.H.O. has listed : skills required for-success in life.

- Self awareness
- Empathy
- Inter personal relations
- Communication
- Critical thinking
- Creative thinking
- Decision making
- Problem solving
- Coping with emotion
- Coping with stress

#### **THE NEW CURRICULUM ADDRESSES THESE AREAS**

Knowing the characteristics of the learner, role of the teacher and how to use the teachers handbook help the teacher to plan and effectively implement learning activities.

#### **Role of a Teacher**

In the earlier approach the teacher was mainly depending on the lecture method for teaching. But in the new method of education the student centered approach is given more importance than the teacher centered approach. Under this changed **scenario** the teacher has to perform the following roles in the classroom.

The teacher should be

- A facilitator of learning
- A guide to the overall development of the student
- A good observer and motivator
- Able to consider the activities, needs, special features and age group of students at higher secondary level.
- Able to understand the limitations of learner and their learning problems.
- An instructional material developer

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- A good communicator
  - An innovator
  - Able to raise leadership qualities and self confidence of the learner
  - An authoritarian in the concerned subject
  - Able to arrest and sustain the attention of the learner
  - Able to bring out and encourage the inborn talents.
  - A resource manager to ensure the optimum utilisation of resources.
  - A systematic record keeper
  - A controller to issue guidance to the students
  - A person with high level of practical competency
  - Able to corelate area of study with familiar environmental situations
  - A self evaluator and good listener
  - Able to create awareness in social problems
  - A person with democratic and humanitarian approach
  - A professionalist as well as philosopher
  - A good evaluator
  - A good organisor and a friend.
  - A co-learner as well as co-researcher
  - Able to give assistance and advice in placement needs and self employment by giving moral and technical support
  - Able to keep moral values
  - A person equipped with skill for using new techniques of learning
  - Optimistic and impartial

### **Child friendly Class Room Atmosphere**

Learning can be effective and enjoyable only when the class atmosphere is according to the new concept of learning and the characteristics of higher secondary teacher.

- Class and seating are arranged in an attractive way
- Democratic nature is upheld
- Always active
- Students interact with teachers without fear
- Opportunity for a variety of activities
- Students allowed to involve interesting group activities

- Learning speed, learning style and different levels of attitudes are considered. Help is extended whenever needed.
- Sufficient instructional materials are available
- There is freedom of expression, students share their ideas and experiences
- Students are given acceptance and encouragement
- Healthy atmosphere
- Needs of each student is given consideration. Happy and energetic atmosphere
- Teachers work considering the rights of students
- Problems handled in a patient way
- Teachers look at all events from the students view point

There will be students of various ability levels in any class because learning style, learning speed, varying exposure to language experiences, physical and psychological problems and varying socio-cultural background.

The learning experiences provided must help to bring the low activities to an expected level and extended the breadth and depth of the skills of the high activities.

By repeating experiences, introducing variations in a learning experience to suit different levels and if needed, formulating additional experiences the problem of varying ability levels can be tackled.

### **Characteristics of Learner at Vocational Higher Secondary Level**

The learner in second year has undergone a learner centered and process oriented learning experience up to first year. The learner at this age is in awakening stage and he is enthusiastic about environment. He needs recognition and encouragement from environment and also recognise as a grown up man. He is adequately competent to select vocational subjects according to his aptitude and interest and to acquire higher education and profession as he wishes. The aspirations about future life is framed in this particular age for seeing national and international job opportunities. Some of the peculiarities of learner at this stage are

- Physical, intellectual and emotional plans have intensive changes during the age and their reflections can be observed
- Ability to enquire discover and establish cause effect relationship between phenomena
- Readiness to undertake challenges
- Capacity to shoulder leadership roles
- Attempt to interpret oneself

- Susceptibility to different pressures
- Doubts, anxieties and eagerness about sex
- Imaging for social recognition

### **Needs of Learner**

- To make acquaintance with a job or self employment through vocational education
- To acquire more knowledge in the concerned area through higher education
- To recognize and encourage the peculiar personality of the later adolescent period
- To enable him to defend against the unfavorable circumstances without any help

### **Role of learner**

- Active participant in the learning process
- Act as a researcher
- Sharer of information
- Sharer of responsibilities
- Collect information
- Takes leadership
- Involves in group work
- Act as a co-participant
- Observes his environment
- Experiments and realises
- Make interpretations and draw inferences
- Mould himself in to an active contributor for the welfare of the society

### **Evaluation**

In vocational higher secondary education, a new approach to education and evaluation should be made. Evaluation must be a systematic and continuous process. As the curriculum is based on vocational stream, capacity building is a most important part and it should be evaluated accordingly. The technical skills, interest in the particular field, communication skill, analysing, organizing and presentation skills etc have to be evaluated. The personal and social qualities also have to be evaluated. Therefore, evaluation should be transparent, continuous and comprehensive.

### **Supporting System**

In learner centered vocational education, a learning methodology has to be organised and a proper learning atmosphere is to be provided. Many organizations

can support the learning activity. They are:-

### **1. School Resource Group (SRG)**

Comprising all teachers (vocational and non vocational), instructors, and lab assistants with academic head as the group leader.

### **2. School Support Group (SSG)**

Comprising PTA president, members of local bodies, members of social clubs, subject experts etc who can contribute guidance /technology /infrastructure / financial assistance etc.

### **3. Parent Teacher Association (PTA)**

Can provide adequate funds for field trips, production cum training centers (PTC), exhibition, On the Job training (OJT) etc.

### **4. Local bodies**

Grama Panchayat, District Panchayat and Block Panchayat can provide infrastructure ie, class rooms, laboratory, library, seminar hall, audiovisual equipments etc.

### **5. Subject club**

All vocational teachers handling same vocational subjects should form a subject club at regional level or district level. This will helps to share the knowledge and practical facilities, production and marketing of materials, services etc.

### **6. Nodal Schools**

Based on excellency, district wise nodal schools may be selected to provide facilities like central library, museums, video conferencing etc.

### **7. Institution Industry Interaction Project (III P)**

This should be implemented in every institution to update knowledge . This also helps for OJT , PTC and field visit.

### **Monitoring system**

Education is a sort of journey from darkness to light satisfying the needs and the wants of the individual and the society. The modernization of education through activity oriented system enhances free thinking and working in a fearless atmosphere. It is a qualitative process not a quantitative one. This necessitates a proper monitoring system. The system of monitoring should have the following features.

- It must be transparent.
- It must enrich the ideas of the facilitator through innovative process.
- It must be time bound and rational.

- It must motivate the facilitator to adopt new strategies.
- It must be recordable and ensure effective feedback for the effective monitoring of the system, three levels of the mechanism should be set up.
  1. School level monitoring group.
  2. Regional level monitoring group.
  3. State level monitoring group

Moreover a social auditing system is advisable to achieve the objective effectively.

### **Features of Learning Process in the New system of Education**

In the new system of education the learning process should be modified in such a way as to enable the learner to construct the knowledge of his own through observation, co-operation, problem solving, social interaction etc. The learning process should consider the nature, ability, social setup, inborn talents and subject selected by the learner. Therefore the learning process should be:

- A continuous mental process
- Simple-learner must feel that he is able to undertake the task
- Enable the learner to attain the curriculum objective
- Interesting
- Suitable to the age and attitude of the learner
- Future possibilities
- Enable group activity
- Challenging
- Time bound
- Constructive and curiosity developing
- Possibilities for evaluation
- Capacity to generate independent thinking
- Ability to enquire, discover and establish cause effect relationship between phenomena.

### **Learning Aids**

To make the teaching and learning process simple and effective , certain learning aids and necessary use of such aids for transacting a complex idea make the class room live and students get more and more involved. The advances in science and technology may be effectively utilised for this purpose. Some of

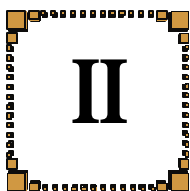
the learning aids are listed below.

- Multimedia
- Over Head Projector
- Computer
- Internet
- Liquid Crystal display Projector
- TV, VCD, DVD and tape recorders
- Working models
- Charts
- Slides
- Video Conferencing facility
- Library
- Text book
- Source book

## **Society**

The new educational policy uplifts the social commitment of the learner. Therefore the society can also give some valuable contributions in this changing situation. The new system also ensures that the learner can perform certain useful services for the betterment of society. The social obligations can be illustrated as follows.

- To enrich social values, aptitude and ability in learner
- To develop entrepreneurial aptitude and ability which helps social welfare and self employment
- New system of education adopts OJT, PTC etc as a part of vocational curriculum which helps to make close contact with the society.
- The resources available from our society can be positively utilised to convene seminars, interview etc.
- Social organisations can help learners to make their education socially committed.
- The social clubs like NSS, Tourism Club, Eco Club, Energy Club etc functioning in schools can make direct link with the society.



## LEARNING STRATEGIES

In the modern era of globalization the introduction of new technologies ensures only the survival of the fittest. So it becomes a necessity to equip the learners to face the growing challenges in the competitive world. Hence the traditional approach to learning is no more relevant in the present context. The teacher should use instructional techniques that motivate the student to construct his own knowledge. Now the learners are not passive listeners, but they are the active participants in the construction of knowledge. Here the teacher – student interaction should be given much importance.

In the new instructional strategy while selecting the methods of teaching, the social and psychological aspects of the learner is to be taken into consideration. The given activities for learning are only suggested one. It can be altered according to the discretion of the teacher.

To obtain the objectives, the new system of education is introduced in the Vocational Higher Secondary Education for attaining the objectives of the courses in this system, we can adopt the following strategies.

### 1. Assignment

Assignment is some specific work assigned to the students as a part of their academic enrichment. There are learning activities undertaken as a continuation of class room activities to realize the curriculum objectives to a broader extent. They should be completed in time bound manner. They help to lead learner to higher level of learning from the present status. Challenging assignment can motivate the students to involve in group dynamics and achieve fruitful results. The teachers may act as a guide.

Assignments may be given on individuals or group basis. Assignment includes preparation of notes, preparation of charts, models, collection, of materials from institutions etc. Assignment develop skills of reference, observation, enquire reporting etc. It ensure the effective utilization of leisure time of the students.

## 2. Seminar

Seminar is a learning strategy involving an in-depth analysis of specific topic, preparation of a paper and presentation . The paper is presented by either one student or a group of students. After the presentation, there will be a discussion/ interaction in which all the students can participate . The students get an opportunity to clear their doubts and make clarification. Seminar helps to develop communication skill and overcome stage fright.

### ***Stages***

i. Selection of Topic

The topic of seminar should be relevant to the subject of study

ii. Assignment of topic to individual student or team

The topic may be assigned to one student or subtopics may be given to a group of students

iii. Collection of relevant information

Information required for seminar can be collected from various sources namely books, magazines, internet, institutions, place and persons.

iv. Preparation of draft paper

Based on the information collected the student may prepare a draft paper and submit it to the teachers for comments. Revise the draft paper based on the comments of the teachers. The required drafts is submitted for approval.

v. Programme Scheduling

The date, time and venue of the seminar is fixed. A seminar leader may be selected from the students

vi. Seminar paper presentation

The student/ students shall present the paper in the seminar. The teacher may function as the moderator during the initial stages.

vii. Discussion / Interaction

Welcome maximum number of responses from the students. Make comments on the topic. This will be followed by a general discussion. All the group members should actively participate in discussion.

viii. Summing up deliberation

The moderator sums up the deliberation

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ix. Evaluation / Feed back

Both teachers and students evaluate the programme.

x. Preparation of final report

A final seminar report is prepared covering all the additional points discussed and consolidated.

### **3. Panel Discussion**

It is a learning strategy in which a panel of experts are allowed to discuss a specific subject under the control and direction of a moderator. Subject can be divided according to the number of panel members. Number of panel members are fixed according to subdivision of points in the subject. Relevant materials and hand out may be given in advance to the learners. The monitor or moderator introduces the subject of discussion and invite a panel member to start the discussion. Each panel member is invited for discussion afterwards. After briefing by the panel members the question are raised from the audience and the panel members give suitable answer to them. A report should be submitted by each learner to the moderator .

### **4. Project**

Project is a self-learning strategy which can exert great influence on the overall development of the learner. Project as learning strategy is to be selected where a problem arises in any part of the curriculum. The students may be divided into groups and assigned different aspects of the problem. Each group works independently .Specific aspects of the problem such as data collection, classification, analysis, report preparation and presentation is to be undertaken by each of the members. Even though the work is divided among the members, it must be ensured that the execution of each and every activity is done with the active participation of all. After analyzing data collected from different sources, the learner arrives at a conclusion that can help to solve the problem. Thereby learner learns the topic through his own activity. The other advantage of this learning activities is that it helps the learner to scientifically handle any problematic situation. It helps in the development of scientific thinking and thereby builds up the students aptitude for the subject.

### **Stages of the project**

#### ***i. Selection of a topic***

The project selected should be related to the curriculum and it should not be a project for projects sake. The topic or problem should arise from the curriculum.

## **ii. Planning of the Project**

(A) Hypothesizing: Hypothesizing means making assumptions based on the available primary information.

(B) Methods and Technique : The methods and Technique should be based on the aim and Hypothesizing of the Project. The nature of the project, suitability of the tools, and the methods of learning should be related to each other.

## **iii. Collection and Tabulation of Data**

The data may be primary, Secondary or tertiary. Either census or sampling method can be used based on the objective of the project. Suitable questionnaires are to be prepared for the collection of primary data.

The collected data is to be classified and tabulated so as to make it easily understandable.

## **iv. Analysis of data and formulation of conclusion**

By analyzing the data, the reliability of the hypothesis can be examined. Preparation of graphs and diagrams and maps will positively help the analysis. The similarities, relations and differences gathered from the analyzed information would tell whether the hypothesis should be accepted or rejected.

## **V. Preparation of Report**

The cover page should have the title of the project, the period of study, name (s) of investigator / group, and the address of the school. The report should be structured in the following order.

- Title
- Preface
- Hypothesis and aim
- Methodology
- Sources of data
- Analysis and conclusion
- Suggestions (if any)
- References
- Appendices (Questionnaire, Observation schedule, check list Etc.)

## **6. Presentation of the Project**

When the project is presented, the learner is being evaluated and accepted. It is through this presentation that ideas are shared with others in the class and society.

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The project methods promotes scientific self learning and makes him capable of solving the problem arising in real life situations.

## **5. Debate**

Debate is a hot and interesting learning activities. A debate can be organized only on a topic on which there is difference of opinion. Therefore a topic suitable for debate has to be found.

Debate can be on relevant topic that is different and interesting to the students and relevant to society. Students with different opinion have to be identified for discussion. Those who have similar opinion should join together to form a side . Those who hold the opposite view will form the other side. It would be good to write down the topic of the debate and displayed in advance. There should also a person to control debate.

Students should be given opportunity to absorb the ideas obtained from discussion and debate, develop the idea through reading and study, and to express them through writing or other means

### **Stages of Debate**

- Topic Selection
- Selection of panels keeping in balance with intelligence, gender etc.
- Selection of moderator
- Collection of information guided by the teacher
- Conducting the debate under the control of moderator by avoiding any sort of personal conflicts
- Conclusion by the moderator expressing his final version or verdict.

## **6. Case Study**

A case may be a person, institution or a community. Case study is an indepth analysis of an actual event or situation. It presents real pictures of situation with facts, information or data . Learners analyse the case to interpret, predict and resolve issues associated with it. The case study provides the learner an opportunity to analyse and apply concepts, data and theory taught from the class. Learners can work individually or in groups.

By studying realistic cases in the classroom, students develop new insights into the solution of specific on – the – job problem and also acquire knowledge of the latest concepts and principles used in problem solving.

Case may be presented by the teacher or may be provided in print form.

A simple case study may have the following steps

- Collection of data
- Conversion of data into information

- Analysis of the case in groups
- Presentation of the finding by each group leader.
- Evaluation

In addition to the above mentioned learning strategy there are many other learning strategies which can be used in appropriate situations to enrich leaning process such as problem solving, Role play, brain storming, debate etc.

### **7. Brain Storming**

This is the best method for solving creative problems. It facilitates generation of ideas quickly.

Rules for conducting Brain storming.

- No response is wrong. So welcome every response.
- Welcome as many responses as possible
- No criticism is allowed
- Allow to work on others idea

### **Steps in Brain storming**

- Presentation of the problem
- Provide relevant information
- Record the ideas put forth by the participants
- Combine similar ideas
- Evaluate each idea/ solution
- Selection of the best solution

If brainstorming is used as an instruction strategy, the last step is not essential

### **8. Discussion**

Discussion is essential for the student to share new finding, idea and conclusion at each stage of learning with fellow students and teachers. In general discussion the teachers should guide the discussion though questioning and summarizing. The major steps involved are

- Introduction initiated by the teacher
- Development of discussion by giving lead points and follow up interactions
- Transition stage in which the key points are reviewed by the teacher and
- Summarizing stage in which teacher provides additional support materials to ensure the achievement of the objectives

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## 9. Group Discussion

Group discussion is an ideal method to develop Co-operation, democratic attitude, friendliness and compromising attitude which are the ultimate aims of education. During group discussion the teacher may observe each group and if needed help them to Channel the discussion towards the common objectives. All students may be given opportunity to take part and express their ideas within a time limit. The conclusion reached may be entered by each student. A group representative must present this during consolidation in which the teacher may correct or add information to ensure that all the relevant ideas have been covered

## 10. Collection

Collection is a continuous learning activity, which ensure complete participation of students. The Collected item may be materials, pictures, charts, ideas, data etc. Collection provides direct experience to learners. An exhibition of collected materials will help to strengthen the concept.

## 11. Practical works

Experimentation contains the process skill in an integrated way. In the new approach of curriculum the student forms idea and comes to conclusion through process. The term 'Practical ' when associated with a science subject usually means an experiment. The objective of doing experiment is to verify some principles associated with theory. The Subjects end here. But this is not the case with 'Vocational Practical'

The ultimate goal of a Vocational Education is to generate skill through continuous practice along with investigation and invention. Continuous practice transforms the unskilled to the skilled. This is the significance and importance of practicals in the Vocational stream. Hence it is very crucial that Vocational teachers as well as instructor should understand the importance of vocational practical and act accordingly.

## 10. Quiz

Quiz programme can be used as an interesting class room tool for transaction of curriculum objectives as well as to evaluate the effectiveness of transaction and achievement of students.

For conducting a quiz programme a topic should be selected based on the above objective

The students are asked to prepare question based on the topic individually. The next day / next hour the students are grouped into 3-4 groups randomly. A question is raised by a particular team and the other teams to answer them. If they can answer the question they get points for that . If all other teams fail to answer the question raised by the team, then the team itself answers the question and explain the background if necessary. All the teams get equal number of chances to ask the question . Time limit is also prescribed for the

conduction of the programme. The team who scores maximum points wins

All the participants can make notes on the questions asked, answers and their explanation which help them in learning

### **13. Models**

Models are used in learning process. It enhances the learning experience. This is based on 'seeing is believing'. It helps the learner a chance to see and feel the model presented. Still models and working models help the students to understand the structure, working principles, actual operation etc.

Steps involved in model preparation are

- Feeling the problem
- Planning the type of model according to co's
- Grouping the students
- Briefing the tasks
  - Aim
  - Need
  - Material required
  - Source of Materials
  - Cost of materials
  - Division of Labour
  - Guidance
  - Fixing of a time limit
- Presentation by each group about
  - How the models were prepared
  - Details of - Expenses
  - Working and principles
- Documentation of the process
- Evaluation
  - By other groups and by the teacher

### **14. Games**

Class rooms can be made attractive by introducing different types of games. Games should be interesting as well as informative. Some of suitable games are

1. Odd man out
2. Cross word puzzles

3. Match the following
4. 'Aswamedham'
5. Link game – Answer using clues.

### **15. Survey**

This strategy involves collection of data from a group under study (books, persons, materials etc.) It develops the social interaction and communication ability of the learner. It also provide a scope for discovery learning.

#### ***Steps involved in survey***

- Objective of survey
- Selection of area for survey/sampling frame
- Selection of survey method
  - Direct method
  - With help of questionnaire/schedule
- Tabulation and analysis
- Consolidation and Presentation

### **16. Exhibition**

It is a learning strategy by which the learner can get a chance to show the skill developed. It provides the intrinsic motivation and exposure.

Exhibition item can be conducted either individually or as a group task. It can be conducted at school / Regional/State/National Level. Necessary publicity and other arrangement can be provided. Presentation, documentation participation and innovative skills of the learner can be evaluated.

### **17. Interview**

Interview is one of the important learning strategy taking the help of a resource person. Interview is an innerview. It provide opinion and information about a topic.

An interview is conducted through the following steps

- Introducing a problem?
- Invite a resource person
- Decide the questions by learners
- Decide the time, place etc.
- How to discuss ?
- How many students to participate?

7. Implementation of the interview

8. Conclusion (Facilitator)

**Interview Schedule** should be prepared before conducting an interview . It contains list of questions prepared by learners, Selection of students, selected names sequence of question etc.

### **18. Field Visit**

Field visit is an inevitable vocational tool to be implemented in vocational Higher Secondary Education. This helps the students to familiarise with the modern technologies and new situation in a different atmosphere. It provides learning through viewing. It is based on the principle that seeing is better than hearing. It enables the learner to retain the learned informations longer and to make the subject more interesting. It motivates and give more confidence in his/her particular vocation.

A suitable centre or institution or site should be identified and prior permission from the authorities should be obtained before conducting the field visit. Give instructions to the learners for collection data/information/materials/Specimens. Teacher may assign different duties to learners by working in different groups.

Each learner should take utmost care and interest during the visit. He/She should observe and interact at the centre/ institution where the field visit is conducted

After the visit, learner should acquire the ability to apply the ideas/concepts in his future carrier. Each learner should submit a detailed report about the field visit.

### **20. Demonstration**

Through demonstration we can present an item/product and emphasize its features very effectively

Eg:- To understand the functioning of a computer

Demonstration Process includes

- Introduction about the item/Material
- Principles – Working
- Operation
- Components
- Merits of the item

## **20. Chart display**

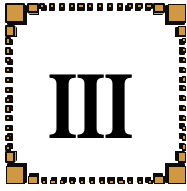
It is also one of the important teaching aids. It can be used in every activities of a learning process.

Chart display is a written or pictorial representation of idea or concept. It is abbreviate, brief and clear. It is prepared by students.

### **Major benefits of Chart display**

- A learner gets clear idea about the concept
- The leaner can retain the ideas in his mind for longer periods
- A complicated idea can be simplified though a chart
- Cheap method of teaching aid.





## **CURRICULUM OBJECTIVES**

- 1 Engine Overhauling & Emission Control
  - 1.1 To develop expertise in student to dismantles & Assemble different types of I.C engines through workshop practicals.
  - 1.2 To familiar's student with all aspect of engine overhauling through demonstration, workshop practicals & field study.
  - 1.3 To make student able to identify & rectify common troubles associated with engines through Reference Books, Observation, Field visit, Project.
  - 1.4 To make student understand the structure and arrangement of exhaust system through observation & collection of data.
  - 1.5 To generate awareness' in student about the importance of environmental protection by reducing harmful Automobile remittent gases - Methods of Emission Controlling through discussion, reference books, data collection and seminar.
- 2 TRANSMISSION SYSTEMS
  - 2.1 To make students understand the necessity of transmission system in an automobile and the qualities required in transmission system through classroom discussion and observation.
  - 2.2 To create awareness in students about the various methods adopted and arrangements of various components in different methods of torque transmission with the help of reference books, field visit and preparation of drawings.
  - 2.3 To familiarize students the various types employed in mechanical transmission system through visual media, demonstration, services manuals and an assignment.
3. CLUTCH SYSTEM
  - 3.1 To make students able to identify requirements of a good clutch and to make them able to identify clutches through classroom discussion, demonstration, preparation of charts etc.

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- 3.2 To make students understand the construction and working of cone, disc and diaphragm clutches, single plate and multiple clutches, centrifugal clutches through workshop practicals, reference books, field visit etc.
  - 3.3 To make students recognize relative merits and demerits of various clutches. Classroom discussion, seminar, preparation of drawings are to be employed.
  - 3.4 To develop expertise in students on maintenance and repair activities of various clutches through workshop practicals, service manuals and field visit.

#### 4 TRANSMISSION

- 4.1 To develop students awareness about the need and functions of gear box in Automobile through demonstration and discussions.
- 4.2 To make students able to differentiate progressive and selective gear boxes to make them understand the working and construction of various types of selective gear boxes, transfer case, gear selector mechanism, gear ratio and over drive through workshop practicals, reference books, group discussion, preparation of drawings and notes.
- 4.31 To develop awareness of students on automatic transmission and the various component (torque convertor, fluid flywheel, planetary gear box) in it through classroom discussion, reference books, preparation of drawings and notes.
- 4.4 To develop expertise in students in maintaining gear boxes, to identify and rectify defects on gear boxes through classroom discussion, workshop practicals, service manuals and field visit.

#### 5 PROPELLER SHAFT AND DIFFERENTIAL UNIT

- 5.1 To make students understand the constructional details and working of drive shaft through demonstration, classroom discussion, preparation of drawings and notes.
- 5.2 To make students understand the construction and functions of universal joints and slip joint through demonstration, classroom discussion, reference books, service manuals and preparation of drawings and notes.
- 5.3 To generate awareness in students about Hotchkiss and torque tube drive through illustrations and preparation of notes on it.
- 5.4 To make students understand the concepts of final drive, its different arrangements and their advantages through illustrations and reference books.
- 5.5 To make students understand the construction and functioning of different types of differential gears through demonstration, reference books, workshop practicals etc.
- 5.6 To make students able to understand construction and functioning of differential housings, front and rear axles, transaxle & wheel mounting arrangements through demonstration, field visit and an assignment.

5.7 To develop student's knowledge on maintenance of drive shaft and its components and to develop expertise on trouble shooting and repairing the same through brain storming and workshop practicals.

## 6 Steering System

6.1 To make students realize the necessity of steering system and required qualities in steering system. Make them aware of steering reversibility through class room discussion initiated by brain storming.

6.2 To familiarize students with Ackermann and fifth wheel steering arrangements through reference books, demonstration and generation of drawings.

6.3 To make students to understand various components and their functions a ..... system and their arrangements .To make them aware about changes in IFS and RFS systems through demonstrations, service manual, workshop practicals, visual media and reference books.

6.4 To make students understand the construction and working of different types of steering gear boxes. To make them aware about steering gear ratio through reference books, demonstrations, workshop practicals and generation of drawings.

6.5 To make students realize various factors effecting steering stability and life of tyre. Make them familiarize with wheel alignment and maintenance activities, wheel balancing, steering recovery, steering geometry and steering wheel free play through demonstration, reference books, field study and a seminar.

6.6 Make students aware about advanced steering systems, advanced technologies in steering linkages and power steering through discussion, reference books, workshop manuals, preparation of notes, etc.

6.7 To make students familiarize with troubles, remedies and repair techniques of steering system through field visit , workshop practicals, service manuals and assignments.

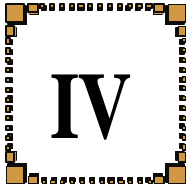
## 7 SUSPENSION SYSTEM

7.1 To develop students understanding of the necessity of suspension system ,sprung & unsprung weight. To make them aware about the factors that affect vehicle stability and riding comfort through brain storming ,observations,reference books and assignments.

7.2 To familiarize students with various components and construction of suspension system through demonstration,class discussion, reference books and assignments.

7.3 To make them understand about the arrangements in rigid suspension system through field study,service manual and collection of data .

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- 7.4 To make them understand about the arrangements in independent suspension system including Macpherson, Wishbone and torsion bar through field study ,demonstrations, service manual and collection of data.
- 7.5 Make students aware of concepts ,construction and functioning of air suspension through field study, multimedia and reference books.
- 7.6 To make students familiarize with the maintenance and rectification of suspension system through workshop practicals, service manual and collection of data.
- 8 WHEELS
- 8.1 To create awareness about the functions and construction of pneumatic wheels through demonstrations, brochures, preparation of notes and diagrams.
- 8.2 To familiarise the students with the function, classification and constructional details of different types of tires and tubes through demonstration, collection of data and seminar.
- 8.3 To make students experienced in maintenance and repair of tyre and tube, and tyre rotation through workshop practicals and field visit.
- 9 BRAKE SYSTEM
- 9.1 To make students to realize the necessity of brake system ,its required qualities, and the factors affecting braking distance through discussion and survey.
- 9.2 To make student aware about the classification of brakes through service manuals ,surveys and reference book.
- 9.3 To make students understand the arrangement of various components in a mechanical brake system and their function through demonstration, reference book and preparation of notes and diagrams.
- 9.4 To make students understand about arrangement of various components in different types of hydraulic brake system through demonstration, reference book workshop practicals and seminars.
- 9.5 To make students understand about the arrangements of various components in different types of air brake system through field visit, preparation of notes and diagrams .
- 9.6 Make student able to compare different types of brakes through group discussion and preparation of notes.
- 9.7 Develop awareness about the advanced technologies adopted in automobile brake through service manuals ,reference book ,field visit and preparation of notes.
- 9.8 Make students able to do the maintenance and repairs of various types of brakes through workshop practice.



## SYLLABUS

### 1 ENGINE OVERHAULING AND EMISSION CONTROL

Dismantling and assembling of Engines- 4 stroke and 2 stroke petrol engine , 4stroke diesel engine - Method of testing compression of an engine - Inspection of cylinder block & cylinder head - Inspection & correction of piston & rings - Ovality & tapes ring of cylinder -measurements - Selection of next size piston - Reboring & finishing of cylinder ,setting of piston - Renewal of cylinder liners - Inspection of valves & valve seat -Methods of reconditioning - Methods of setting valve timing - Methods of checking crankshaft for concentricity-Reconditioning crank & main journals-selection of appropriate bearings - Inspection of connecting rod for bent-Inspection of camshaft for wears - Methods of reconditioning - Inspection of spark plugs ,nozzles, filters, fuel injection pump etc-Recommended, repair practices - Engine trouble shooting -Common troubles & repair practices- Exhaust System & Emission Control System - Scavenging-Construction of muffler-Exhaust gases - Pollution control - Catalytic converter- Positive crank case ventilation system-Emission control norms.

### 2 TRANSMISSION SYSTEM

Necessity of transmission system-Qualities required for transmission system - Overview of electric ,hydraulic & mechanical transmission - various methods of torque transfer-Arrangements of components in mechanical transmission - Components in mechanical transmission & their functions.

### 3 CLUTCH SYSTEM

Classification, requirements, construction, & working of various clutches viz-cone, single plate, multiplate, diaphragm and centrifugal clutches.

### 4 TRANSMISSION

Progressive and selective gear boxes-Floor shift & column shift arrangements - Classification ,construction &working of various selective gear boxes-Gear selector mechanism-Gear ratios-Overdrive-Transfer case

- Automatic transmission system -Construction & working of fluid coupling ,torque converter,planetary, gear box ,over running clutch -Arrangement of components in Automatic transmission - Maintenance of clutches and gear boxes -Grades of lubricating oil-Troubles & repair tactics associated with clutches and gear boxes.

## 5 PROPELLER SHAFT FINAL DRIVE & DIFFERENTIAL

Functions, construction & working of drive shaft-Universals joints & slip joint. Open shaft &torque tube drive - Functions, construction & working of final drive & differential mechanism -their classification - differential housing - Front &rear axles -Wheel mounting arrangements -Transaxles - Maintenance of drive shaft, final drive& differential - Differential oil - Troubles & repair of the above components.

## 6 STEERING SYSTEM

Necessity of steering system-Requires qualities ,Reversibility of steering - Ackermann & Davis, fifth wheel steering system - Steering system components -Steering wheel, steering column, steering gear box, tie rod, tie rod end, pitman arm, steering knuckle, drag link - Arrangements of steering system components in independent and rigid suspension - Steering gear boxes - Rack and pinion ,worm & wheel, worm & roller, worm &nut,Recirculating ball etc. - Their construction & working, steering gear ratio, free play - Factors of steering stability & tyre wear-Wheel alignment -Caster ,camber toe in, toe out, king pin inclination -Wheel balancing - Slip angle -Cornering force -Under steer & oversteer-Steering recovery - Furning radius - Power steering -Advanced technologies in steering linkages - Maintenance & Repairs of steering system -Methods of adjusting wheel alignment.

## 7 SUSPENSION SYSTEM

Necessity of suspension system -Sprung & unsprung weight -Factors affecting vehicle stability & riding comfort . - Rigid & independent suspension system - Components of suspension system -springs - Helper springs - Spring shackles - Shock absorbers -Stabilizers etc- their construction and working - McPherson strut & Wishbone mechanism - Arrangements of rigid & independent suspension system using leaf spring, coil spring & torsion bar - Air suspension system - Maintenance & Repairs of suspension system - Measuring of spring camber & recambering ,Procedure of checking the shock absorber & replacing the same.

## 8 WHEELS

Function & construction of wheel- Function ,classification & construction of different types of tyres &tubes - Maintenance & Repairs of replacement of tyre &tube.

## 9 BRAKE SYSTEM

Necessity of brake system & the required qualities-Factors affecting braking distance, Classification of brakes - Various components in Mechanical brake system-their arrangement & functioning - Various components in different types of hydraulic brakes & serve brakes- their arrangement & functioning - Arrangement of various components in Air brake system - Comparison of different types of brake systems - Advanced technologies in Automobile braking ,Abs etc. - Maintenance & Repairs of various brakes

# LIST OF PRACTICAL WORKS

## Unit 1

- Disassembling and assembling of
  1. 2 stroke engine
  2. 4 stroke petrol engine
  3. 4 stroke diesel engine
- Ovality and taperness measurement of cylinder
- Valve clearance adjustment
- Valve lapping
- Spark plug cleaning and gap adjustment
- Engine overhauling
- Firing order setting

## Unit 2

- Demonstration and study of transmission system
- The drive chain adjustment of a 2 wheeler

## Unit 3

- Dismantling and refitting of clutch system
- Disassembling and assembling of various clutches with repair

## Unit 4

- Dismantled study of various types of gearboxes
- Gear oil changing
- Disassembling and assembling of various gearboxes with repair

## UNIT 5

- Disassembling and Assembling
- Dismantling of universal joint and slip joint
- Dismantling of rear axle and differential housing

- Removal of differential and final drive
- Study of final drive and differential mechanism.
- Disassembling and assembling of final drive and differential and repair.
- Differential oil changing.

Unit 6

- Removal and refitting of steering system
- Disassembling and assembling of different types of steering gears and repair
- Free play adjustment
- Wheel alignment adjustments

Unit 7

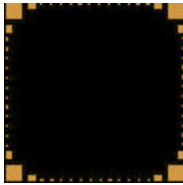
- Repair and maintenance of different types of suspension systems and its components

Unit 8

- Wheel removal and refitting
- Inflation checking and repair of tyre and tubes

Unit 9

- External brake adjustments
- Internal brake adjustments
- Study of hydraulic brake system
- Brake bleeding



## PLANNING YEAR PLAN

Term	Month	Unit No	Name of Unit	Hour	MRA	
					Hour	Period
I	June	I	Engine overhauling and	38		112
	July	I	Engine control			
	July-August	II	Transmission System	9		30
II	August	III	Clutch system	9		30
	August- September	IV	Transmission	16		50
	October	V	Propeller shaft, Final drive & differential	21		68
	November	VI	Steering System	19		62
	November-December	VII	Suspension System	15		52
	January	VIII	Wheels	14		62
III	February-March	IX	Brake	19		50

## UNIT PLAN

### INTRODUCTION

Unit plan is a specific plan of activities for a unit/chapter. It will be intune with activities assigned in the year plan. It also helps to arrange the learning and evaluation activities suitably to attain the curriculum objectives. In this source book a model unit plan is suggested. It tries to define the curriculum objectives of one unit, a few learning activities are proposed and the concept/ideas/items are also identified. In this unit plan the learning material including reference books are also mentioned. It is only a suggested model, hence the teacher can modify learning activities according to the need and demand of the class room environment and situations.

### Sample Unit Plan

Name of the teacher :  
Name of the school :  
Subject :  
Unit : Clutch system  
Class : II year  
Time :

### Curriculum Objectives

- 1 To make students able to identify requirements of a good clutch and to make them able to identify clutches through classroom discussion, demonstration preparation of charts etc.
- 2 To make students understand the construction and working of cone, disc and diaphragm clutches, centrifugal clutches through workshop practicals, reference books, field visit etc.
- 3 To make students recognize relative merits and demerits of various clutches- Classroom discussion, seminar, preparation of drawings are to be employed.
- 4 To develop expertise in students on maintenance and repair activities of various clutches through workshop practicals, service manuals and field visit.

### Syllabus

Classification ,requirements ,construction,& working of various clutches .viz- cone,single plate ,multiplate,diaphragm and centrifugal clutches.

### Content specification

- Classification
- Construction and working of
  - a. cone clutch

- 
- b. Single plate clutch
  - c. Multiple clutch
  - d. Diaphragm clutch
  - e. Centrifugal clutch
- Merits and demerits of each type.
  - Comparison between single plate and multiplate clutches

### **Learning Activities**

1. Discussion on principles, requirements and qualities of good clutch.
2. Demonstration of various clutches and charts to compare and to classify.
3. Collection of clutches and components from workshops.
4. Workshop practicals to disassemble and assemble friction clutches.
5. Field visit to familiarise various types of clutches
6. Gathering knowledge on advanced/unconventional and unavailable clutch mechanisms through reference books.
7. A project work on the purpose of a specific clutch on a specific vehicle.
8. Discussion on merits and demerits of various clutches.
9. Preparation of notes
10. A seminar to compare various clutches.
11. Workshop practicals to make student able to recognise the faults on a clutch and to repair them.
12. Referring service manuals and visiting outside workshops to familiarise clutch defects and repair techniques.

### **Concepts/Ideas/Terms/Name**

- Friction
- Area of contact
- Applied force
- Frictionous surfaces
- Coefficient of friction
- Centrifugal force
- Angular force
- Axial force
- Heat dissipation

### **Learning Material**

Charts, reference books, brochures, service manuals, various clutches and its components.

### **Output**

Discussion note, project report, seminar report, drawings, practical skill.

### **CE items**

Seminar, Project

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## DAILY PLAN

### INTRODUCTION

Daily plan is the systematic organisation of learning activities during each period. The activities designed should be appropriate to achieve curriculum objectives. It includes curriculum objectives, content specification, CE items and a list of essential learning materials. It can be prepared in two columns. The first column contains the learning activities (process) and the second column for responses. Proper planning of lesson enhance both the learner and teacher to achieve the objectives.

### **Guidelines for preparing a daily plan based on learning**

- Curriculum objective should be stated clearly.
- Include content specification.
- Learning activities should be appropriate to time, need of the learners, learning atmosphere and also consider the age of the learner.
- The teacher can club the period judiciously to get continuity in learning process.
- Individual participation should be ensured in the group activities and group decision.
- Learning activities should be challenging, interesting, live and thought provoking.
- The teacher must motivate the learner by giving tips and clues in every stage of learning process.
- Proper guidance explanations and relevant examples should be given wherever it is necessary.
- Evaluation questions may be asked to understand the level of comprehension of the learner.
- Response part of the daily plan can be completed only after the execution of the classroom activity.
- Further planning should be based on this responses.
- CE items and its activities should be given in detail.
- Special information, principles, ideas and concepts also be written separately in a box in the process columns.
- Term evaluation questions may be written at the end of the daily plan.

### **Sample Daily plan**

Name of the teacher :  
Name of the school :  
Subject : MRA  
Unit : Clutch system  
Topic : Classification of clutches  
Class : II year  
Strength :  
Period : 1 Hr  
Date :

### **Curriculum Objectives**

- 1 Identification of the requirement of a good clutch and classification of clutches.

### **Content specification**

A good clutch has to satisfy many parameters, for it to offer reliable, trouble free and long service life.

Automobiles on our roads employ a vast range of clutches according to its make and model. A workshop technician must be familiar with all of them.

### **Concept/Ideas**

Automobiles employ gradual engagement clutches to transfer torque of engine to gear box. There are many opposing forces which they must withstand and they should possess specific qualities.

According to type and purpose, different types of clutches are employed.

### **CE items**

Nil

### **Learning Materials**

Reference books, Brochures, Charts

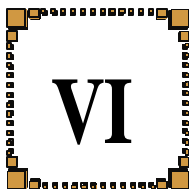
### **Output**

Discussion note, prepared charts

<b>Process</b>	<b>Response</b>
<p>1. The teacher maintain the continuity of learning by refreshing the contents of previous unit. i.e. Mechanical Transmission system and enquires student about the path of powerflow. A discussion is initiated by the Teacher on the component which connect engine and gear box. The output of discussion should indicate the purposes of clutch, its qualities, size, position and ease of operation. Teacher may monitor student by suggesting that crank shaft of a running engine should not be forcefully restricted during breaking.</p> <p>2. Demonstrate available types of clutches and friction plates in the school workshop.</p> <p>3. Demonstrate friction plate of a multiplate clutch (two wheeler clutches) and collect students inference on its design and size.</p>	<ul style="list-style-type: none"> <li>• Response of some of the students suggested that they need more understanding of the previous unit.</li> <li>• Involvement of student on the discussion was satisfactory</li> <li>• Participation of some of students was necessarily restricted so as to encourage more students.</li> <li>• Students were enthusiastic to know about differences in construction and functioning of different clutches.</li> <li>• Some of the student response was positive and towards the right direction.</li> </ul>

**TERM PLAN (PRACTICAL)****STANDARD XI****MRRTV**

<b>Term</b>	<b>Month</b>	<b>Unit No</b>	<b>Name of Unit</b>	<b>Curriculum Objectives</b>	<b>Hour</b>	<b>Total</b>
I	June	I	Symbols	-	52	
	July	I	Symbols (Contn..) Soldering Practice	-	52	
	August	I	Soldering (Contn..), PCB, Extension Board	-	52	
II	September	II	OHM's Law, Krichoff's Law, Multimeters	1.3.2, 2.3.1, 2.3.3	52	208
	October	II, III	CRO, Diode Characteristics	2.3.5, 3.3.7	52	
	November	III, IV, V	Zener Regulator, Rectifiers (3 nos) D.C Power supply	5.3.1 to 5.3.7		
	December	VI, VII	Amplifiers, Oscillators	6.3.1 to 6.3.7	52	156
	January	VIII	Multivibrator, Integrator, Differentiator, Clipper, Clamper	7.3.1 to 7.3.5	52	48
III	February	IX	Digital ICs, Flip-flop	9.3.1, 9.3.4, 9.3.8	52	
	March	X	D/A converter, Revision	9.3.10	52	156
						520



## EVALUATION

Evaluation is a systematic process of collecting, analysing, synthesising and interpreting evidences of students' progress and achievements both in cognitive and non-cognitive areas of learning. Evaluation has to play significant role in making the learning process more effective. It provides diverse experience to the learners, keeping in view the skill to be attained continuously by them.

As the curriculum is based on a particular vocation the selected stream is the most important part and it should be evaluated accordingly. Technical skills, interest and devotion in the field, communication skills, organisational skill and presentation skills are to be evaluated. Evaluation of the personal and social qualities also should be done. So the evaluation should be continuous and comprehensive.

### **Continuous and Comprehensive Evaluation (CCE)**

Our traditional evaluation methods measure only the memory and recollection capacity of the learner. To eliminate/ overcome the limitation the evaluation should be done on multi dimensional ways by measuring multiple intellectual capacities of the learner. So it is better to evaluate the learner in a continuous and comprehensive manner. CCE helps the learner to understand and develop his own progress and to develop adequate strategies for further improvement.

#### *Merits*

- Assess the allround development of the learner on a continuous basis through a variety of activities.
- Effective feed back is possible
- Remedial diagnostic teaching is possible
- Process as well as products are assessed.

### **components of Evaluation**

In order to floursigh continuous and comprehensive evaluation we make use of the following components of evaluation

1. Continuous Evaluation (CE)
2. Terminal Evaluation (TE)
3. Practical Evaluation (PE)

### **1. Continuous Evaluation (CE)**

In the activity based classroom, teacher provides variety of experiences through different tools. Brain storming sessions, group work, discussions, project, seminar, debate, field visits, practical works etc. will really flourish joyful learning. By considering the practicability and the nature of the subject the following tools are advised for continuous evaluation.

A series of learning activities are grouped into five major thrust areas as follows

#### ***Investigative activities***

Activities which create a spirit of enquiry, investigation and a mind for research in the learner belong to this group.

For example.

- Study project
- Case study
- Field study

#### ***Interactive activities***

Activities which improve the communication skill, activities of sharing ideas, etc.

For example

- Seminar
- Panel discussion
- Debate
- Group discussion

#### ***Assigned task***

Activities assigned to the learners to enrich/ strengthen the concepts and ideas.

For example

- Assignment
- Collections

#### ***Performance task (Tests)***

Activities related to the achievements of the learner.

For example

- Class test (oral/ written/ performance test)
- Quiz

- Open book examination
- Interview

### **Practical based activities**

For example

- Laboratory work
- Album
- Improvisation

From the above five group of activities, the teacher has the freedom to choose any three areas for evaluation purpose. However the teacher must make sure that the learner should undergo activities related to all the five areas during the course of the two years.

### **1. Investigative activity**

#### **a) Study Project**

Sl.No.	Stages	Criteria	Score	Total Scores
1.	Planning	Relevance of the study, Identification of problem, Ability to select appropriate tools, ability to select suitable earing method.	4/3/2/1	
2.	Data collection	Ability to collect sufficient and relevant data. Ability to classify and arrange data for analysis. Reliability and authenticity of the data collected.	4/3/2/1	
3.	Analysis and inference	Ability to analyses the data, Systematic arrangements. Ability to draw inferences based on analysis. Ability to give suggestions based on inference.	4/3/2/1	
4.	Report Presentation	Ability to present in logical and sequential order, authenticity of report, time bound comparison.	4/3/2/1	
5.	Viva-Voice	Knowledge of content and process. Ability to analyse data. Ability to justify inference. Ability to explain strategies and methods adopted.	4/3/2/1	
			<b>Total</b>	<b>20</b>

**b. Case Study**

Sl.No	Criteria	Score	Total Scores
1.	Identifying the problem	4/3/2/1	
2.	Approach to the problem	4/3/2/1	
3.	Time bound Action	4/3/2/1	
4.	Analysis of the problem	4/3/2/1	
5.	Problem solving / Reporting	4/3/2/1	

**c. Field study**

Sl.No	Criteria	Score	Total Scores
1.	Attitude and readiness towards the task	4/3/2/1	
2.	Capacity for Observation	4/3/2/1	
3.	Data collection	4/3/2/1	
4.	Application of ideas	4/3/2/1	
5.	Documentation / Recording	4/3/2/1	

**II. Interactive Activities****a. Seminar**

Sl.No	Criteria	Score	Total Score
1.	Planning and Organization	4/3/2/1	
2.	Collection of data / content	4/3/2/1	
3.	Observation / appraisal and clarity	4/3/2/1	
4.	Content knowledge	4/3/2/1	
5.	Presentation	4/3/2/1	

**b Debate/ Panel Discussion**

Sl.No	Criteria	Score	Total Score
1.	Readiness to participate	4/3/2/1	
2.	Depth of subject knowledge	4/3/2/1	
3.	Communication skill	4/3/2/1	
4.	Ability to justify the stand in a democratic way	4/3/2/1	
5.	Presentation	4/3/2/1	

**c. Group Discussion**

Sl.No	Criteria	Score	Total Score
1.	Readiness to participate	4/3/2/1	
2.	Depth of subject knowledge	4/3/2/1	
3.	Communication skill	4/3/2/1	
4.	Ability to justify in a democratic way	4/3/2/1	
5.	Leadership quality	4/3/2/1	

**III. Assigned Task****a. Assignment**

Sl.No	Criteria	Score	Total Scores
1.	Awareness of the content	4/3/2/1	
2.	Comprehensiveness of the content	4/3/2/1	
3.	Systematic and sequential arrangement	4/3/2/1	
4.	Observation/suggestion/views/judgment/evaluation	4/3/2/1	
5.	Timely Submission	4/3/2/1	

**b. Collection**

Sl.No	Criteria	Score	Total Score
1.	Collection of materials / documents	4/3/2/1	
2.	Relevance and comprehensiveness	4/3/2/1	
3.	Presentation	4/3/2/1	
4.	Awareness of the content	4/3/2/1	
5.	Time bound progress of work	4/3/2/1	

**IV Performance task (Test)****a. Interview**

Sl.No	Criteria	Score	Total Score
1.	Planning	4/3/2/1	
2.	Preparation of Questions	4/3/2/1	
3.	Communication skill	4/3/2/1	
4.	Participation	4/3/2/1	
5.	Report preparation and presentation	4/3/2/1	

**b. Quiz**

Sl.No	Criteria	Score	Total Score
1.	Preparation of Questions	4/3/2/1	
2.	Relevance of Questions	4/3/2/1	
3.	Presentation	4/3/2/1	
4.	Active Participation	4/3/2/1	
5.	Time management and final report	4/3/2/1	

**V. Practical bases activity****a. Practical work**

Sl.No	Criteria	Score	Total Score
1.	Involvement and Handling of tools	4/3/2/1	
2.	Skills in doing work	4/3/2/1	
3.	Time bound action	4/3/2/1	
4.	Capacity for observation, analysis and innovation	4/3/2/1	
5.	Documentation and recording	4/3/2/1	

**b. Model Preparation**

Sl.No	Criteria	Score	Total Score
1.	Relevance	4/3/2/1	
2.	Improvisation Skill	4/3/2/1	
3.	Creativity	4/3/2/1	
4.	Awareness of content	4/3/2/1	
5.	Model display/ Report	4/3/2/1	

**c. Album**

Sl.No	Criteria	Score	Total Score
1.	Comprehensiveness	4/3/2/1	
2.	Relevants	4/3/2/1	
3.	Presentation	4/3/2/1	
4.	Awareness of content	4/3/2/1	
5.	Time bound completion	4/3/2/1	

**Terminal or Term End Evaluation (TE)**

It is the written form of evaluation aimed at evaluating the facts, concepts and ideas gained by the learner. The test should not be aimed to evaluate the memory alone. Questions are framed in such a way that the learners are able to apply different mental process while answering. The Terminal Evaluation questions give more emphasis on application, analysis and synthesis level.

The maximum scores for TE is 80 and the minimum is 24 (30%). The questions should be formulated taking into consideration the time required to read, think, understand and write answers. These aspects should be considered while fixing the scores also. To avoid blind guessing, multiple choice and application level questions may be mixed. The total number of questions may vary from time to time. All the questions should be based on the curricular objectives. Open ended questions may be included. Choice questions, if included also should be based on the same curricular objectives.

**Vocational Competency Evaluation (VCE)**

Vocational Competency Evaluation is to evaluate the vocational skill and aptitude developed by the learners during the learning process. This is a system to judiciously evaluate the required value addition and consequent capacity building in the concerned vocational curriculum. The vocational education is aimed at developing interest, skills and devotion in specific vocational fields. As other evaluation components like CE, PE and TE cannot assess the vocational competencies and professional skills, acquired by the learners an internship evaluation (IE) component has been introduced to meet this requirement.

Internship evaluation should be done based on the following components like regularity and punctuality, value addition and capacity building.

### 1. Regularity and punctuality

Regularity and punctuality has vital role in vocational education as learning is a continuous process, the regular presence of the learner is a must for attaining maximum efficiency.

### 2 Value Addition

Value addition is the qualitative measure of the learner's interest, devotion perseverance and efficiency. Value addition can be evaluated through conducting field visits/ vocational survey. The experiences gained through field visit / vocational survey increases the level of intrinsic motivation and positive attitude towards the vocational field and thereby increase his value as a semiprofessional.

### 3. Capacity Building

It gives a quantitative measure of the learner's skill in graded area exposure. Capacity building can be evaluated through conducting the following activities.

1. OJT / Simulated experiment
2. Performance – camp/exhibition/clinic
3. Performance – Production/Service cum Training centre (PTC)

These components help the learner to practice the acquired skills in the real situation and thereby increasing self-confidence and promoting self reliance.

### Practical Evaluation (PE)

The scholastic area includes those area in which the learner attain knowledge and skills based on the curriculum. This leads to create more interest on certain area of a subject. "Emphasis should be given to each topic for learning activity and develop skills. In the practical Examination, the external Examiner is able to evaluate the skills that are attained by learning experiences. The practical Examination question paper is always activity based.

### Practical Evaluation (PE) Items

#### Split up of Score

Indicators	Total	Percentage score
1. Requirement of tools Identified.	10	7.5 %
2. Procedure	30	20 %
3. Work done and Spot viva	60	40 %
4. Tools handling and neatness	15	10 %
5. Viva	25	15 %
6. Record	10	7.5 %
<b>Total</b>	<b>150</b>	<b>100 %</b>

Practical examination should be result oriented. After dismantling, students must be required to observe diamensions of components and note any damages in this components.

The maximum score of PE is 150 and the minimum score is 60 (40%)

## Vocational Competency Evaluation Indicators

No	Items	Scores
1.	Regularity and punctuality	10
2.	Field visit / survey (anyone) vocational project (anyone)	20
3.	OJT/Simulated experiment performance - Camp/exhibition/clinic Performance - PTC /Practical skills (anyone)	20
	TOTAL	50

Sl.No	Items	1	2	3	4	5
1.	Regularity	Never regular	Often regular	Equally regular	Most of the time regular	Always regular
2.	Puntuality	Never punctual	Often punctual	Usually Punctual	Most of the time punctual	Always punctual

item	Evaluation indicators	scores	Score
Regularity and punctuality Value addition	<p><b>Field visit</b></p> <ul style="list-style-type: none"> <li>• Attitude and readiness towards the task</li> <li>• Capacity for observation</li> <li>• Data collection</li> <li>• Application of ideas</li> <li>• Documentation/recording</li> </ul> <p style="text-align: center;">Or</p> <p><b>Survey</b></p> <ul style="list-style-type: none"> <li>• Planning</li> <li>• Data collection</li> <li>• Consolidation of data and analysis</li> <li>• Drawing inference</li> <li>• Reporting</li> </ul>	<p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p>	<p>10</p> <p>20</p>
Capacity Building	<p><b>OJT/Simulated experiment/ Practical skill</b></p> <ul style="list-style-type: none"> <li>• Involvement/participation</li> <li>• Skills in doing work/ communication skills</li> <li>• Time bound action</li> <li>• Capacity for observation, analysis and innovation</li> <li>• Documentation, recording and display</li> </ul> <p style="text-align: center;">Or</p> <p><b>Performance in camp/exhibition/clinic</b></p> <ul style="list-style-type: none"> <li>• Ability for planning and organizing</li> <li>• Mastery of subject</li> <li>• Ability for communication</li> <li>• Innovation</li> <li>• Involvement/social commitment</li> </ul> <p style="text-align: center;">Or</p> <p><b>Performance in production/service cum training centre (PTC)</b></p> <ul style="list-style-type: none"> <li>• Mastery of vocational skills</li> <li>• Managerial capacity</li> <li>• Promoting self confidence</li> <li>• Innovation approach</li> <li>• Promoting self reliance</li> </ul>	<p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p> <p>4/3/2/1</p>	<p>20</p>

## Grading

Continuous Evaluation is essential for activitybased learning process. But the skills achieved by the students cannot be completely measured in terms of marking system. Marking system proved unscientific in evaluating the growth and development of individual students both in cognitive and non-cognitive areas. To overcome this limitation, a popular mode of evaluating students' performance known as grading system has been introduced. A 9 point scale absolute grading system is used to record the evaluation.

The score percentage and corresponding letter grade is given below:

Score in percentage	Grade
90-100	A+
80-89	A
70-79	B+
60-69	B
50-59	C+
40-49	C
30-39	D+
20-29	D
Below 20	E



## SUBJECT APPROACH

### Introduction

Gandhiji envisaged development of roads as a parameter to our nation's growth. Our roads and vehicles on them have evolved ever since and now we possess express ways on which most sophisticated technologies transport men and 'cargo'. At the same time, we have criss- cross village roads on which Sturdy Ambassadors still cruise.

Many of World's automobile giants have accepted India as a potential automobile market with enormous man power and low cost potential land. They have set up vast manufacturing units providing job opportunities to lakhs of people. Their products on road need expert technicians across the country to ensure their trouble free life. We have numerous authorised service centres of most of these companies offering quality of service at affordable prices. These centres employ technicians trained to perform specific tasks and have special service tools designed to perform specific repair works.

Definitely automobile industry has established itself as a rapidly growing sector in our industrial arena. It offers great job opportunities to those who can perform repair and maintenance activities of vehicle. Vocational Higher Secondary Education department offers the course MRA ( Maintenance and Repairs of Automobiles) which is designed to explore these potential.

### Course Objective

The prime objective of the course is to equip students with technologies necessary to perform repairs and maintenance of various automobiles. It offers them possibilities to venture as entrepreneurs or to find a job in any of the numerous service centres across the country.

After successful completion of the course, students have the option to go for higher studies as well.

### Curriculum Objectives

- 1 To learn the structure and working of various units in an automobile
- 2 To understand the possible defects and their symptoms which can happen to various components of automobiles.

- 3 To develop skills in students to provide periodic and systematic maintenance to automobile.
- 4 To mould out technicians who can perform service of all types of vehicles independently.
- 5 To develop man power having technical knowledge in this field.
- 6 To enable students with the capacity to work together in the society.
- 7 To make students qualified for higher studies in this field.

### **Learning Approach**

Learning is a continuous and smooth process leading to a behavioural change in the learner. In a broad sense the learner himself has to create knowledge. The real knowledge can be acquired only through activities in which the learner is a participant. Proper understanding of technical subjects inevitably demands 'hands on' experiences. The learning process should result in the development of various facts of multiple intelligence. More over the knowledge and skill acquired by the learner must be contributive for the overall development of the society and should serve as an indicator of social development.

To brief up, it can be said that the learning of the subject should help the learner to earn his livelihood by the successful implementation of the skills and knowledge he has developed.

### **Learning Strategies**

The learning process should advance through two phases; in the first phase, the learner thoroughly understands the problem met out to him. In the second phase he develops solutions to the said problem.

The circumstances to help the learner to complete these phases successfully are to be created by the teacher. In other words the teacher becomes a guide who directs his student towards feasible solutions to a particular problem. Also, during learning process, the student is encouraged to achieve his own findings and to proceed in quest of more knowledge.

Observations, researches etc. are very much integral for this type of learning. Group activities are powerful tools which ensure active participation of each student. They also help to maintain learner's interest on the subject of study.

Students must be encouraged to contribute and share the ideas which they have derived and to develop such ideas through group discussions.

Collective researches, evaluation of such researches and other similar group activities must be organised by the teacher. It is desirable to assign responsibilities of these activities to students themselves to make them capable to individually conduct such work.

Workshop practicals, assignments, seminars, observations, projects, field visits etc must be effectively utilised in the process of teaching.

Developing ability in students to identify possible defects that may occur in automobiles is a key factor in the advanced method of teaching the subject. More over student evaluate all possible repairs techniques and should suggest most apt solution for the specific problem. Such a method provides them with a in-depth knowledge of a problem as well as its solution. Whenever possible provide students with opportunity to experience the on hand problems. For example, suppose a particular vehicle is not yielding the fuel efficiency suggested by its manufacturer. The students must be required to analyses the reasons for this shortcoming physically and suggest all possible remedial measures. Doing so, he develops a detailed knowledge about fuel system of an automobile.

Field visit is another effective tool, which helps students to directly communicate with problematic areas. Workshops deal with vehicles of different troubles every day. In a class room the teacher and students can discuss only specific problems. But a field visit develops the perspective of a student in to a wider one. Conduct such visits as frequently as possible and make it a practice of student to prepare detailed report after each visit.

**PART II**

**UNIT WISE ANALYSIS**

# 1

# ENGINE OVERHAULING AND EMISSION CONTROL

## INTRODUCTION

An engine is expected to deliver maximum power with minimum fuel consumption. Unless maintained at optimum condition, its performance deteriorates gradually. By overhauling the engine an efficient service technician can review the performance to a great extent.

During the past few years, vehicle population on our roads have increased in many multiples. Strict norms and regulations are enforced internationally, to protect the environment from the hazards of pollution by the exhaust gases. An automobile mechanic must be aware of these responsibilities and should be able to adopt pollution control methods.

## SYLLABUS

Dismantling and assembling of Engines- 4 stroke and 2 stroke petrol engine, 4stroke diesel engine - Method of testing compression of an engine - Inspection of cylinder block & cylinder head - Inspection & correction of piston & rings - Quality & taperness of cylinder - measurements - Selection of next size piston - Boring & finishing of cylinder, setting of piston - Renewal of cylinder liners - Inspection of valves & valve seat - Methods of reconditioning - Methods of setting valve timing - Methods of checking crankshaft for concentricity - Reconditioning crank & main journals - selection of appropriate bearings - Inspection of connecting rod for bent - Inspection of camshaft for wears - Methods of reconditioning - Inspection of spark plugs, nozzles, filters, fuel injection pump etc - Recommended repair practices, Engine trouble shooting - Common troubles & repair practices - Exhaust System & Emission Control System - Scavenging - Construction of muffler - Exhaust gases - Pollution control - Catalytic converter - Positive crank case ventilation system - Emission control norms.

## CURRICULUM OBJECTIVES

- 1.1 To develop expertise in student to dismantle & assemble different types of I.C engines through workshop practicals.
- 1.2 To familiarise student with all aspects of engine overhauling through demonstration, workshop practicals & field study.
- 1.3 To make student able to identify & rectify common troubles associated with engines through Reference Books, Observation, Field visit, Project.

- 1.4 To make student understand the structure and arrangement of exhaust system through observation & collection of data.
- 1.5 To generate awareness in student about the importance of environmental protection by reducing harmful Automobile emittent gases - Methods of Emission Controlling through discussion, reference books, data collection and seminar.

## **Learning Activity**

### **1.1 DISMANTLING & ASSEMBLING OF ENGINES**

#### **ACTIVITY**

#### **1 Workshop practicals**

In actual workshop the mechanic is required to dismantle and assemble various types of engines through school workshop practice, the student must be made competent to do the work in a systematic manner.

### **1.2 ENGINE OVERHAUL**

#### **ACTIVITY**

- 1) Demonstration
- 2) Workshop practicals
- 3) Field study

The Automobile mechanic must be wellversed in Identifying & Rectifying defects on engine components. Through Inspection of dismantled engine components he can develop Traits favoring the same.

### **1.3 IDENTIFICATION & RECTIFICATION OF TROUBLES ASSOCIATED WITH ENGINE .**

#### **ACTIVITY**

- 1) Reference Book
- 2) Observation
- 3) Field Visit

There are numerous reasons for an engine to be defective. The mechanic must be competent enough to diagonise the exact cause from the symptoms.The field visit should complement to broadens his perspective in this .

### **1.4 EXHAUST**

#### **ACTIVITY**

- 1) Observation

2) Collection of data

An inefficient exhaust system can cause considerable reduction in fuel economy. Moreover, engine noise is controlled by the exhaust system. Brochures & field survey.

**1.5 EMISSION CONTROL**

**ACTIVITY**

- 1) Discussion
- 2) Reference Book
- 3) Data Collection
- 4) Seminar

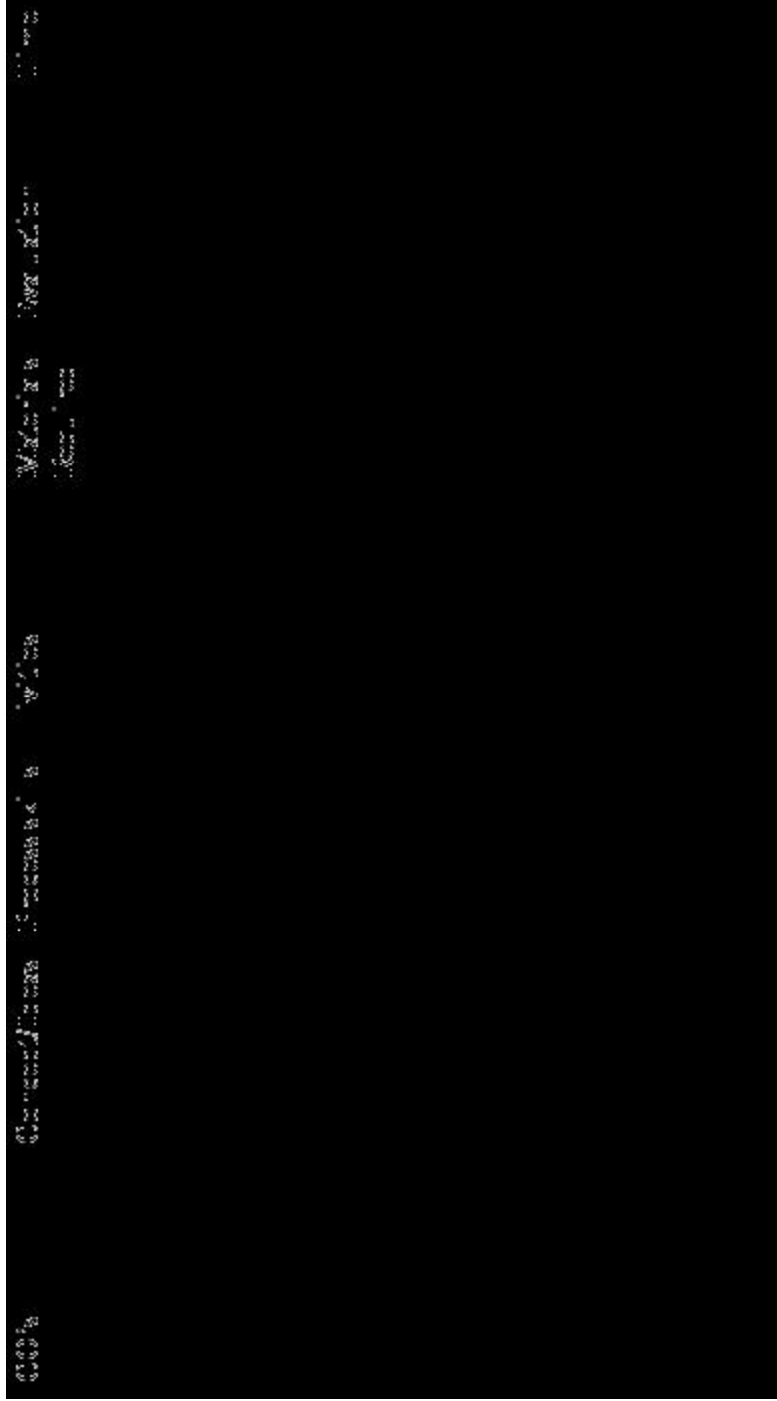
An automobile mechanic should have the clear sense of protecting environment through various emission control systems. Growing number of vehicles has made norms on this regard very stringent.

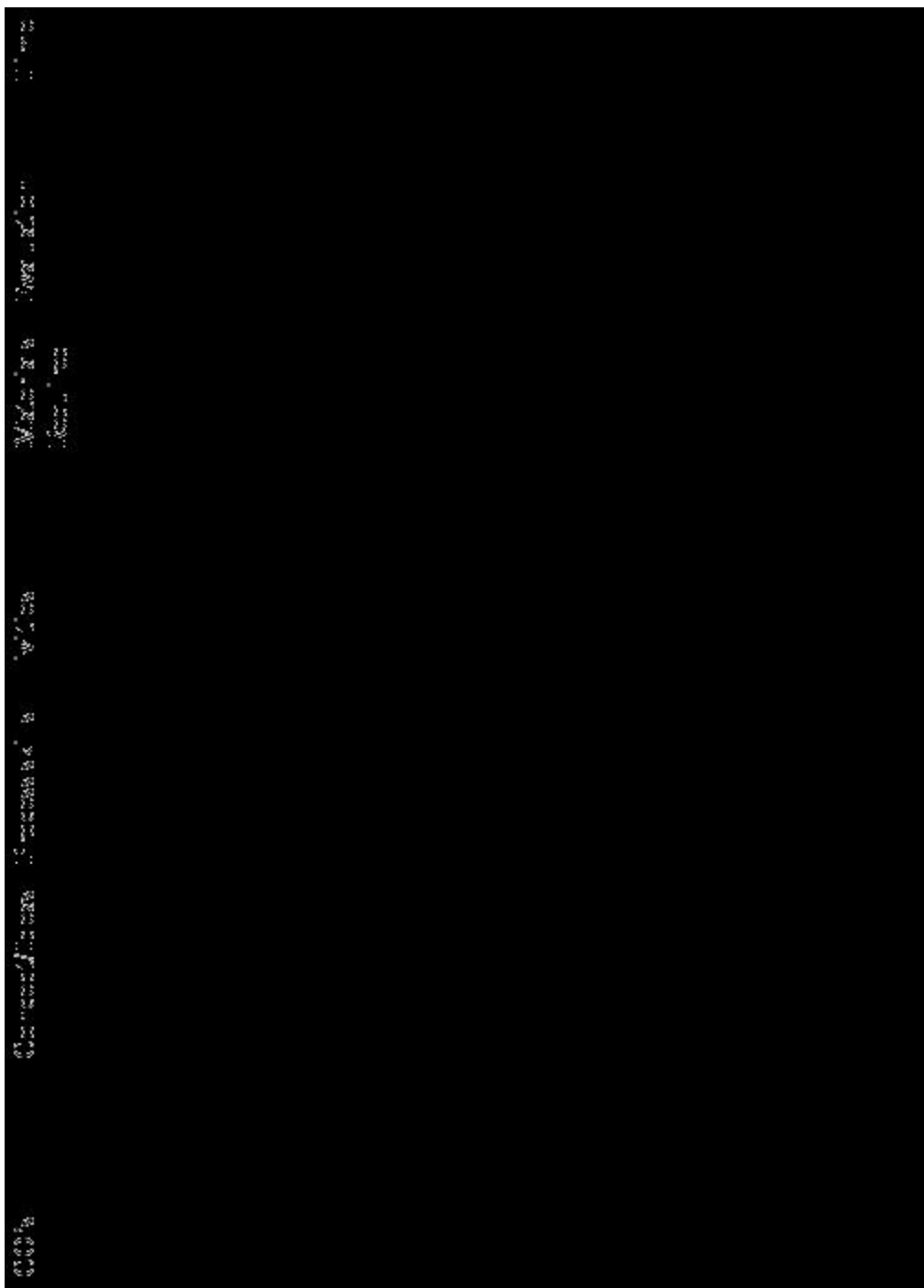
**Discussion Points**

Role of Automobile in air pollution, Reasons for increase in quantity, Norms & methods of maintaining pollution at a controlled level.

**ENGINE OVERHAULING AND EMISSION CONTROL**

**UNIT ANALYSIS 1**





# 2

## NECESSITY OF TRANSMISSION SYSTEM

### INTRODUCTION

The mechanism through which the driving torque of the engine is transmitted to the driving wheel of the vehicle is comprised of various components. Its design and construction differs with respect to the maker of vehicle. Workshop mechanics must be familiar with all types of transmission mechanisms and its components.

### SYLLABUS

Necessity of transmission system-Qualities required to transmission system - Overview of electric, hydraulic & mechanical transmission -various methods of torque transfer-Arrangements of components in mechanical transmission - Components in mechanical transmission.& their functions.

### CURRICULUM OBJECTIVES

- 2.1 To make students understand the necessity of transmission system in an automobile and the qualities required in transmission system through classroom discussion and observation.
- 2.2 To create awareness in students about the various methods adopted and arrangements of various components in different methods of torque transmission with the help of reference books, field visit and preparation of drawings.
- 2.3 To familiarize students the various types employed in mechanical transmission system through visual media, demonstration, service manuals and an assignment.

### LEARNING ACTIVITIES

#### 2.1 NECESSITY OF TRANSMISSION SYSTEM

##### ACTIVITY

- 1) Observation
- 2 Class room discussion based on observation

By observing various vehicles in motion in different situations, students are made to realize the necessity of transmission system. Their observations are consolidated in class room discussion.

### DISCUSSIONS POINTS

- Situations which necessitates gear shifting

- How wheels are made to rotate by engine.

## 2.2 ARRANGEMENTS OF COMPONENTS IN DIFFERENT TYPES OF TRANSMISSIONS SYSTEMS.

### ACTIVITY

- 1) Referring various books
- 2) Field visit
- 3) Preparation of charts/drawings

Various vehicles employ different methods as well as different components to transfer engine torque to road wheels.

### COLLECTION

Arrangements of exhaust system of various vehicles. Brouchers & field survey.

## 2.3 EMISSION CONTROL

### ACTIVITY

- 1) Discussion
- 2) Demonstration
- 3) Assignments on the list of components & their functions.

A general discussion can be conducted. Demonstration of various components is to be conducted so that students get a clear understanding of various components and their functioning in transmission system.

### DISCUSSION POINTS

Functions of

- Clutch
- Gear box
- Universal joint
- Propeller shaft
- Final drive
- Differential
- Rear axles

## 2.4 VARIOUS TYPES OF MECHANICAL TRANSMISSION SYSTEM

### ACTIVITY

- 1) Visual media
- 2) Demonstration

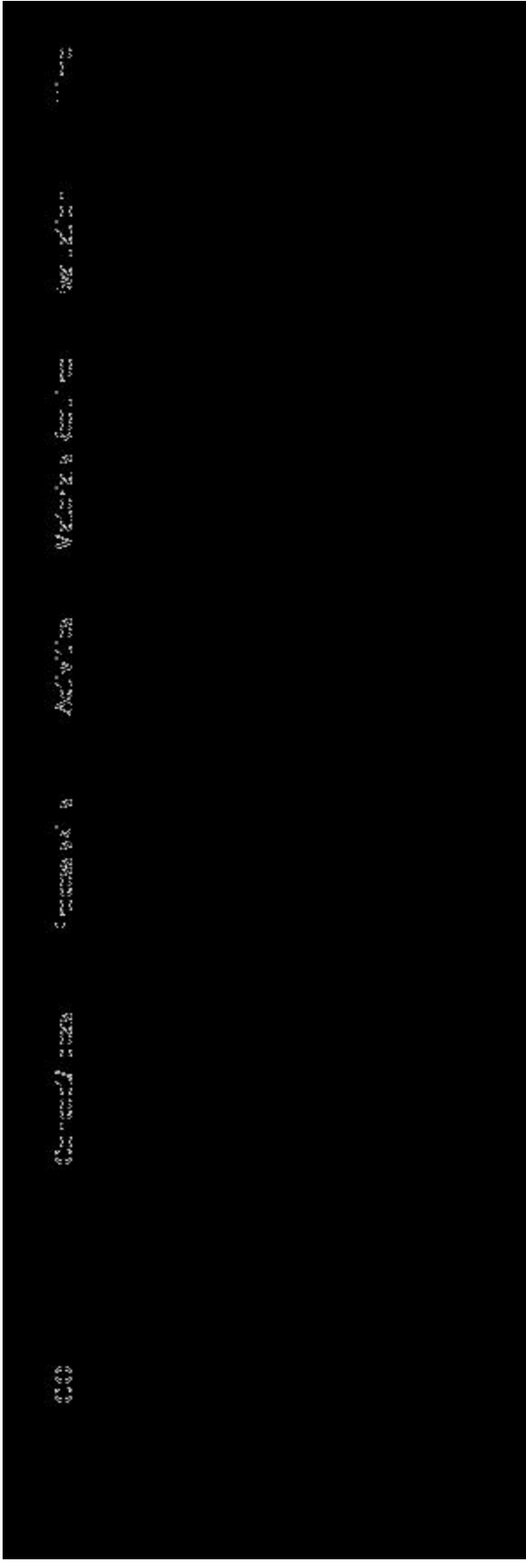
- 3) Service manual
- 4) Assignment
  - a. Comparison
  - b. List out vehicles using various mechanical transmission systems.

Different vehicles employ different methods like :

- 1) Front wheel drive
- 2) Rear wheel drive
- 3) Four wheel drive
- 4) Chain drive etc.

UNIT ANALYSIS 2

NECESSITY OF TRANSMISSION SYSTEM



# 3

## CLUCHSYSTEM

### INTRODUCTION

Automobile clutches are mechanisms, which are used to connect or disconnect the transmission of torque from one rotating part to another. Their operation should be smooth and progressive. Any loss of torque at clutch has drastic effect on the performance of vehicle. Most of our vehicles employ manual transmission in which friction clutches are used. Gradual wear of friction elements cannot be avoided and a mechanic should give consistent attention to clutches, so as to avoid break downs and loss of power.

### SYLLABUS

Classification ,requirements ,construction,& working of various clutches .viz-cone,single plate ,multiplate,diaphragm and centrifugal clutches.

### CURRICULUM OBJECTIVES

- 3.1 To make students able to identify requirements of a good clutch and to make them able to identify clutches through classroom discussion, demonstration preparation of charts etc.
- 3.2 To make students understand the construction and working of cone, disc and diaphragm clutches, centrifugal clutches through workshop practicals, reference books, field visit etc.
- 3.3 To make students recognize relative merits and demerits of various clutches, classroom discussion, seminar, preparation of drawings are to be employed.
- 3.4 To develop expertise in students on maintenance and repair activities of various clutches through workshop practicals, service manuals and field visit.

### LEARNING ACTIVITY

#### 3.1 PRINCIPLE REQUIREMENTS, QUALITIES AND CLASSIFICATION OF CLUTCHES

##### ACTIVITY

- 1) Discussion
- 2) Demonstration of components and illustration.
- 3) Preparation of charts
- 4) Collection

Automobiles employ different clutches in accordance with their type and purpose.

## DISCUSSIONS POINTS

- Friction
- Area of contact
- Heat dissipation
- Selection of clutches

### 3.2 CONSTRUCTION & WORKING OF DIFFERENT FRICTION CLUTCHES

#### ACTIVITY

- 1) Workshop practicals
- 2) Field visit
- 3) Referring various books
- 4) Project

Mechanism used to engage and disengage friction element with the driver element decides the type of clutch.

#### PROJECT

Collection of different types of clutch units and write down the reason for using such clutches in those vehicles.

### 3.3 COMPARISON OF VARIOUS CLUTCHES

#### ACTIVITY

- 1) Discussion
- 2) Preparation of drawings & notes
- 3) Seminar

Clutches are chosen for different vehicles as per the type & purpose of vehicles.

Discussion Point:- Merits & demerits of various clutches.

### 3.4 MAINTENANCE & REPAIR OF CLUTCHES

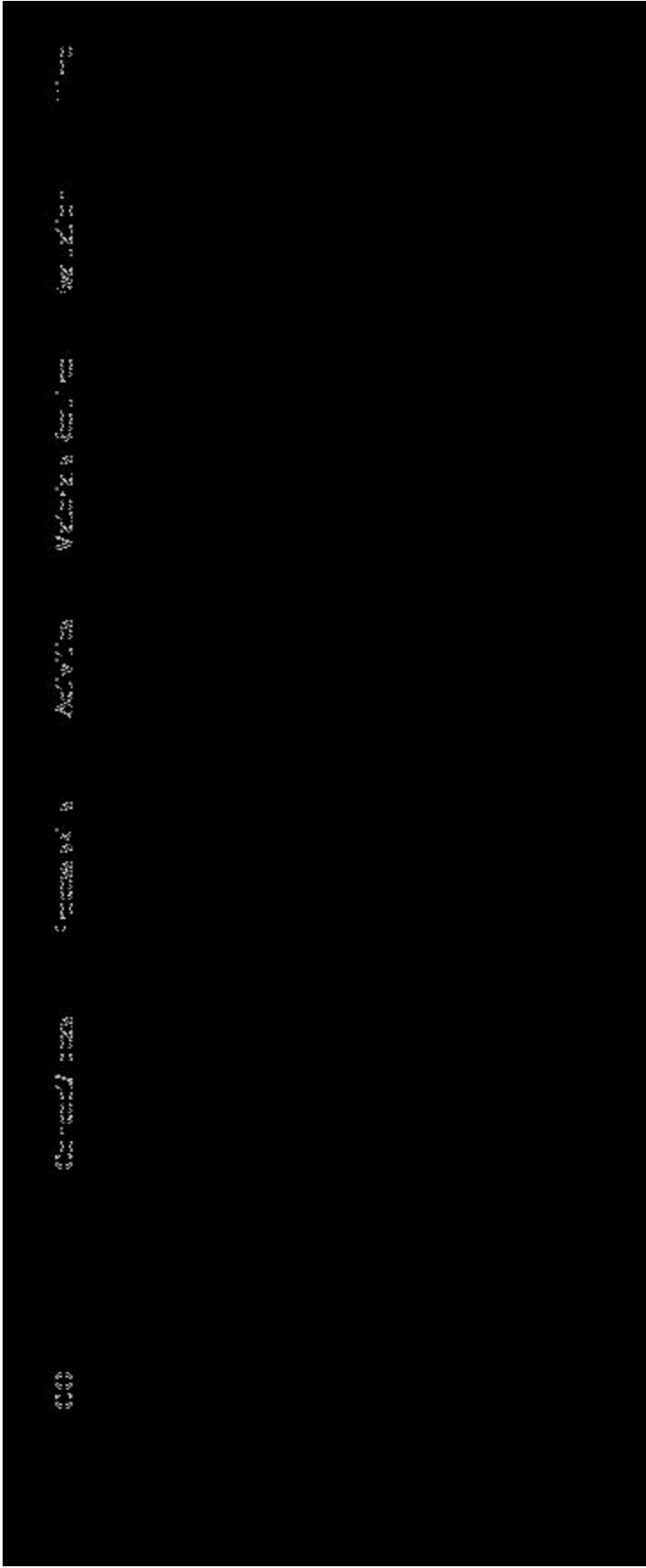
#### ACTIVITY

- 1) Workshop practicals
- 2) Service manuals
- 3) Field visit

By observations, students are made to recognize the reasons which make a clutch defective & they are trained in workshop to rectify defective clutches.

**UNIT ANALYSIS 3**

**CLUTCH SYSTEM**



# 4

## TRANSMISSION

### INTRODUCTION

The Torque requirements of an automobile varies continuously during motion due to various factors. To ensure movement of vehicles at a uniform speed, gear boxes, which are capable to provide a vast range of tractive efforts are employed. Since there is an assembly of interrelated moving metal components, possibility of heat generation and wear is high. Mechanic must have a clear understanding of their arrangement, repairs and maintenance.

### SYLLABUS

Progressive and selective gear boxes-Floor shift & column shift arrangements - Classification ,construction &working of various selective gear boxes-Gear selector mechanism-Gear ratios-Overdrive-Transfer case - Automatic transmission system -Construction & working of fluid coupling ,torque converter, planetary gear box ,over running clutch -Arrangement of components in Automatic transmission - Maintenance of clutches and gear boxes -Grades of lubricating oil-Troubles & repair tactics associated with clutches and gear boxes.

### CURRICULUM OBJECTIVES

- 4.1 To develop students awareness about the need and functions of gear box in Automobile through demonstration and discussions.
- 4.2 To make students able to differentiate progressive and selective gear boxes to make hem understand the working and construction of various types of selective gear boxes, transfer case, gear selector mechanism, gear ratio and over drive through workshop practicals, reference books, group discussion, preparation of drawings and notes.
- 4.31 To develop awareness of students on automatic transmission and the various component (torque convertor, fluid flywheel, planetary gear box) in it through classroom discussion, reference books, preparation of drawings and notes.
- 4.4 To develop expertise in students in maintaining gear boxes, to identify and rectify defects on gear boxes through classroom discussion, workshop practicals, service manuals and field visit.

### LEARNING ACTIVITIES

#### 4.1 FUNCTION OF GEARBOX

##### ACTIVITY

- 1) Demonstration of vehicles in motion

- 2) Discussion
- 3) Preparation of Notes

Gear mechanism introduced required leverage in transmission, so as to improve fuel economy in varying condition of speed and load.

#### **DISCUSSION POINT**

- Purpose of gear shifting

### **4.2 PROGRESSIVE AND SELECTIVE GEAR BOXES, GEAR RATIOS**

#### **SUBTOPIC**

Construction & working of

- 1) Various types of selective gear boxes
- 2) Transfer case
- 3) Gear selector mechanism and overdrive

#### **ACTIVITY**

- 1) Workshop practicals
- 2) Demonstration, Visual media
- 3) Field visit
- 4) Referring Books
- 5) Seminar
- 6) Preparation of Drawings & Notes

Gear box maintains engine speed at most economical value under all conditions of vehicle movement. Students must be familiarised with main types of gear boxes.

#### **DEMONSTRATION & FIELD VISIT**

Observation of construction and functions of relevant mechanisms

#### **SEMINAR TOPICS**

1. Development on the field of transmissions with the help of illustrations.

### **4.3 AUTOMATIC TRANSMISSION**

#### **ACTIVITY**

1. Discussion
2. Reference books
3. Assignment

Eventhough automatic transmission is not widely used on Indian roads, students of Automobile maintenance must be aware of functioning of components employed in the same.

#### DISCUSSION POINTS

- Purpose and working of torque converter - fluid flywheel
- Epicyclic gearbox
- Overdrive with planetary mechanism.

#### 4.4 MAINTENANCE AND REPAIRS OF GEARBOXES

##### ACTIVITY

1. Discussion
2. Workshop practicals
3. Field visits
4. Service Manuals

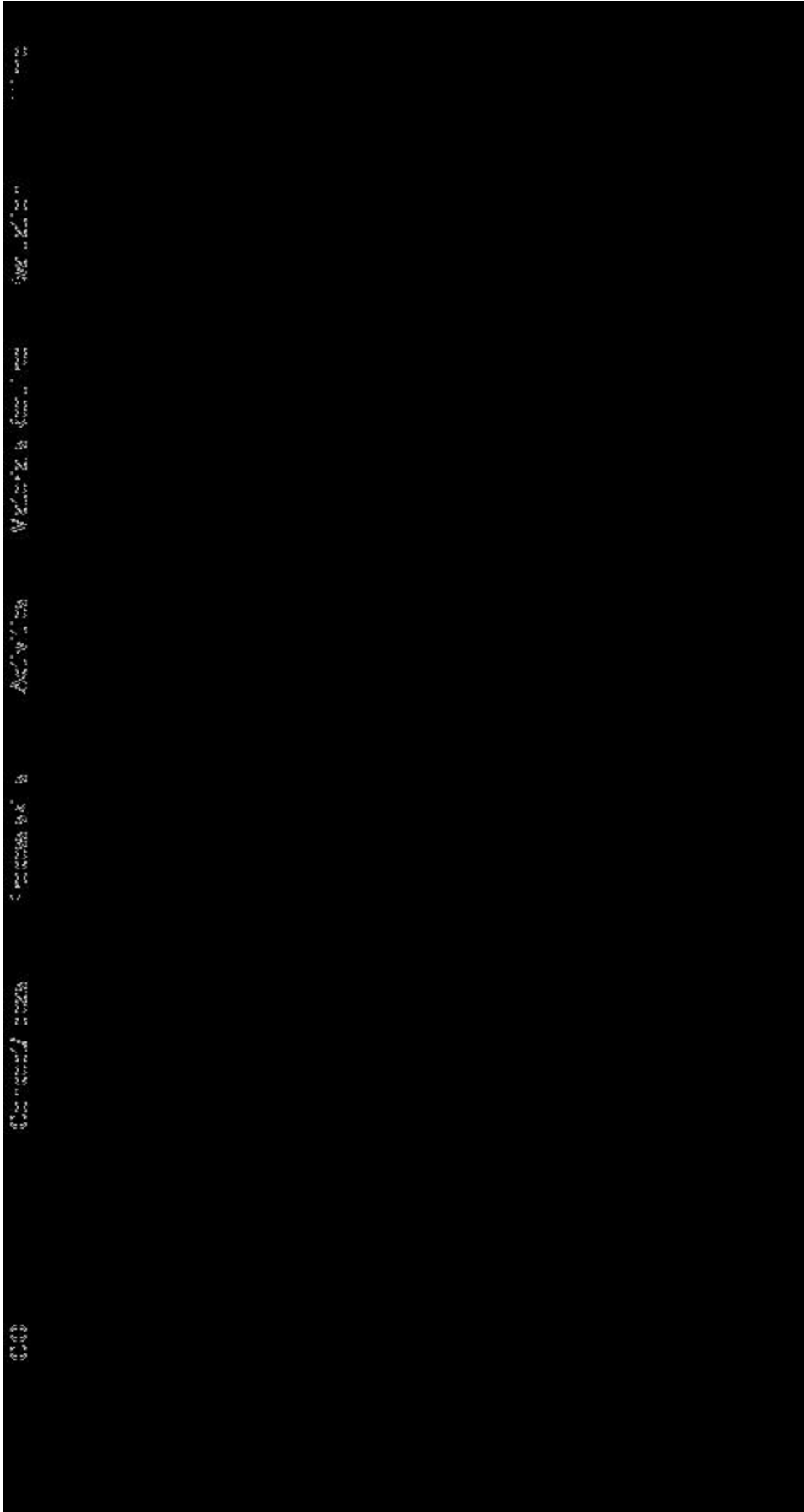
Since gearboxes contribute very much to the overall performance of an automobile, they require continuous attention, care and prompt repairs.

#### DISCUSSION POINTS

- Probable damages and correction
- Recommended maintenance tactics

**TRANSMISSION**

**UNIT ANALYSIS 4**



# 5

## PROPELLER SHAFT AND DIFFERENTIAL UNIT

### INTRODUCTION

The torque from gearbox is transmitted to the differential through propeller shaft and universal joints. The differential then transmits the torque to the rear axle to which the rear wheels are connected. The shafts, axles and different joints has to withstand the terminal stresses of the transmitting torque so that vibrations and whip will not occur at high speeds. The differential unit provides relative movement to the drive wheels when the vehicle is taking a turn. The mechanic must have a clear idea about their arrangement, repairs and maintenance.

### SYLLABUS

Functions, Construction & working of drive shaft, Universals joints & slip joint, Open shaft & torque tube drive, Functions, construction & working of final drive & differential mechanism, their classification, Differential housing, Front & rear axles, Wheel mounting arrangements, Transaxles, Maintenance of drive shaft, final drive & differential, Differential oil - Troubles & repair of the above components.

### CURRICULUM OBJECTIVES

- 5.1 To make students understand the constructional details and working of drive shaft through demonstration, classroom discussion, preparation of drawings and notes.
- 5.2 To make students understand the construction and functions of universal joints and slip joint through demonstration, classroom discussion, reference books, service manuals and preparation of drawings and notes.
- 5.3 To generate awareness in students about Hotchkiss and torque tube drive through illustrations and preparation of notes on it.
- 5.4 To make students understand the concepts of final drive, its different arrangements and their advantages through illustrations and reference books.
- 5.5 To make students understand the construction and functioning of different types of differential gears through demonstration, reference books, workshop practicals etc.
- 5.6 To make students to understand construction and functioning of differential housings, front and rear axles, transaxle & wheel mounting arrangements through demonstration, field visit and an assignment.
- 5.7 To develop student's knowledge on maintenance of drive shaft and its components and to develop expertise on trouble shooting and repairing the same through brain storming and workshop practicals.

## **LEARNING ACTIVITY**

### **5.1 CONSTRUCTION AND WORKING OF DRIVE SHAFT**

#### **ACTIVITY**

1. Demonstration
2. Discussion
3. Assignment

Drive shaft gives drive to the driving axle. It plays a very important role in heavy vehicles.

#### **ASSIGNMENT**

1. Individual assignment to prepare notes with drawing.

### **5.2 UNIVERSAL JOINT AND SLIP JOINT**

#### **ACTIVITIES**

1. Demonstration
2. Discussion
3. Referring books and service manuals
4. Individual assignment

Drive shaft is subjected to constant variations in its length and inclinations.

#### **DISCUSSION POINTS**

1. Methods through which rotary motion can be imparted to an inclined shaft with minimum vibration.
2. Method by which length of a rotating shaft can be varied.

#### **ASSIGNMENT**

Explaining the construction and functioning of related components.

### **5.3 DRIVE SYSTEMS**

#### **ACTIVITY**

1. Demonstration of illustrations
2. Preparation of notes

Open shaft and tongue tube concepts.

### **5.4 FINAL DRIVE**

#### **ACTIVITY**

1. Illustration
2. Reference books

Mechanism which offer a final and fixed speed reduction, a 90° deviation in Torque Transmission, bevel spiral and Hypoid gears etc. construction and working.

### 5.5 DIFFERENTIAL

#### ACTIVITY

1. Workshop practicals
2. Demonstration
3. Referring books
4. Seminar

The Mechanism without which no Automobile can properly negotiate curves and slippery roads is of utmost importance.

#### SEMINAR TOPIC

Construction and working of Differential mechanism with the help of illustration.

### 5.6 DIFFERENTIAL HOUSINGS, FRONT AND REAR AXLES, TRANSAXLE, WHEEL MOUNTING ARRANGEMENT

#### ACTIVITY

1. Demonstration
2. Field visit
3. Assignment

These mechanisms and related forms are very relevant in all generation vehicles. It is very necessary for an Automobile mechanic to be familiar with them.

#### ASSIGNMENT

Individual assignment which explain construction and working of the above with the help of diagrams.

### 5.7 MAINTENANCE & REPAIRS OF DRIVE SHAFT & COMPONENTS

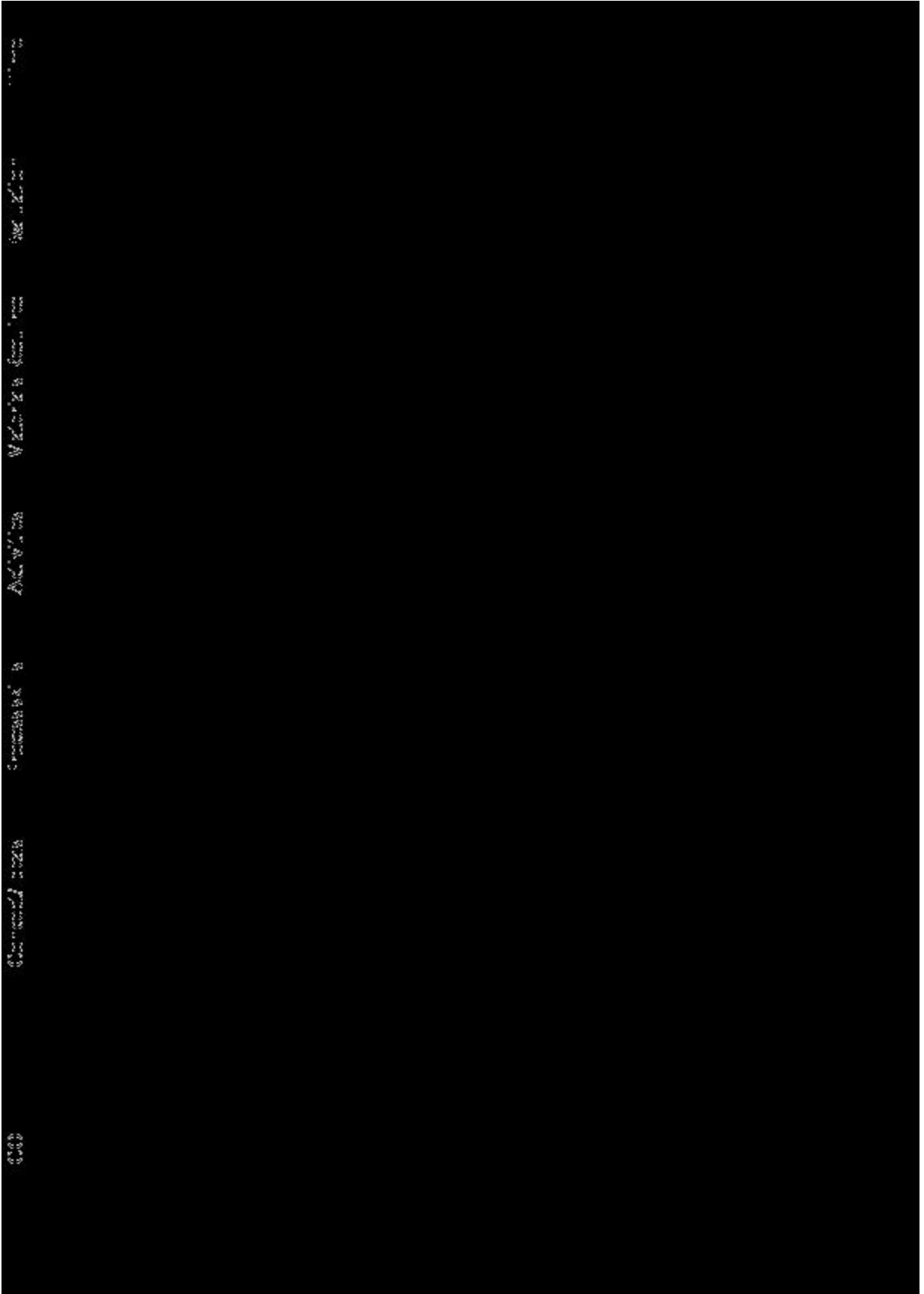
#### ACTIVITY

1. Brain storming
2. Workshop practicals
3. Preparation of notes & drawings

Continuously moving interconnected mechanisms are easily damaged, if proper care is not given.

**PROPELLER SHAFT AND DIFFERENTIAL UNIT**

**UNIT ANALYSIS 5**



# 6

## STEERING SYSTEM

### INTRODUCTION

The steering of a four wheeled vehicle is arranged so that the front wheels will roll truly without any lateral slip. The steering system essentially consists of a steering gear and steering linkage. The function of the steering system is to convert the rotary movement of the steering wheel into angular turn of the front wheels. The steering system also absorb a large part of the road shocks, thus preventing them from being transmitted to the driver. This unit gives a clear idea to the mechanic about the arrangement, repairs and proper maintenance of various steering systems.

### SYLLABUS

Necessity of steering system-requireds qualities, Reversibility of steering - Ackerman & Davis Steering Mechanisms, fifth wheel steering system - Steering system components -Steering wheel, Steering column, steering gear box, tie rod, tie rod end, pitman arm, steering knuckle, drag link - Arrangements of steering system components in independent and rigid suspension - Steering gear boxes-Rack and pinion, Worm & wheel, Worm & roller, Worm & nut, Recirculating ball etc. - their construction & working, steering gear ratio, free play - Factors of steering stability & tyre wear-Wheel alignment, Caster, camber toe in, toe out, king pin inclination, Wheel balancing, Slip angle, Cornering force. Under steer & oversteer, Steering recovery, Turning radius - Power steering - Advanced technologies in steering linkages - Maintenance & Repairs of steering system - Methods of adjusting wheel alignment.

### CURRICULUM OBJECTIVES

- 6.1 To make students realize the necessity of steering system and required qualities in steering system. Make them aware of steering reversability.
- 6.2 To familiarize students with Ackerman and fifth wheel steering arrangements through reference books, demonstration and generation of drawings.
- 6.3 To make understand various components and their functions in a steering system and their arrangements .To make them aware about changes in IFS and RFS systems through demonstrations, service manual, workshop practicals,visual media and reference books.
- 6.4 To make students understand the construction and working of different types of steering gear boxes. To make them aware about steering gear ratio through reference books, demonstrations, workshop practicals and generation of drawings.

- 6.5 To make students realize various factors effecting steering stability and life of tyre. Make them familiarize with wheel alignment and maintenance activities, wheel balancing, steering recovery and steering geometry, steering wheel free play through demonstration, reference books, field study and a seminar.
- 6.6 Make students aware about advance steering system ,advanced technologies in steering linkages and power steering through discussion, reference books, workshop manuals preparation of notes, etc.
- 6.7 To make students familiarize with troubles, remedies and repair techniques of steering system through field visit, workshop practicals, service manuals and assignments.

## **LEARNING ACTIVITY**

### **6.1 NECESSITY OF STEERING SYSTEM AND ITS REQUIRED QUALITIES**

#### **ACTIVITY**

1. Brain storming
2. Observation
3. Preparation of notes

A mechanism which provide directional control with ease. The vehicle has to meet destination without trouble.

#### **SUBJECT OF BRAIN STORMING**

Why is the mechanism necessary?

What should be its qualities/requirements?

### **6.2 ACKERMANN AND FIFTH WHEEL STEERING ARRANGEMENT**

#### **ACTIVITY**

1. Referring book
2. Demonstration
3. Generation of drawings

### **6.3 COMPONENTS OF STEERING SYSTEM, THEIR FUNCTIONS. ARRANGEMENT OF COMPONENTS IN IFS AS WELL AS RFS SYSTEM.**

#### **ACTIVITY**

1. Demonstration
2. Service manual
3. Workshop practicals
4. Visual media

5. Referring books

There are numerous components in Steering system, which are arranged as required in such a way to suit the purpose.

**6.4 STEERING GEAR BOXES, STEERING GEAR RATIO**

**ACTIVITY**

1. Demonstration
2. Workshop practical
3. Generation of drawing

The mechanism which reduces the effect of driver, while ensuring smooth and accurate movement of steered wheels.

**6.5 FACTORS AFFECTING STEERING STABILITY, STEERING GEOMETRY, WHEEL BALANCING**

**ACTIVITY**

1. Demonstration
2. Field study
3. Referring book
4. Seminar

Interrelation of wheels and steering system components directly influence riding and driving comfort. It also affects the life of these components.

**6.6 ADVANCED STEERING SYSTEM, POWER STEERING**

**ACTIVITY**

1. Discussion
2. Reference books
3. Workshop manuals

Increased vehicle population and increase in driving hours has necessitated the adoption of power steering in smaller vehicles recently. To ensure maximum comfort of the driver, advancements have taken place in steering system components as well.

**DISCUSSION POINTS**

1. Advanced Technologies
2. Collapsible Steering
3. Safety Air Bags
4. Power Steering

**6.7. MAINTENANCE & REPAIRS OF STEERING SYSTEM.**

**ACTIVITY**

1. Field visit
2. Work shop practical
3. Assignment

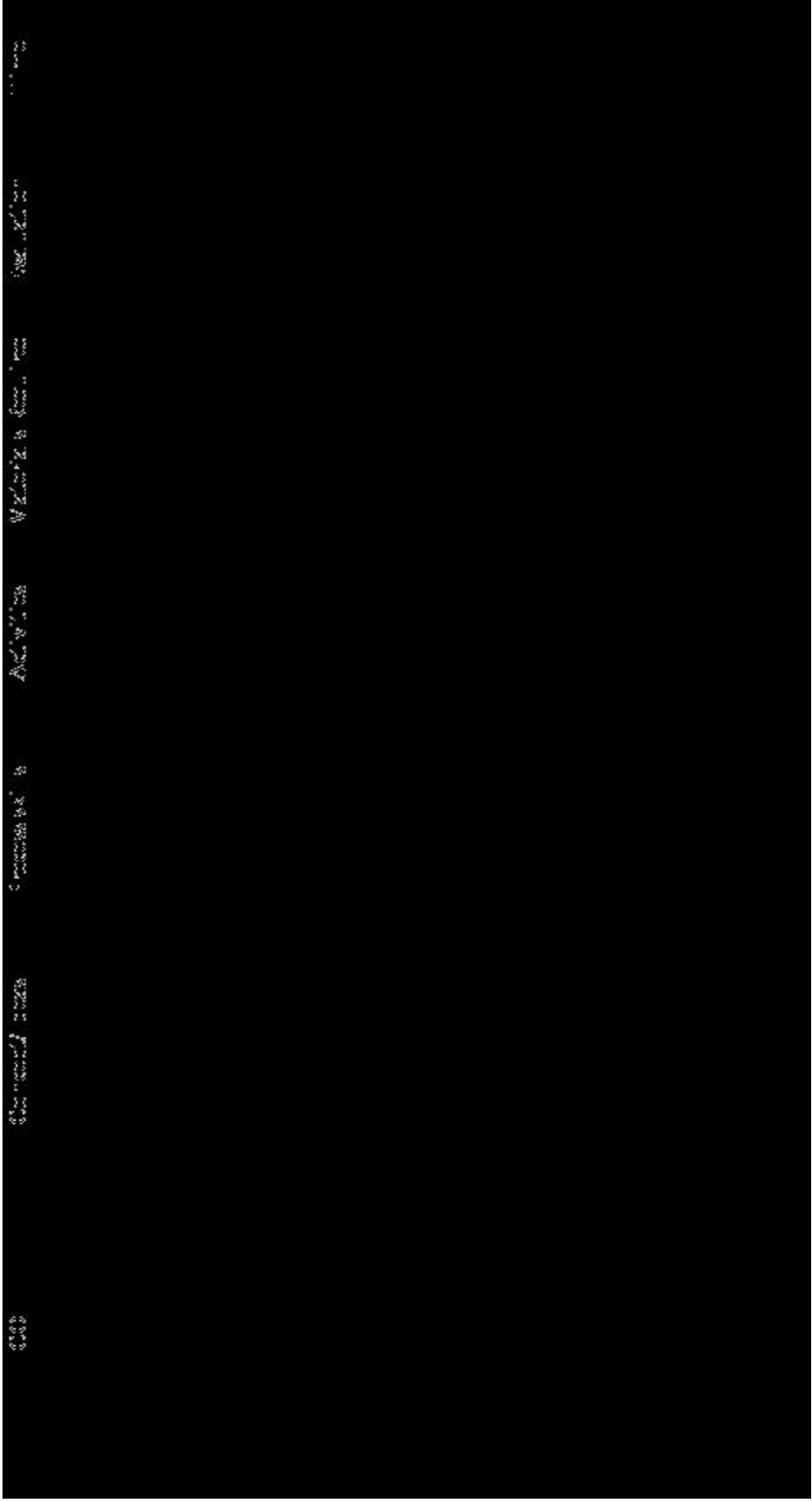
Trouble free steering system is necessary to reduce accidents. Students must be well versed with preventive maintenance activities & Repair techniques of the same.

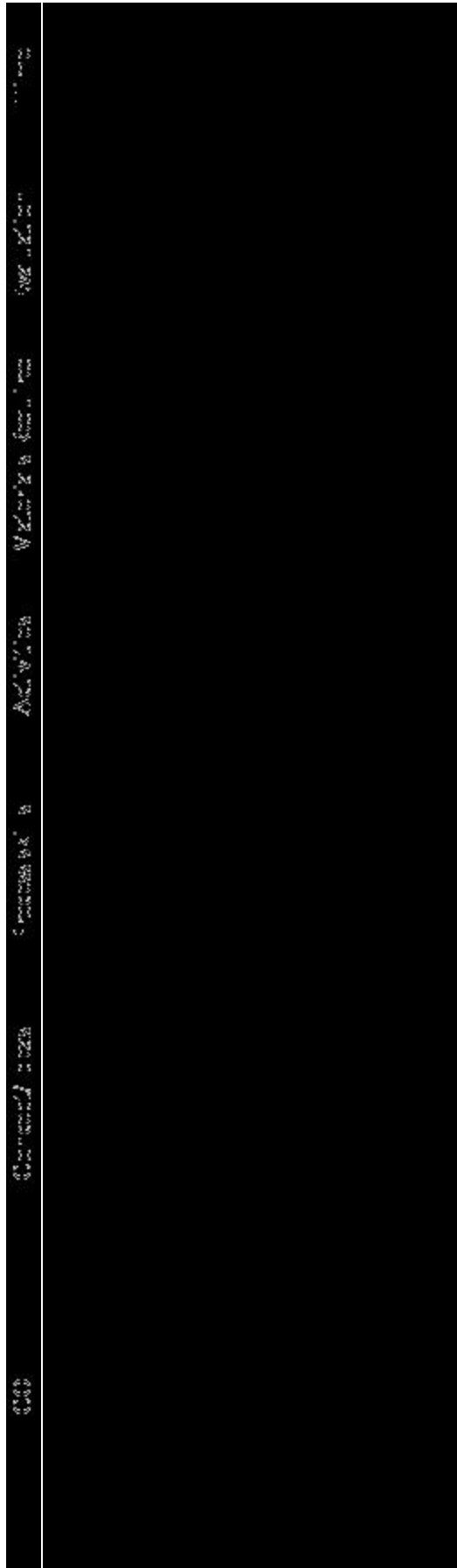
**ASSIGNMENT**

Explaining common troubles in steering system.

UNIT ANALYSIS 6

STEERING SYSTEM





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Sl. No.	Name of the Candidate	Roll No.	Grade	Remarks
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# 7

## SUSPENSION SYSTEM

### INTRODUCTION

The suspension system including different types of springs, shock absorptions and their mountings are to damp the road shocks transmitted to the frame by the wheels as they roll over the road. The suspension system of a motor vehicle is divided into rear end suspension and front end, suspension. By learning this area the student gets a clear idea about the arrangement, repairs and maintenance of different types of suspension units in vehicles.

### SYLLABUS

Necessity of suspension system -Sprung & unsprung weight -Factors affecting vehicle stability & riding comfort . - Rigid & independent suspension system - Components of suspension system -springs - Helper springs-Spring shackles-Shock absorbers-Stabilizers etc- their construction and working - MacPherson strut & Wishbone mechanism - Arrangements of rigid & independent suspension system using leaf spring, coil spring & torsion bar - Air suspension system - Maintenance & Repairs of suspension system - Measuring of spring camber & recambering ,Procedure of checking the shock absorber & replacing the same.

### CURRICULUM OBJECTIVES

- 7.1 To develop students understanding the necessity of suspension system ,sprung & unsprung weight .To make them aware with the factors that affect vehicle stability and riding comfort through brain storming ,observations,reference books and assignments.
- 7.2 To familiarize students with various components and construction of suspension system through demonstration,class discussion, reference books and assignments.
- 7.3 To make understand about the arrangements in rigid suspension system through field study,service manual and collection of data .
- 7.4 To make understand about the arrangements in independent suspension system including Macpherson ,Wishbone and torsion bar through field study ,demonstrations, service manual and collection of data.
- 7.5 Make students aware of concepts ,construction and functioning of air suspension through field study ,multimedia and ,reference books.
- 7.6 To make students familiarize with the maintenance and rectification of suspension system through workshop practicals service manual and collection of data.

## **Learning Activities**

### **7.1 NECESSITY OF SUSPENSION SYSTEM, SPRUNG AND UNSPRUNG WEIGHT.**

#### **ACTIVITY**

1. Brain storming
2. Observation
3. Reference books
4. Assignment

Suspension system ensures two purposes.

1. Optimum vehicle stability
2. Maximum Riding comfort

#### **ASSIGNMENT**

Individual Assignment suggesting factor effecting vehicle stability & Riding comfort.

### **7.2 COMPONENTS OF SUSPENSION SYSTEM**

#### **ACTIVITY**

1. Demonstration
2. Discussion
3. Reference books
4. Preparation of Notes & Drawings

Since different vehicles employ different components, which fulfil their suspension requirements, students must be familiarised with all of them.

### **7.3 ARRANGEMENT OF RIGID SUSPENSION SYSTEM**

#### **ACTIVITY**

1. Field Study
2. Service manuals
3. Collection of data
4. Preparation of drawings

Arrangement of suspension system differs from vehicle to vehicle.

Data to be collected. Suspension Arrangement of different makes & models.

#### **7.4 ARRANGEMENT OF INDEPENDENT SUSPENSION SYSTEM**

##### **ACTIVITY**

1. Field Study
2. Service manuals
3. Collection of data
4. Preparation of drawings

Macpherson strut, Wishbon Arm & Torson bar arrangements are the most prominent and independent suspension arrangements.

Data to be collected - Suspension arrangement of different makes & models.

#### **7.5 AIR SUSPENSION**

##### **ACTIVITY**

1. Field Study
2. Multimedia
3. Reference book

Air suspension is gaining prominence in Buses & Luxury cars - students must be given a clear understanding of the same.

#### **7.6 MAINTENANCE & RECTIFICATION OF TROUBLES IN SUSPENSION SYSTEM.**

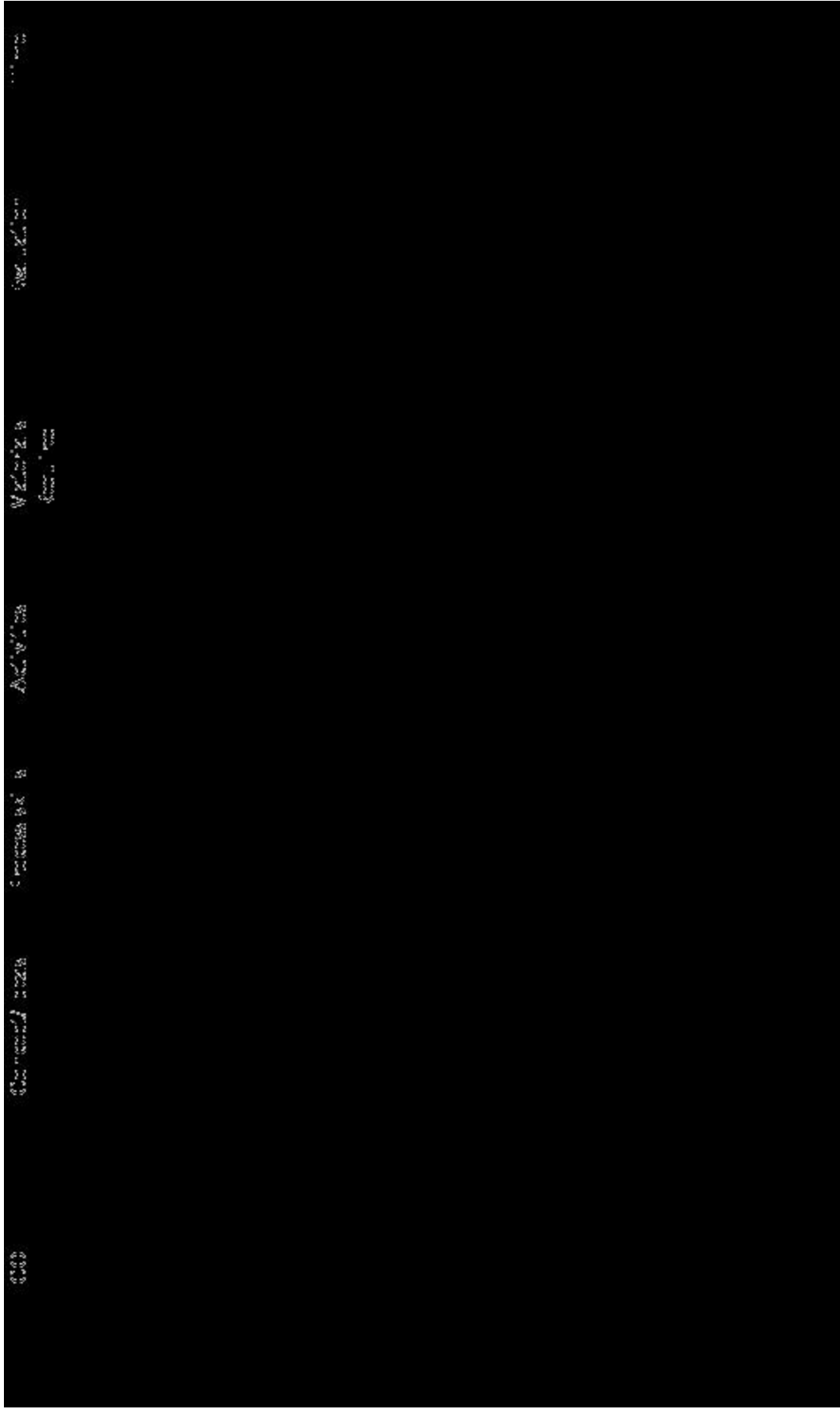
##### **ACTIVITY**

1. Workshop practicals
2. Seminar Manual
3. Collection of data

Short faults in suspension leads to extensive damages. Moreover, the condition of a vehicle is primarily assessed by the performance of its suspension system.

**SUSPENSION SYSTEM**

**UNIT ANALYSIS 7**





# 8

## WHEELS

### INTRODUCTION

Wheels are connected to the rear and front axles. As the axles turn, wheels also turn and the vehicle moves on the road. The power developed by the engine is to turn the wheels so that the vehicle moves on the road. The wheels not only support the weight of the vehicle, but also protect it from the road shocks. The wheels must resist the braking stresses and withstand side thrust. This unit gives a clear idea to the student about the arrangement, repairs and maintenance of wheels and tyres.

### SYLLABUS

Function & construction of wheel- Function, classification & construction of different types of tyres & tubes - Maintenance & Repairs, replacement of tyre & tube.

### CURRICULUM OBJECTIVES

- 8.1 To create awareness about the functions and constructions of pneumatic wheels through demonstrations, brochures, preparation of notes and diagrams.
- 8.2 Familiarise the students with the function, classification and constructional details of different types of tyres & tube through demonstration, collection of data and seminar.
- 8.3 To make students experienced in maintenance and repairs of tyre and tube and tyre rotation through workshop practicals and field visit.

### LEARNING ACTIVITIES

#### 8.1 CONSTRUCTION AND FUNCTIONS OF AUTOMOBILE WHEEL

##### ACTIVITY

1. Demonstration
2. Collection of data - from external sources
3. Preparation of notes and diagrams

Since there is rapid development in this field continuous updation is necessary. Students must be motivated to maintain latest records.

## **8.2 CLASSIFICATION, CONSTRUCTION AND FUNCTIONS OF TYRES AND TUBES**

### **ACTIVITY**

1. Demonstration
2. Collection of data
3. Seminar

Wide range of tyres are present in our market . Imported tyres also have their market share. An automobile technician must be able to guide his customers to choose the appropriate tyre.

### **COLLECTION**

Considerable data can be gathered from Tyre dealers and Brochures of manufactures.

### **SEMINAR**

Data collected by all students must be consolidated and presented as a seminar by a group or by a student.

## **8.3 MAINTENANCE, REPAIRS & REPLACEMENT OF TYRES & TUBE, WHEELS**

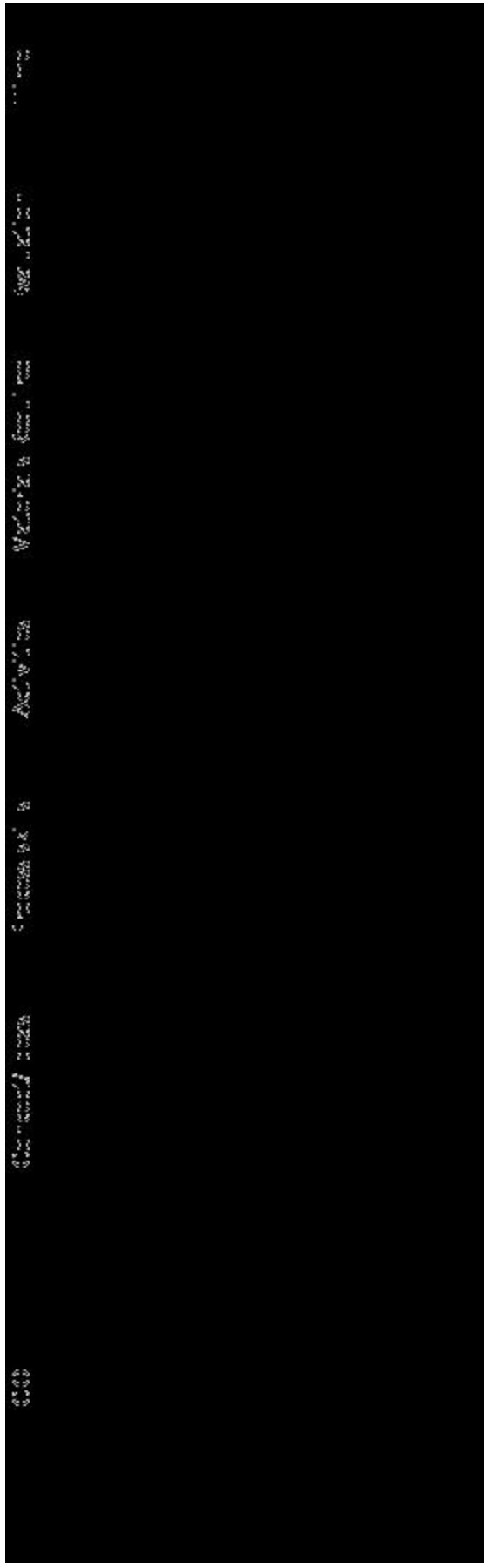
### **ACTIVITY**

1. Workshop practicals
2. Field visit

Repairing a purchased tube, replacement of tread etc. does not include in regular automobile workshop practice. Still, Automobile Technician must be familiarised with the procedures. Proper maintenance of tyre must be encouraged to increase its life.

**WHEELS**

**UNIT ANALYSIS 8**



# 9

## **BRAKESYSTEM**

### **INTRODUCTION**

Brakes are applied on the wheels to stop the vehicle. Brakes are used to stop or slow down the vehicle in the shortest possible distance in emergencies and to control the vehicle to be retained when descending a hill. By learning this chapter the student gets a clear understanding about the arrangement, repairs and maintenance of different types of brakes like mechanical brakes, hydraulic brake, servo brakes, air brakes and engine exhaust brakes.

### **SYLLABUS**

Necessity of brake system & the required qualities-Factors affecting braking distance, Classification of brakes - Various components in Mechanical brake system-their arrangement & functioning - Various components in different types of hydraulic brakes & servo brakes-their arrangement & functioning - Arrangement of various components in Air brake system - Comparison of different types of brake systems - Advanced technologies in Automobile braking ,Abs etc. - Maintenance & Repairs of various brakes.

### **CURRICULUM OBJECTIVES**

- 9.1 To make students to realize the necessity of brake system ,its required qualities,factors affecting braking distance through discussion and survey.
- 9.2 To make student aware about the classification of brakes through service manuals ,surveys and reference book.
- 9.3 To make students understand about arrangement of various components in a mechanical brake system and their function through demonstration, reference book and preparation of notes and diagrams.
- 9.4 To make students understand about arrangement of various components in different types of hydraulic brake system through demonstration, reference book workshop practicals and seminars.
- 9.5 To make students understand about the arrangements of various components in different types of air brake system through field visit, preparation of notes and diagrams.
- 9.6 Make student to compare the different types of brakes through group discussion and preparation of notes.
- 9.7 Develop awareness about the advanced technologies adopted in automobile brake through service manuals, reference book, field visit and preparation of notes.
- 9.8 Make students able to do the maintenance and repairs of various types of brakes through workshop practice.

## **Learning Activities**

### **9.1 NECESSITY OF BRAKE SYSTEM & ITS REQUIRED QUALITIES**

#### **ACTIVITY**

1. Discussion
2. Survey

Improved Road conditions, availability of new generation cars etc. has increased the driving speed of automobiles. So as to ensure safety, all vehicles must possess efficient Braking Mechanism.

#### **DISCUSSION POINTS**

1. Factors affecting braking distance
2. Qualities required in Brake System.

### **9.2 CLASSIFICATION OF BRAKES**

#### **ACTIVITY**

1. Service Manuals
2. Survey
3. Reference book

Different types of Brake systems are incorporated in vehicles. Students must know about latest technologies adopted in Braking system and be able to classify the braking systems of various vehicles.

### **9.3 ARRANGEMENT AND FUNCTIONING OF COMPONENTS IN MECHANICAL BRAKE SYSTEM**

#### **ACTIVITY**

1. Demonstration
2. Reference book
3. Assignment

Mechanical braking is relevant in automobiles generally in parking Brakes. Its mechanism must be familiarised.

#### **ASSIGNMENT**

Individual assignment to prepare notes and diagrams explaining the mechanical brake system.

### **9.4 ARRANGEMENT OF COMPONENTS IN DIFFERENT TYPES OF HYDROULIC BRAKE SYSTEM AND ITS FUNCTIONING**

#### **ACTIVITY**

1. Demonstration
2. Workshop practical
3. Reference book
4. Seminar

Almost all medium segment vehicles and passenger cars employ power Assisted Hydraulic Braking System. Thorough knowledge on the functioning of the every component must be developed in Technicians.

#### **SEMINAR**

Components and their arrangement in Hydraulic & Servo Brake Systems (including Disc Brakes) with the help of illustrations and actual components.

### **9.5 ARRANGEMENT OF COMPONENTS IN DIFFERENT TYPES OF AIR BRAKE SYSTEM.**

#### **ACTIVITY**

1. Field visit
2. Assignment

A detailed study of Air Brake System is more feasible by a field visit.

#### **ASSIGNMENT**

Data collected through field visit must be consolidated in class room discussion and students must be individually assigned to prepare a paper explaining the topic.

### **9.6 COMPARISON OF BRAKE SYSTEM**

#### **ACTIVITY**

1. Group discussion
2. Objective of discussion

To make student to able to assess and compare different braking mechanisms. After the discussion, they must consolidate appropriate ideas in to a note.

### **9.7 ADVANCEMENT IN TECHNOLOGIES OF BRAKE SYSTEM**

#### **ACTIVITY**

1. Service manuals
2. Reference books
3. Field visit

Even though school workshop may not possess advanced braking mechanism, students must be able to acquire latest techniques on them. It is easier to depend on outside sources. Students must be motivated to maintain knowledge on further developments.

### **9.8 PREVENTIVE MAINTENANCE AND REPAIR OF BRAKING SYSTEM**

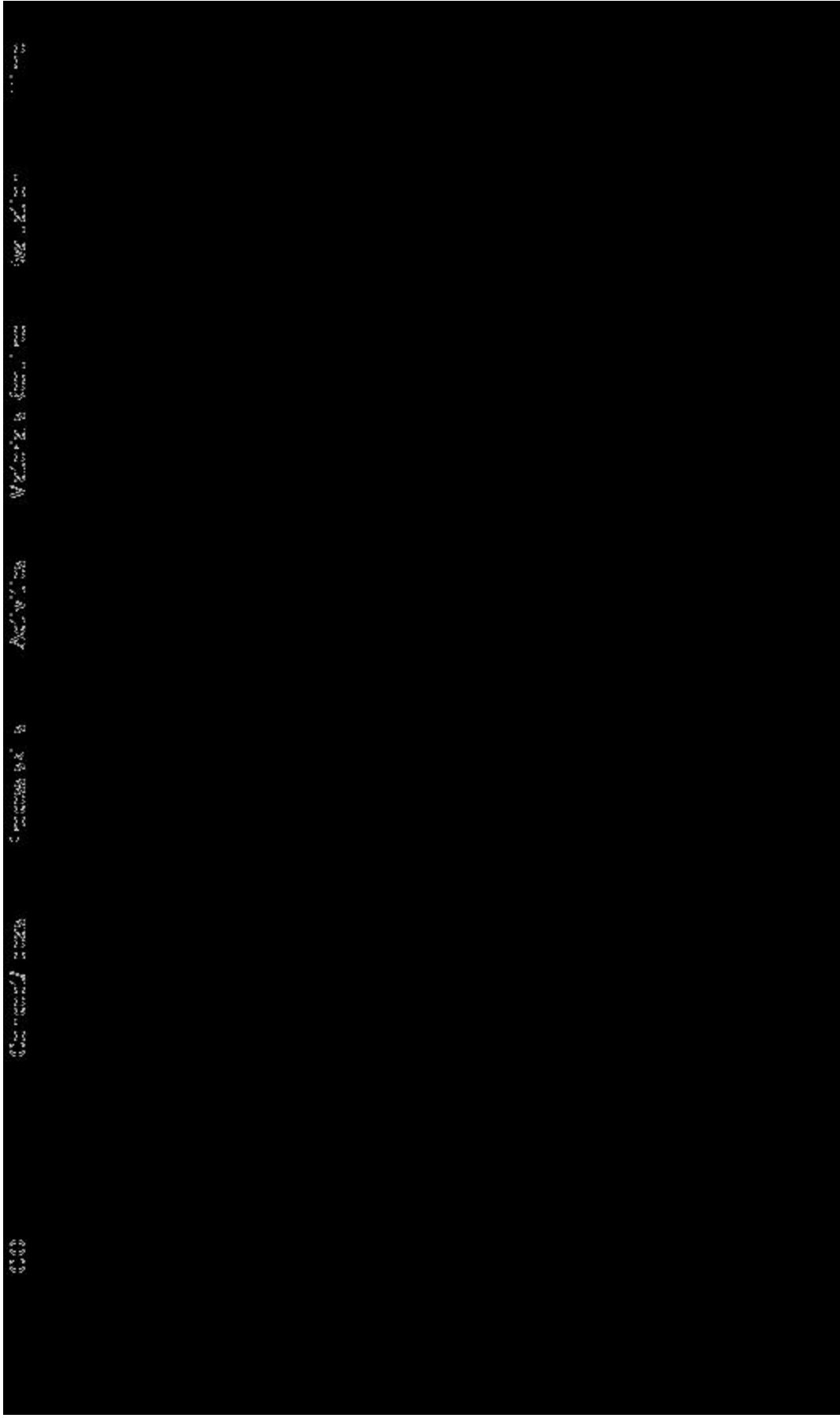
#### **ACTIVITY**

1. Workshop practicals
2. Field visit

It is necessary for an automobile mechanic to develop ability to perform preventive maintenance of braking system. Also trouble shooting and repairing of the same is a Major activity in automobile workshops.

**BRAKE SYSTEM**

**UNIT ANALYSIS 9**





**PART III**

# Practicals

## LIST OF PRACTICAL ACTIVITIES

### UNIT 1

- Disassembling and assembling of
  1. 2 stroke engine
  2. 4 stroke petrol engine
  3. 4 stroke diesel engine
- Ovality and taperness measurement of cylinder
- Valve clearance adjustment
- Valve lapping
- Spark plug cleaning and gap adjustment
- Engine overhauling
- Firing order setting

### UNIT 2

- Demonstration and study of transmission system
- The drive chain adjustment of a 2 wheeler

### UNIT 3

Dismantling and refitting of clutch system  
Disassembling and assembling of various clutches with repair

### UNIT 4

- Dismantled study of various types of gearboxes
- Gear oil changing
- Disassembling and assembling of various gearboxes with repair

### UNIT 5

- Disassembling and Assembling
- Dismantling of universal joint and slip joint
- Dismantling of rear axle and differential housing
- Removal of differential and final drive
- Study of final drive and differential mechanism.
- Disassembling and assembling of final drive and differential and repair.
- Differential oil changing.

**UNIT 6**

- Removal and refitting of steering system
- Disassembling and assembling of different types of steering gears and repair
- Free play adjustment
- Wheel alignment adjustments

**UNIT 7**

- Repair and maintenance of different types of suspension systems and its components

**UNIT 8**

- Wheel removal and refitting
- Inflation checking and repair of tyre and tubes

**UNIT 9**

- External brake adjustments
- Internal brake adjustments
- Study of hydraulic brake system
- Brake bleeding

# SAMPLE QUESTIONS

## UNIT I

1. Give some suggestions to increase the mileage of your petrol vehicle?
2. When your vehicle lacks power, what should you do?
3. Assess the different exhaust smokes and its reasons?
4. Write down the different steps of engine tuning?
5. An engine shows more oil consumption through every day oil level checking. What are the possible reasons?

## UNIT II

1. Electric vehicles are more suitable in factory campuses than conventional vehicles. Why?
2. In which type of Automobile, you find a 'Transaxle'?

## UNIT III

1. New generation car have their \_\_\_\_\_ and \_\_\_\_\_ gears as over drive.
2. No separate clutch pedal is employed on vehicles using a fluid clutch. Why?

## UNIT V

1. Minimum two universal joints are required to transmit power through inclined shafts. Is it true? Why?
2. Give the name of a drive system which having no propeller shaft?
3. Some noises are arising from a differential. How can you differentiate these noises? Give the remedies.
4. Is it possible to work a differential without oil? Write your clarification?

## UNIT VI

1. Choose the write answer.  
When you turn the steering wheel the left and right wheels make
  - i. equal angular turn
  - ii. unequal angular turnJustify your answer in not more than three sentences.
2. A power steering system without control on its power assistance is dangerous. Why?

**UNIT VII**

1. Defect of which component in a suspension system will you attribute to, if you observe a vehicle bouncing up and down.
2. Why are helper springs called so?

**UNIT VIII**

1. Why different sizes of wheels are using in different vehicles?
2. Writes notes on
  - i. Wheel tramp
  - ii. Wheel carcass
  - iii. Tyre inflation
3. Write the different steps of tyre changing?
4. Write a brief note on tyre rotation?

**UNIT IX**

1. What are the required qualities of brake system?
2. Different types of vehicles are used in Automobile vehicles? Classify.
3. Vehicles with Hydraulic braking system are not recommended to each run with its engine on off condition. Why?

## LIST OF ACTIVITIES

### UNIT 1

- Workshop practicals
- Collection
- Seminar

### UNIT 2

- Discussion

### UNIT 3

- Preparation of charts
- Workshop practicals
- Seminar

### UNIT 4

- Group discussion
- Class test
- Workshop practical

### UNIT 5

- Seminar
- Assignment
- Workshop practical

### UNIT 6

- Workshop practical
- Class test
- Assignment

### UNIT 7

- Assignment
- Collection of data
- Workshop practicals

### UNIT 8

- Collection of data
- Seminar
- Workshop practicals

### UNIT 9

- Group discussion
- Workshop practicals
- Class test

## **UNIT 1**

### **Engine Overhauling & Emission Control**

- 1.1 To develop expertise in student to dismantles & Assemble different types of I.C engines through workshop practical.
- 1.2 To familiar's student with all aspect of engine overhauling through demonstration, workshop practical & field study.
- 1.3 To make student able to identify & rectify common troubles associated with engines through Reference Books, Observation, Field visit, Project.
- 1.4 To make student understand the structure and arrangement of exhaust system through observation & collection of data.
- 1.5 To generate awareness' in student about the importance of environmental protection by reducing harmful Automobile remittent gases – Methods of Emission Controlling through discussion, reference books, data collection and seminar.

## **UNIT 2**

### **TRANMISSION SYSTEMS**

- 2.1 To make students understand the necessity of transmission system in an automobile and the qualities required in transmission system through classroom discussion and observation.
- 2.2 To create awareness in students about the various methods adopted and arrangements of various components in different methods of torque transmission with the help of reference books, field visit and preparation of drawings.
- 2.3 To familiarize students the various types employed in mechanical trans mission system through visual media, demonstration, services manuals and an assignment.

## **UNIT 3**

### **CLUTCH SYSTEM**

- 3.1 To make students able to identify requirements of a good clutch and to make them able to identify clutches through classroom discussion, demonstration preparation of charts etc.
- 3.2 To make students under stand the construction and working of cone, disc and diaphragm clutches, centrifugal clutches through workshop practicals, reference books, field visit etc.

- 3.3 To make students recognize relative merits and demerits of various clutches classroom discussion, seminar, preparation of drawings are to be employed.
- 3.4 To develop expertise in students on maintenance and repair activities of various clutches through workshop practicals, service manuals and field visit.

#### UNIT 4

##### TRANSMISSION

- 4.1 To develop students awareness about the need and functions of gear box in Automobile through demonstration and discussions.
- 4.2 To make students able to differentiate progressive and selective gear boxes to make hem understand the working and construction of various types of selective gear boxes, transfer case, gear selector mechanism, gear ratio and over define through workshop practicals, reference books, group discussion, preparation of drawings and notes.
- 4.3 To develop awareness of students on automatic transmission and the various component (torque convertor, fluid flywheel, planetary gear box) in I through classroom discussion, reference books, preparation of drawings and notes.
- 4.4 To develop expertise in students in maintaining gear boxes, to identify and rectify defects on gear boxes through classroom discussion, workshop practicals, service manuals and field visit.

#### UNIT 5

##### PROPELLER SHAFT AND DIFFERENTIAL UNIT

- 5.1 To make students understand the constructional details and working of drive shaft through demonstration, classroom discussion, preparation of drawings and notes.
- 5.2 To make students understand the construction and functions of universal joints and slip joint through through demonstration ,classroom discussion, reference books, service manuals and preparation of drawings and notes.
- 5.3 To generate awareness in students about Hotchkiss and torque tube dine through illustrations and preparation of notes on it.
- 5.4 To make students understand the concepts of final drive, its different arrangements and their advantages through illustrations and reference books.
- 5.5 To make students understand the construction and functioning of different types of differential gears through demonstration, reference books, workshop practicals etc.

- 5.6 To make students to understand construction and functioning of differential housings, front and rear axles, transaxle & wheel mounting arrangements through demonstration, field visit and an assignment.
- 5.7 To develop student's knowledge on maintained of drive shaft and its components and to develop expertise on trouble shooting and repairing the same through brain storming and workshop practicals.

#### UNIT 6

- 6.1 To make students realize the necessity of steering system and required qualities in steering system. Make them aware of steering sensibility by brain storming to be adopted
- 6.2 To familiarize students with Ackerman and fifth wheel steering arrangements through reference books, demonstration and generation of drawings.
- 6.3 To make understand various components and their functions in an aware about tee and their arrangements .To make them aware about changes in IFS and RFS systems through demonstrations, service manual workshop practicals, visual media and reference books.
- 6.4 To make students understand the construction and working of different types of steering gear boxes. To make them aware about steering gear ratio through reference books, demonstrations, workshop practicals and generation of drawings.
- 6.5 To make students realize various factors effecting steering stability and life of tyre. Make them familiarize with wheel alignment and maintenance activities ,wheel balancing ,steering recovery and steering geometry, steering wheel free play through demonstration ,reference books ,field study and a seminar.
- 6.6 Make students aware about advance steering system ,advanced technologies in steering linkages and power steering through discussion, reference books, workshop manuals preparation of notes, etc.
- 6.7 To make students familiarize with troubles, remedies and repair techniques of steering system through field visit, workshop practical, service manuals and assignments.

#### CHAPTER-VII

#### SUSPENSION SYSTEM

- 7.1 To develop students understanding the necessity of suspension system ,sprung & unsprung weight .To make them aware with the factors that affect vehicle stability and riding comfort through brain storming ,observations, reference books and assignments.
- 7.2 To familiarize students with various components and construction of suspension system through demonstration, class discussion, reference books and assignments.
- 7.3 To make understand about the arrangements in rigid suspension system through field study, service manual and collection of data.
- 7.4 To make understand about the arrangements in independent suspension system including McPherson, Wishbone and torsion bar through field study, demonstrations, service manual and collection of data.
- 7.5 Make students aware of concepts, construction and functioning of air suspension through field study, multimedia and, reference books.
- 7.6 To make students familiarize with the maintenance and rectification of suspension system through workshop practical service manual and collection of data.

## UNIT 8

### WHEELS

- 8.1 To create awareness about the functions and constructions of pneumatic wheels through demonstrations, brochures, preparation of notes and diagrams.
- 8.2 Familiarize the students with the function, classification and constructional details of different types of tires of tube through demonstration, collection of data and seminar.
- 8.3 To make students experienced in maintenance and repair of tyre and tube and tyre rotation through workshop practical and field visit.

## UNIT 9

### BRAKE SYSTEM

- 9.1 To make students to realize the necessity of brake system, its required qualities, factors affecting braking distance through discussion and survey.
- 9.2 To make student aware about the classification of brakes through service manuals, surveys and reference book.
- 9.3 To make students understand about arrangement of various components in a mechanical brake system and their function through demonstration, reference book and preparation of notes and diagrams.

- 9.4 To make students understand about arrangement of various components in different types of hydraulic brake system through demonstration, reference book workshop practicals and seminars.
- 9.5 To make students understand about the arrangements of various components in different types of air brake system through field visit, preparation of notes and diagrams.
- 9.6 Make student to compare the different types of brakes through group discussion and preparation of notes.
- 9.7 Develop awareness about the advanced technologies adopted in automobile brake through service manuals, reference book, field visit and preparation of notes.
- 9.8 Make students able to do the maintenance and repairs of various types of brakes through workshop practice.

### ENGINE OVERHAULING AND EMISSION CONTROL

CO's	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Enable students to dismantle and assemble different types of IC engines	Different engine have different methods of dismantling assembling.	<ul style="list-style-type: none"> <li>• Understanding</li> </ul>	<ul style="list-style-type: none"> <li>• Workshop practicals</li> <li>• Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>• Engines</li> <li>• Workshop tools</li> <li>• Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Participation</li> <li>• Work skill</li> </ul>	
2. Understanding all aspects of engine overhauling.	Removing, disassembling, Inspection, service & Assembly and refitting of engine.	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Detecting</li> </ul>	<ul style="list-style-type: none"> <li>• Workshop practicals</li> <li>• Demonstration</li> <li>• Field study</li> </ul>	<ul style="list-style-type: none"> <li>• Engines</li> <li>• Workshop tools</li> <li>• Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Participation</li> <li>• Work skill</li> </ul>	
3. Make students able to identify and rectify common troubles associated with engine.	Various troubles arises in Automobile engines.	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Detecting</li> <li>• Technical ability</li> </ul>	<ul style="list-style-type: none"> <li>• Referring books</li> <li>• Observation</li> <li>• Field visit</li> </ul>	<ul style="list-style-type: none"> <li>• Engines</li> <li>• Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Participation</li> </ul>	
4. .Make students understand the structure and arrangement of exhaust system.	Exhaust system contains different arrangements.	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Observation</li> <li>• Communication</li> </ul>	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Collection of data</li> </ul>	<ul style="list-style-type: none"> <li>• Chart</li> <li>• Text book</li> <li>• Drawings</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Collection</li> </ul>	
5. Enable students to protect environment by reducing harmful automobile emission gases.	Gases emitted from automobiles contain toxic ingredients. Which are harmful to health and surroundings.	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Communication</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion</li> <li>• Reference book</li> <li>• Data collection</li> <li>• Seminars</li> </ul>	<ul style="list-style-type: none"> <li>• Text book</li> <li>• Manuals</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Analysis</li> <li>• Presentation</li> </ul>	
6. Understanding students the different methods of controlling emission	Different methods are adopting to attain different norms for pollution control.	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Communication</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion</li> <li>• Chart preparation</li> </ul>	<ul style="list-style-type: none"> <li>• Chart</li> <li>• Text book</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> </ul>	

II

CO's	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
Understand the necessity of transmission system and its qualities	How the torque is transmitted from engine to the wheels with minimum power loss	<ul style="list-style-type: none"> <li>• Communication</li> <li>• Observation</li> </ul>	<ul style="list-style-type: none"> <li>• Workshop practicals</li> <li>• Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>• Engines</li> <li>• Workshop tools</li> <li>• Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Participation</li> <li>• Work skill</li> </ul>	
Enable students to know about different components in torque transmission,	Various components are required to transmit torque from engine to wheels.	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Defecting</li> </ul>	<ul style="list-style-type: none"> <li>• Workshop practicals</li> <li>• Demonstration</li> <li>• Field study</li> </ul>	<ul style="list-style-type: none"> <li>• Engines</li> <li>• Workshop tools</li> <li>• Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Participation</li> <li>• Work skill</li> </ul>	
Understanding students about mechanical transmission system.	Mechanical transmission system is commonly used in Automobiles.	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Defecting</li> <li>• Technical ability</li> </ul>	<ul style="list-style-type: none"> <li>• Reference books</li> <li>• Observation</li> <li>• Field visit</li> </ul>	<ul style="list-style-type: none"> <li>• Engines</li> <li>• Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> <li>• Participation</li> </ul>	

UNIT-II

CO	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Understand the necessity of transmission system and its qualities	How the torque is transmitted from engine to the wheels with minimum power loss	*Communication *Observation	*Discussion *Observation *Demonstration	*Text book *Chart paper *Service manuals	*Understanding	
2. Enable students to know different components in torque transmission,	Various components are required to transmit torque from engine to wheels.	*Observation *Understanding	*Reference books *Field visit *Preparation of drawings	*Text book *Drawings	*Understanding	
3. Understand mechanical transmission system.	Mechanical transmission system is commonly used in Automobiles.	*Observation *Understanding	*Visual media *Demonstration *Service manuals	*CD/DVD *Text book	*Understanding	

UNIT-III

CO	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Understanding classification and requirements of a good clutch	According to type and purpose, different types of clutches are employed	*Communication *Observation	*Discussion *Demonstration *Preparation of charts	*Text book *Brochures *Charts	*Acquired knowledge	
2. Understanding the construction and working of different clutches.	Construction is different for different clutches	*Communication *Observation	*Workshop practicals *Field visit *Reference books	*Clutches *Text books	*Participation *Understanding	
3. Merits and demerits of various clutches.	Most advantages clutch must be used for torque transmission.	*Communication	*Discussion *Seminars	*Brochures *Charts	*Presentation *Understanding	
4. Maintenance & Repair activities of various clutches.	Continuous working of clutch arises various troubles.	*Observation *Analysis *Work skill	*Workshop practicals *Field visit *Service manuals	*Manuals *Clutches	*Knowledge *Participation *Work skill	

UNIT-IV

<b>CO</b>	<b>Concept/Ideas</b>	<b>Process skills</b>	<b>Activities</b>	<b>Materials Required</b>	<b>Evaluation</b>	<b>Time</b>
1. Functions of gear box	Different torque and power is required at different running conditions.	*Communication *Observation	*Demonstration *Discussion	*Gear box	*Acquired knowledge	
2. Classification, construction and working of gear boxes	Different arrangements of gears are employed in different automobile for different purposes.	*Working skill *Observation	*Workshop practical *Reference books *Group discussion *Preparation of drawings and notes	*Actual components *Books	*Skill *Notes and drawings *G.D	
3. Make awareness about components of automatic transmission	Skillful arrangements of mechanisms and gears to relieve the	*Communication	*Reference books *Class room discussion	*Reference books *Illustration	*Participation *Acquired knowledge *Notes	

	driver from major part of work.		*Preparation of drawings and notes			
4. Develop students to maintenance and rectify the defects in gearboxes.	Continuous operation and gear shifting require a periodic maintenance & repair.	*Working skill *Observation	*Workshop practicals *Field visit *Referring Service manuals	*Actual components *Service manuals	*Participation *Acquired knowledge	

#### UNIT – V

##### PROPELLER SHAFT & DIFFERENTIAL UNIT

CO	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Understanding the constructional details and working of drive shaft	*Transfer torque, which changes the angle and length without vibration.	*Communication *Observation	*Demonstration *Discussion *Preparation of notes & drawings	*Notes & drawings	*Acquired knowledge	
2. Construction and function of universal joint & slip joint.	*Which providing angular and lengthwise adjustments.	*Observation	*Demonstration *Discussion *Reference books *Service manuals *Preparation of	*Reference books *Service manuals *Notes & drawings	*Acquired knowledge	

			notes & drawings			
3. Awareness in Hotchkiss drive and torque tube drive.	*Different methods of arrangements gives advantages in propeller shaft construction.	*Communication *Observation	*Illustrates *Demonstration of notes	*Actual materials	*Acquired knowledge	
4. Understanding the concepts of final drive and its different arrangements.	Speed and torque conversion techniques.	*Observation	*Illustration *Reference books *Demonstration (Actual)	*Actual material *Reference books	*Acquired knowledge	
5. Understanding construction and functioning of different types of differential.	Different types of gears are arranged in differential housing to transfer power.	*Communication *Observation	*Demonstration *Reference books *Field study *Seminars	*Reference books *Types of differential	*Seminars *Acquired knowledge	
6. Construction & functioning of differential houses forent and rear axles etc.	Difference in speed between rear wheels while turning a curve.	*Observation	*Demonstration *Field visit *Assignment	*Differential *Reference books	*Assignment *Participation	
7. Understanding maintenance & Repair of drive shaft.	Continuous operate of live shaft arises various troubles.	*Thinking ability *Work skill *Communication	*Brain storming *Workshop practicals	*Service manual *Actual materials	*Participation	

UNIT-8

CO	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Function and construction of pneumatic wheels.	Pneumatic wheels are the most important part for smooth transferring of vehicle.	*Observation	*Demonstration *Preparation of notes & diagrams	*Brochures	*Notes and drawings	
2. Classification & construction of different types of tyres & tubes.	For getting running advantages ,different types of tyres are required.	*Observation *Analysis *Communication	*Demonstration *Collection of data *Seminars	*Data's *Brochure *Reference books	*Presentation	
3. Maintetance & Repairs of tyres and tubes; tyre rotation.	Continuous running and griping with road arises a maximum wear & tear on tyre.	*Work skill	*Work shop practicals *Field visit	*Actual components	*Participation	

UNIT-9

BRAKE SYSTEM

CO	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Necessity & qualities of brake system.	For stopping & controlling the vehicle, a good brake system is important.	*Communication	*Discussion *Survey	*Data's	*Survey report	
2. Awareness about	Different types of	*Communication	*Survey	*Service manuals	*Survey report	

classification of brakes.	brakes are used in vehicles for improving the quality to control the vehicle.		*Reference books	*Reference books		
3. Arrangements & functions of Mechanical brake system.	Conventional Mechanical brake systems are the basics of all other brake system	*Illustration *Communication	*Demonstration *Referring books *Preparation of notes & diagrams	*Reference books *Notes *Diagram	*Notes & diagrams	
4. Arrangements & functions of Hydraulic brake system.	A liquid medium is used to transfer the brakes effort to the wheels.	*Observation	*Field visit *Notes & diagrams preparation	*Notes *Diagram	*Acquiring knowledge *Notes	
5. Arrangement of components in Air brake system	Air can be employed as an excellent medium to transmit braking force if adequate safety measures are undertaken.	Observation Ability to research	Field visit Preparation of notes and diagrams	Reference books Brochures	Notes Diagram Understanding	
6. Comparison between different types of brakes	Compare in application level and install most suitable breaks in the vehicle.	Communication	Group discussion Preparation of notes	Reference book	Participation Group discussion Notes	
7. Making awareness in advanced technologies of automobile brake system.	In safety measures, advanced technologies are installed for increasing the	Observation	Field visit	Service manual Reference books	Participation	

	efficiency of brakes					
8. Maintenance and repairs of various types of brakes.	Continuous operation of brakes arises various problems. Timely correction is very important	Work skill	Workshop practice	Service Manual Different types of brakes	Working ability	

## CHAPTER –6

### STEERING SYSTEM

CO	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Necessity and qualities of steering system.	Movement without directional control is fatal.	Creative thinking	Class room discussion, Brain storming	–	Participation, Understanding	
2. Ackermann and fifth wheel steering system.	Steering can be designed differently according to requirements.	Conceptualization, Drawing skill	Demonstration, Referring books, Generation of drawings.	Books, charts	Drawing, Understanding	
3. Components of steering system and their arrangement.	Similar components can be arranged in different ways to develop the most suitable steering	Observation, Working skill	Demonstration , Referring books, Workshop practicals	Service manuals, visuals ,actual components.	Participation, Understanding, Workshop skill.	

	formation					
4. Steering gear boxes steering gear ratio.	Effort to be applied at steering wheel must be minimal and its result should be accurate.	Observation, Working skill	Demonstration, Referring books, Generation of drawings	Actual components, Reference books	Participation, Understanding, Workshop skill.	
5. Factors affecting steering stability and life of tyre.	Relative position of wheel with automatic frame is not a consistent one and its positioning has a great roll in steering stability and life of tyre & exhaust system.	Creative thinking Observation, Ability to Research.	Demonstration, Referring books, Workshop, Making drawings	Actual components, Reference books	Participation, Understanding, Workshop skill.	
6. Advanced technologies in the field of steering.	Since steering effort is directionally proportional to load and is inversely proportional to speed, a right balance can be achieved through external means only.	Inferring, Creative thinking	Discussion , Referring books, Preparation of notes	Brochures, Service manuals, Reference books.	Prepared notes Understanding	
7. Familiarization of troubles, repair techniques of steering system.	Proper attention is necessary for trouble free operation of steering system	Observation, Ability to collect data	Field visit, Workshop practical Assignment	Service manuals, Reference books, Damaged components	Working skill, Assignment paper Understanding	

CHAPTER-7

SUSPENSION SYSTEM

CO	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Necessity of suspension system, factors affecting vehicle stability and riding comfort.	Suspension system is meant not only for the comfort of passengers and cargo, but also for the satisfactory of automobile as a whole.	Observation, Ability to collect data	Brain storming, Assignment	Reference books	Participation, Assignment paper, Understanding	
2. Components and construction of suspension system.	Springs can be reduce shocks but if its resilience is not controlled it can create more damage.	Observation, Ability to collect data, Communication skill	Demonstration, Discussion, Assignment	Reference books, Suspension system components	Participation, Assignment paper, Understanding	
3. Arrangements of components in rigid suspension system	Suspension arrangement in which road shock on one wheel is transmitted to the other in rigid suspension system.	Observation, Communication skill	Field study, Collection of data	Service manuals, Reference books	Prepared notes, Understanding	
4. Arrangements of components in	Suspension arrangement in	Observation, Communication	Field study, Collection of	Independent suspension	Prepared notes, Understanding	

independent suspension system	which road shock on one wheel is not transmitted to the other in independent suspension system.	skill	data, Demonstration	system components, Service manuals, Charts		
5. Air suspension system	Air is an excellent shock absorber and a cushioning agent	Creative thinking, Ability to collect data	Field study, Referring books, Research	Multimedia Reference books Available components	Prepared notes Understanding	
6. Maintenance & rectification of suspension system	The system that protect an automobile against road shocks needed consistent care & maintenance.	Workshop skill, Ability to diagnosis.	Workshop practical, Collection of data, Survey	Service manuals, Charts, Damaged components	Acquired skills Understanding	

## SYLLABUS

2<sup>nd</sup> Year Theory

### UNIT-1

#### ENGINE OVERHAULING AND EMISSION CONTROL

- Dismantling and assembling of Engines-4 stroke and 2 stroke petrol engine ,4stroke diesel engine.

- Method of testing compression of an engine.
- Inspection of cylinder block &cylinder head.
- Inspection & correction of piston &rings.
- Quality & tapes ness of cylinder –measurements.
- Selection of next size piston.
- Reboring & finishing of cylinder ,setting of piston.
- Renewal of cylinder liners.
- Inspection of valves & valve seat –Methods of reconditioning.
- Methods of setting valve timing .
- Methods of checking crankshaft for concentricity-Reconditioning crank &main journals-selection of appropriate bearings.
- Inspection of connecting rod for bent-Inspection of camshaft for wears - Methods of reconditioning.
- Inspection of spark plugs ,nozzles,filters,fuel injection pump etc -Recommended.
- Repair practices.
- Engine trouble shooting –Common troubles & repair practices.

#### Exhaust System & Emission Control System

-Scavenging-Construction of muffler-Exhaust gases –Pollution control –Catalytic converter-Positive crank case ventilation system- Emission control norms.

### UNIT-2

#### TRANSMISSION SYSTEM

- Necessity of transmission system-Qualities required to transmission system.
- Overview of electric ,hydraulic & mechanical transmission –various methods of torque transfer-Arrangements of components in mechanical transmission.
- Components in mechanical transmission.& their functions.

### UNIT-3

#### CLUTCH SYSTEM

-Classification ,requirements ,construction,& working of various clutches .viz-cone,single plate ,multiplate,diaphragm and centrifugal clutches.

#### UNIT-4

##### TRANSMISSION

-Progressive and selective gear boxes-Floor shift & column shift arrangements.

-Classification ,construction &working of various selective gear boxes-Gear selector mechanism-Gear ratios-Overdrive -Transfer case.

-Automatic transmission system –Construction & working of fluid coupling ,torque converter,planetary,Gear box ,over running clutch –Arrangement of components in Automatic transmission .

-Maintenance of clutches and gear boxes –Grades of lubricating oil-Troubles & repair tactics associated with clutches and gear boxes.

#### UNIT-5

##### PROPELLER SHAFT FINAL DRIVE & DIFFERENTIAL

- Functions,construction & working of drive shaft-Universals joints & slip joint. Open shaft &torque tube drive.

- Functions, construction & working of final drive & differential mechanism –their classification – differential housing.

- Front &rear axles –Wheel mounting arrangements –Transaxles.

- Maintenance of drive shaft, final drive& differential - Differential oil.

- Troubles & repair of the above components.

#### UNIT –6

##### STEERING SYSTEM

- Necessity of steering system-Requires qualities ,Reversibility off steering.

- Ackerman & Davis ,fifth wheel steering system.

- Steering system components –Steering wheel ,steering column ,steering gear box ,tie rod ,tie rod end ,pitman arm ,steering knuckle,drag link.

- Arrangements of steering system components in independent and rigid suspension.

- Steering gear boxes-Rack and pinion ,worm &wheel, worm & roller, worm &nut,Recirculating ball etc.

- Their construction & working ,steering gear ratio, free play.

- Factors of steering stability & tyre wear-Wheel alignment –Caster ,camber toe in ,toe out ,king pin inclination -Wheel balancing –Slip angle –Cornering force –Under steer &oversteer-Steering recovery –Turning radius.
- Power steering –Advanced technologies in steering linkages.
- Maintenance & Repairs of steering system –Methods of adjusting wheel alignment.

#### UNIT-7

##### SUSPENSION SYSTEM

- Necessity of suspension system –Sprung & unsprung weight –Factors affecting vehicle stability & riding comfort .
- Rigid & independent suspension system.
- Components of suspension system –springs.
- Helper springs-Spring shackles-Shock absorbers-Stabilizers etc- their construction and working.
- McPherson strut & Wishbone mechanism.
- Arrangements of rigid & independent suspension system using leaf spring, coil spring &torsion bar.
- Air suspension system.
- Maintenance & Repairs of suspension system.
- Measuring of spring camber & recambering ,Procedure of checking the shock absorber & replacing the same.

#### UNIT-8

##### WHEELS

- Function & construction of wheel.
- Function ,classification & construction of different types of tyres &tubes.
- Maintenance & Repairs of replacement of tyre &tube.

#### UNIT-9

##### BRAKE SYSTEM

- Necessity of brake system & the required qualities-Factors affecting braking distance, Classification of brakes.
- Various components in Mechanical brake system-their arrangement & functioning.
- Various components in different types of hydraulic brakes & serve brakes- their arrangement & functioning.
- Arrangement of various components in Air brake system.

- Comparison of different types of brake systems.
- Advanced technologies in Automobile braking ,Abs etc.
- Maintenance & Repairs of various brakes

## ACTIVITIES

### CHAPTER-1

#### 1.1 Dismantling & Assembling of Engines

Activity- (1) Workshop practicals.

In actual workshop the mechanic will be required to dismantle and assemble various types of engines through school workshop practice, the student must be made competent to do the work in a systematic manner.

#### 1.2 Engine Overhaul

Activity-(1) Demonstration

(2) Workshop practicals

(3) Field study

The Automobile mechanic must be well versed in Identifying & Rectifying defects on engine components. Through Inspection of dismantled engine components can help him to develop Traits favoring the same.

#### 1.3 Identification & Rectification of troubles associated with engine .

Activity-(1) Reference Book

(2) Observation

(3) Field Visit

There can be numerous reasons for an engine to be defective. These mechanic must be competent enough to diagnose the exact cause from the symptoms. The field visit should complement to broaden his perspective in this .

#### 1.4 Exhaust

Activity- (1) Observation

(2) Collection of data

An inefficient exhaust system can cause considerable reduction in fuel economy .More over engine noise is controlled by the exhaust system. Brochures & field survey.

#### 1.5 Emission Control

Activity-(1) Discussion

(2) Reference Book

(3)Data Collection

(4)Seminar

An automobile mechanic should have the clear sense of protecting environment through various emission control systems. Growing population of vehicles has made norms on this regard very stringent.

Discussions Points: -Role of Automobile in air pollution, Reasons for increase in quantity, Norms & methods of maintain pollution at a controlled level.

## UNIT-II

### 2.1Necessity of Transmission System

Activity- (1) Observation

(2) Class room discussion based on observation

By observing various vehicles in motion in different situations,students are made to realize the necessity of transmission system. Their observations are consolidated in class room discussion.

Discussions Points:-1.Situations which necessitates gear shifting

2.How wheels are made to rotate by engine.

2.2Arrangements of components in different types transmissions systems.

Activity-(1)Referring various books

(2)Field visit

(3)Preparation of charts/drawings

Various vehicles employ different methods as well as different components to transfer engine torque to road wheels.

Collection: -Arrangements of exhaust system of various vehicles. Brouchers &field survey.

### 2.3Emission Control

Activity-(1)Discussion

(2)Demonstration

(3)Assignments on list of components &their functions.

A general discussion can be conducted .Demonstration of various components also conducted so that students get a clear understanding of various components and their functioning in transmission system.

Discussion Points:-

Functions of (1)Clutch

(2)Gear box

(3)Universal joint

(4) Propeller shaft

(5) Final drive

(6) Differential

(7) Rear axles

2.4 Various types of mechanical transmission system

Activity-(1) Visual media

(2) Demonstration

(3) Service manual

(4) Assignment:- (a) Comparison

(b) List out vehicles using various mechanical transmission systems.

Different vehicles employ different methods like (1) Front drive

(2) Rear drive

(3) Four wheel drive

(4) Chain drive etc.

### UNIT-III

3.1 Principle Requirements, Qualities and Classification of clutches

Activity-(1) Discussion

(2) Demonstration of components and illustration.

(3) Preparation of charts

(4) Collection

Automobiles employ different clutches in accordance with their type and purpose.

Discussions Points :- (1) Friction

(2) Area of contact

(3) Heat desire

(4) Selection of clutches

3.2 Construction & working of different friction clutches

Activities:- (1) Workshop practicals

(2) Field visit

(3) Referring various books

(4) Project

Mechanism used to engage and disengage friction element with the driver element decides the type of clutch.

Project:- Collection of different types of clutch units and write down the reason for such clutches used in those vehicles.

Collection :- Arrangements of exhaust system of various

### 3.3 Comparison of various clutches

Activities:- (1) Discussion

(2) Preparation of drawings & notes

(3) Seminar

Clutches are chosen for different vehicles as per the type & purpose of vehicles.

Discussion Point:- Merits & demerits of various clutches.

### 3.4 Maintenance & Repair of clutches

Activities:- (1) Workshop practicals

(2) Service manuals

(3) Field visit

By observations, students are made to recognize the reasons which make a clutch defecture & they are trained in workshop to rectify defecture clutches.

CO's	Concept/Ideas	Process skills	Activities	Materials Required	Evaluation	Time
1. Enable students to dismantle and assemble different types of IC engines	Different engine have different methods of dismantling assembling.	<ul style="list-style-type: none"> <li>Understanding</li> </ul>	<ul style="list-style-type: none"> <li>Workshop practicals</li> <li>Demonstration</li> </ul>	<ul style="list-style-type: none"> <li>Engines</li> <li>Workshop tools</li> <li>Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>Understanding</li> <li>Participation</li> <li>Work skill</li> </ul>	
2. Understanding all aspects of engine overhauling.	Removing, disassembling, Inspection, service & Assembly and refitting of engine.	<ul style="list-style-type: none"> <li>Understanding</li> <li>Detecting</li> </ul>	<ul style="list-style-type: none"> <li>Workshop practicals</li> <li>Demonstration</li> <li>Field study</li> </ul>	<ul style="list-style-type: none"> <li>Engines</li> <li>Workshop tools</li> <li>Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>Understanding</li> <li>Participation</li> <li>Work skill</li> </ul>	
3. Make students able to identify and rectify common troubles associated with engine.	Various troubles arises in Automobile engines.	<ul style="list-style-type: none"> <li>Understanding</li> <li>Detecting</li> <li>Technical ability</li> </ul>	<ul style="list-style-type: none"> <li>Referring books</li> <li>Observation</li> <li>Field visit</li> </ul>	<ul style="list-style-type: none"> <li>Engines</li> <li>Service manuals</li> </ul>	<ul style="list-style-type: none"> <li>Understanding</li> <li>Participation</li> </ul>	
4. Make students understand the structure and arrangement of exhaust system.	Exhaust system contains different arrangements.	<ul style="list-style-type: none"> <li>Understanding</li> <li>Observation</li> <li>Communication</li> </ul>	<ul style="list-style-type: none"> <li>Observation</li> <li>Collection of data</li> </ul>	<ul style="list-style-type: none"> <li>Chart</li> <li>Text book</li> <li>Drawings</li> </ul>	<ul style="list-style-type: none"> <li>Understanding</li> <li>Collection</li> </ul>	
5. Enable students to	Gases emitted from	<ul style="list-style-type: none"> <li>Observation</li> <li>Communication</li> </ul>	<ul style="list-style-type: none"> <li>Discussion</li> <li>Reference</li> </ul>	<ul style="list-style-type: none"> <li>Text book</li> <li>Manuals</li> </ul>	<ul style="list-style-type: none"> <li>Understanding</li> <li>Analysis</li> </ul>	

protect environment by reducing harmful automobile emission gases.	automobiles contain toxic ingredients. Which are harmful to health and surroundings.		<ul style="list-style-type: none"> <li>• book</li> <li>• Data collection</li> <li>• Seminars</li> </ul>		<ul style="list-style-type: none"> <li>• Presentation</li> </ul>	
6. Understanding students the different methods of controlling emission	Different methods are adopting to attain different norms for pollution control.	<ul style="list-style-type: none"> <li>• Observation</li> <li>• Communication</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion</li> <li>• Chart preparation</li> </ul>	<ul style="list-style-type: none"> <li>• Chart</li> <li>• Text book</li> </ul>	<ul style="list-style-type: none"> <li>• Understanding</li> </ul>	