

**VOCATIONAL HIGHER SECONDARY  
FIRST YEAR**

**MAINTENANCE AND OPERATION OF  
MARINE ENGINES**

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**Teachers' Sourcebook**



**Government of Kerala  
Department of Education**

**2005**

**State Council of Educational Research & Training (SCERT)**

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## Preface

*Dear Teachers,*

*In the context of the changing scenario in the field of education, the role of the teacher is not simply to teach the syllabi. The emerging needs of education calls for a facilitator's role from teachers. The learning process has been student centered and activity oriented. Learning activities must enable the student to develop process domain and multiple intelligence skills to their maximum extent.*

*This sourcebook has been written primarily for the benefit of teachers to teach maintenance and operation of marine engines at Vocational Higher Secondary Level. The subject matter has been designed in such a way to help the teacher to provide suitable learning activities for effective learning. The success of the approach depends upon the vision and commitment of teacher. It is also expected that teacher has to seek help from other sources like reference books available in libraries, websites etc.*

*Hope that this sourcebook will help to develop the skill and experience of students resulting in generating of a lot of self employments in the field of maintenance and operation of marine engines.*

*With regards,*

Thiruvananthapuram,  
25.11.2005

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# **PART I**

# GENERAL APPROACH

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## **Introduction**

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 'to work' has determined the destiny, progress and cultural development of the human race. As we all are aware, the objective of education 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 utilise 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 the sense that the content and methodology of vocational Higher Secondary Education have to be approached.

The Vocational Higher Secondary course was 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.

A learning environment which ensures vocational aptitude, vocational training, basic life skills, competencies related to different subjects, appropriate values and attitudes and existential readiness has to be provided here.

The curriculum should be one which recognises the specific personality of the learner and should develop it in a desirable way. It should provide opportunity to imbibe novel ideas to follow a critical approach and for learning through experiences.

The competency to transform ones own resources for the betterment of the society and the individual is to be ensured in each individual. Training in the sense of equality, democratic sense, environmental consciousness and devotion to the constitution is an inseparable factor of the curriculum.

The need of a systematic curriculum is prevailing in vocational subjects. A scientifically structured curriculum incorporating the unique features peculiarity of Kerala ensuring the possibility of higher education and utilising the national and international possibilities of employment is required.

The new curriculum should be capable of assimilating the life skills, scientific temper, attitude of co-existence, leadership qualities and mental health to face the challenges of life. It should be capable of strengthening the competencies imbibed by the learners up to the tenth class.

A curriculum for selecting vocational areas according to the aptitude of the students, learning it in depth, acquire general awareness in the basic areas and to secure jobs has become the social need of the day. A learner centred, process oriented, need based vocational curriculum is envisaged.

### **What is learning?**

- Learning is construction of knowledge and so it is a live and continuous mental process.
- Learning is a process of advancement through adding and correcting in the light of comparing the new issue with the previously learned concepts.
- Learning takes place as a part of the effort to solve problems.
- Learning takes place by assimilating bits of knowledge into ones own cognitive structure.
- Learning is not a linear process. It is a spiral process growing deeper and wider.
- Learning is an intellectual process rather than the mere memorisation of facts. Learning is a conglomeration of a variety activities like problem analysis, elucidation, critical thinking, rational thinking, finding out co-relations, prediction, arriving at conclusions, 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 and against the encroachment of the sectarianism of caste and religion.

The learner should be able to take firm steps and deferred against the social crisis like privatisation, liberalisation, globalisation etc. and against all kinds of dominations.

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 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 recognised 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 existentialist intelligence intrapersonal and interpersonal intelligence.

The basis of new approaches on curriculum, teaching- learning process are derived from the developments place 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 learner, they have;

- Great curiosity
- Good imagination
- Numerous other qualities and interests
- Independent individuality
- Interest in free thinking and working in a fearless atmosphere.
- Have 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.

The 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 analyse the collected ideas and proofs and come to a conclusion is called *process skills*. Some important *process skills* are,

**the skills;**

- To observe
- To collect data and record
- To classify
- To measure and prepare charts
- To experiment
- To predict
- To recognise and control the variables
- To raise questions
- To generalise
- To form a hypothesis and check.
- To conclude
- To communicate
- To predict and infer
- To use tools.
- 

**Observation** is the process of acquiring knowledge through the senses. It is purely objective oriented. Learning experiences which provide the opportunity to use all the senses may be used.

The process of grouping is known as **classifying**. Starting from simple groupings of data, it can extend to the level of classification into minute sub-groups.

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
- 

**Creativity** is an essential component of process and activities. The element of creativity is involved in finding out problems, formation of hypothesis, finding 'solutions' to problems etc. Through activity oriented learning experiences, opportunities to express creativity can be created.

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

**'Hypothesis'** is a temporary conclusion drawn using insight. Based on knowledge and experiences relating to the problems the causes and solutions can be guessed.

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.

### **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 sub section 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 that learning 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 conceptions.

Learning is a live mental process. Rather than the ability for memorisation of facts cognitive process has to be given emphasis. The process of problem analysis, elucidation, critical thinking, rational thinking, finding out co-relation, 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 of the learner regarding the learning process.

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

### **Learner - His Nature and Features**

The learners in standard XI has undergone a learner centered and process oriented learning experience up to X standard. 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 foreseeing national and international job opportunities. Some of the peculiarities of the learner at this stage are:

- Physical, intellectual an emotional planes are intensive changes during this 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.
- Longing for social recognition.

### **Needs of the Learner**

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

### **Role of the Learner**

- Active participant in the learning process.
- Acts as a researcher
- Sharer of information
- Sharer of responsibilities
- Collects information
- Takes leadership
- Involves in group work

- Acts as a co- participant
- Observes his environment
- Experiments and realises
- Makes interpretations and draws inferences.
- 

### **Role of the Teacher**

The teacher should;

- consider the ‘Stress and strain’ of the teenagers
- understand the socio- economic and cultural background of the students.
- promote and motivate the students to construct knowledge.
- arrange proper situations to interact in and outside of the classroom.
- guide the students by explanations, demonstrations etc.
- promote opportunity for co-operative learning and collaborative learning.
- facilitate interpersonal and intra-personal interactions.
- act as a democratic leader.
- act as a problem solver
- effectively guide the students for the selection and conduct of various continuous evaluation elements.
- continuously evaluate the progress of the learners.
- gives scaffolding/support wherever necessary.
- motivate for learning
- promote divergent thinking.
- act as a democratic group leader.
- act as a co-learner
- gives variety of learning experiences.
- be a constant student
- facilitate for reference/data collection
- have a clear understanding about the age, needs, peculiarities, abilities, nature, aptitude etc. of the learner.
- have the ability to motivate the learner in order to acquire and enrich their knowledge.
- be a guide to the learner in developing insights and creating responses on current affairs.

- be capable to lead the learner into a variety of learning methods and process based on curriculum objectives.
- be a link between school and community.
- be a good organiser, guide, friend, philosopher and co-learner.
- have an inter disciplinary approach in learning activities.
- be able to guide the learner in his/her career prospects based on his interest aptitude and ability.
- be impartial and democratic.
- provide ample experiences to attain the basic values and objectives of the curriculum.
- 

## **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 initiate the models, situations are to be created to help the children act models as themselves.

### **2 Learning by discussion**

That 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 cautions 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 these 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 and peers and elders. Even though some can fulfil the learning activity by themselves there is the possibility of a higher excellence. If appropriate help is forth covering 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: a live mental process**

Learning is a cognitive process, only a teacher who has an awareness as to what the cognitive process is alone can arrange learning situations to the learner to involve in it. Learning can be made effectively and intellectual sharpness can be improved by giving opportunity for the cognitive processes like reminding, recognising compromising , co- relating, comparing, guessing, summarising and so on. How is cognitive process considered in language learning? Take guessing and prediction for example.

- Guessing the meaning from the context.
- Guessing the content from the heading.
- Predicting the end of the story.
- Guessing the incident, story from the picture.

- Guessing the facts from indications.
- and other such activities can be given the following activities can be given for the cognitive process of summarisation.
- Preparation of blue print.
- Preparation of list.
- Preparation of flow chart.
- Epitomising in one word.
- Giving titles and so on.
- Symbols, performance of characters indications, lines of a poem, tables, pictures, concepts, actions, body language and such things can be given for interpretation. Process based language given for interpretation. Process based language learning has to give prime importance to the cognitive process.

## **9 Internal motivation**

Internal motivation is given more importance than external motivation. The teacher has to arouse the internal motivation of the learner, A person internally motivated like this alone can immerse in learning and own its responsibility. How motivating is each of the activities is to be assessed.

## **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 document 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 competence effective a 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 and explaining things sequential and arithmetical calculations are capable of developing this area of intelligence.

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

In those who are able to visualise 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 Kinaesthetic 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, initiating 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 Intelligence**

The concept of emotional intelligence put forward by **Daniel Golman** was 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 solutions 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 ten skills required for success in life.

- Self awareness
- Empathy
- Inter personal relations
- Communication

- Critical thinking
- Creative thinking
- Decision making
- Problem solving
- Copying with emotion
- Copying 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.

### **Objectives of the Vocational Higher Secondary Curriculum**

- To facilitate higher education while giving opportunity to enter in the field of employment.
- To develop environmental awareness, sense of national integration, tolerance and human values so as to ensure social and cultural improvement.
- To enable the learner to find on his own employment.
- To inculcate mental courage in the learner to face unfavourable situations.
- To make human resource development possible.
- To enable the learner to understand social problems and to react appropriately.
- To develop the learner to identify and develop his own competencies.
- To develop vocational aptitude, work culture and attitude in the learner so as to provide useful products and services to the society.
- To create an awareness about mental and physical health.
- To acquire awareness about different job areas and to provide backgrounds for acquiring higher level training in subjects of interest.
- To develop possibilities of higher education by creating awareness about common entrance examinations.

- To provide situation for the encouragement of creative thinking and organising training programmes in each area, creative abilities and to develop artistic talents.

### **Nature of Approach**

The learning device is to be organised in the selected vocational subjects in such a way that adequate practical experience should be given, making use of the modern technology. The development in each area on the basis of information technology is to be brought to the learner. The work experience in the respective fields(OJT, Field trip, Production/Service ..... training, Survey, Workshop, Exhibition, Youth festival, Physical fitness etc.) are to be adjusted suitable to the learning and evaluation process. The participation and leadership of the students in planning and execution is to be ensured through this kind of activities. Social service is to be made a part of the course.

### **Approach towards Vocational Higher Secondary Education**

The learning methodology has to be organised so as the learning provide adequate practical thinking on the opted vocational subject utilising the new technology. The development of information technology should be made available in each sector. Work experience, OJT, Field trip production, Service cum training centre, Survey, Workshops, Exhibitions, Youth festivals, Physical fitness etc should be systematised well appropriate to learning and evaluation. Learner participation should be ensured in the planning and implementation of these activities. Social service should be a part of the course. If a learner has to change his school, he should be provided an opportunity to continue his studies in the new school. While considering criteria for admission to higher courses, grades of vocational subjects should also be given due weightage. In tune with the changes in the Vocational Higher Secondary Education changes should be ensured in the field of higher education.

The teachers have to take special care in arranging learning activities for the development of all the faculties of intelligence.

### **Learning activities and learning atmosphere**

A proper learning atmosphere is essential for the betterment of learning activities.

They are:

- Proper physical environment
- Healthy mental atmosphere

- Suitable social atmosphere
- Active participation of PTA, Local bodies and SRG
- Reference materials and visual media equipments.
- Academic monitoring
- School Resource Group (SRG)

# **APPROACH TO MAINTENANCE AND OPERATIONS OF MARINE ENGINES**

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## **Introduction**

Vocational education, a dream of Mahatma Gandhi, was realized by the central government to address the problem of massive unemployment among the youth in our country. Among the different vocational courses introduced fisheries courses has great relevance. Being a country with a vast coastline of about 8000 Km fishing and allied industries play an important role, in providing employment to a vast majority of the population as well as sustaining the economy with the foreign exchange earned from the export of various fisheries products. Among the maritime status of India, Kerala holds a remarkable position in fisheries sector. Moreover the importance of fisheries in Kerala's economic developments was emphasised by our President Dr.A.P.J.AbdulKalam.

In our modern life mechanisation gives us a better way to cope with different situations. So in the fishing industry also traditional crafts are changed to mechanized crafts. That means we are using marine engines in our vessels. Thus we are able to do fishing efficiently and with less effort. But for the proper operation of marine engines one must know it and do its maintenance properly. This course proposes to make the students understand the operation of marine engines and, after the completion of this course, they will be able to do the maintenance.

## **Aims**

- To create general awareness about the maintenance and operations of marine engines and their significance
- To impart knowledge and training on various marine engines and maintenance techniques
- To create and develop confidence and skills for initiatives in self employment in fisheries sector.

## **Educational Approach**

The studies conducted by UNESCO, SCERT on the various defects of teacher centred education has evolved a new idea of student centred educational approach. According to this approach the learning activities should pave way for the construction of knowledge. While

selecting the learning activities one should take into account the nature, mental ability and skills of students. This approach should explore in activities which are methods like problem solving and self studying. It is important that the new educational approach should create opportunities for individual learning, co-learning and group learning.

For this we can adopt different strategies and techniques.

### **1 Discovery learning**

The teacher has to create an atmosphere that encourages the learner to discover ideas and facts of his own. For example the teacher can assign the students to identify and classify different marine engine parts. This gives an opportunity for the learner to observe the different marine engine parts.

### **2 Co-operative learning**

In this method the learners learn by helping each other. The negotiations among peers take place here.

For example, if we want to take an awareness among the students about different starting methods, the students can be divided into different groups and a group discussion on the topic can be conducted. The ideas evolved from the discussion can be consolidated and presented in the class by one person from each group.

### **3 Collaborative learning**

The two important aspects of this method of learning are sharing of ideas and negotiation among the learners. Suppose we want to deal with different filters used in engine, here also they can be divided into groups and the teacher can ask them to collect different types of filters and their working and uses. Their observation can be consolidated and presented in the class. Their observations can be consolidated and presented.

## **Learning Objectives**

- 1 To create basic knowledge of maintenance and operation of marine engines.
- 2 To familiarise the students with thermodynamics systems.
- 3 To develop an idea about IC engine classifications.
- 4 To familiarise with engine parts and its functions.
- 5 To know about the working cycle of petrol and diesel engine.
- 6 To develop a general idea about the fuel system used in engines.
- 7 To understand the necessity and functions of lubrication system.
- 8 To familiarise the different types of cooling systems.

9 To understand various types of starting systems.

10 To understand various methods of transmission of power in marine engines.

**Scope of Maintenance and Operation of Marine Engines**

1 Proper engine operation

2 Able to do engine maintenance

3 Increase engine life

4 Reduced overall cost

5 Increased job opportunities through self employment

# CURRICULUM OBJECTIVES

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- To develop the idea of thermodynamic system, surroundings and boundary through experiments.
- To refresh the idea about pressure, temperature, volume, specific volume and density through experiments and observations.
- To understand clearly the concepts of heat, power and energy through discussion.
- To understand Zeroth Law, 1<sup>st</sup> Law and 2<sup>nd</sup> Law of thermodynamics through observation.
- To understand heat engines, IHP, BHP and FHP
- To refresh the concepts of a heat engine and to study the classification
- To list out and hence to study the major parts of an IC engine
- To acquire a good knowledge of the working principles of an IC engine
- To study the terminology related to an IC engine like stroke length, dead centres, swept volume, clearance volume and compression ratio
- To understand the working of spark ignition engines.
- To develop the concept of cycle of operation of petrol engine
- To provide an idea about the main parts of two stroke engines
- To give a thorough knowledge of the working of two - stroke SI engines
- To understand the main parts of a four stroke petrol engine and its working
- To introduce the working of Battery coil ignition system and Magnetto ignition system
- To give elementary idea about the working and parts of a carburettor
- To understand the cycle of operation of compression ignition engines
- To identify the major parts of a CI engine
- To have a thorough knowledge of the working principle of a two - stroke diesel engine and to identify its important parts.
- To have a thorough knowledge of the working principle of a four-stroke diesel engine and to identify the major parts.

- To distinguish the low compression, high compression and medium compression engines, with suitable examples
- To have an idea about improving the engine performance
- To have a clear idea about the process of supercharging
- To familiarise with diesel engine parts, their functions and materials for construction
- To understand cylinder block and cylinder head
- To understand the functions of crank case, sump
- To have a clear idea about piston, piston rings
- To develop a clear idea about crank shaft and connecting rod and their working
- To understand bearings and their functions
- To differentiate between push rod and rocker arm
- To study the working of valves and valve guides
- To have a proper understanding about oil pumps and fuel injectors
- To develop the idea about fly wheel
- To understand the function and importance of fly wheel
- To understand the functions of oil filters
- To understand the importance of super chargers
- To develop a general idea about the fuel system used in diesel engines
- To get familiarised with the various components like storage tank, service tank, fuel feed pump etc.
- To have an idea about fuel injection system like solid injection system and air injection system
- To understand the working of different types of fuel injectors like blast injector, mechanically operated injectors, automatic injectors
- To have a clear understanding about different types of nozzles like single-hole nozzle, multi-hole nozzle, pintle nozzle, pintaux nozzle
- To develop an idea about fuel lines
- To understand the necessity and functions of lubrication system
- To study the properties of lubricating oil like viscosity, viscosity index, flash point, pour point, cloud point, fire point, cleanliness, colour, specific gravity etc.
- To go through various types of lubricating systems like petroil, splash, dry sump, semi pressure and full pressure system
- To familiarise with different types and working of lubricating pumps and filters

- To understand the need for cooling in an internal combustion engine
- To know the difference between air cooling and water cooling (Sea water cooling and fresh water cooling)
- To have an elementary idea of heat exchanges in marine vessels
- To understand various types of starting system used in engine
- To get a clear idea about the hand starting, electric starting and air starting
- To have a knowledge on cold and hot starting
- To understand various methods of transmission of power in marine motor such as direct drive, reduction drive and reduction and reverse drive
- To be familiarised with the components and functions of transmission system
- To understand the installation of transmission system

# SYLLABUS

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## Unit 1

### Fundamental Concepts of Thermodynamics

- Fundamental concepts of thermodynamics
- Pressure --- temperature --- specific volume density --- heat energy
- Power --- First and Second Law of thermodynamics --- heat engine. IHP --- BHP --- FHP

## Unit 2

### Basics of Internal Combustion Engines

- Types of heat engine --- IC Engine --- Parts and working principle --- Stroke of piston --- Dead centres --- cylinder total volume --- swept volume --- clearance volume --- compression ratio etc.

## Unit 3

### Spark Ignition Engines

- SI Engines, parts --- cycle working --- two-stroke and four-stroke --- ignition system components and working (battery coil, magneto) --- Carburetors etc.

## Unit 4

### Compression Ignition Engines

- CI engines, parts --- cycle working --- two stroke and four stroke --- low medium and high compression engines --- methods of improving engine performance, supercharging etc.

## Unit 5

### Diesel Engine - Parts, Functions and Materials

- Cylinder block, Cylinder head --- Crank case --- sump --- piston --- piston rings (oil rings and scrapper and compression rings) --- connecting rod --- crank shaft --- bearings --- cam shaft --- push rod --- rocker arms --- valves --- valve guides --- pumps --- injectors --- fly wheel --- oil filters --- super chargers --- different types etc.

**Unit 6**

**Fuel System**

- Storage tank, service tank --- fuel feed pump --- fuel filters --- fuel injectors (different types of fuel injectors and principles of working)

**Unit 7**

**Lubricating System**

- Need for lubrication ---- dual effect of lubrication ---- qualities of lubricating units ---- lubricating pump ---- lubricating oil filters

**Unit 8**

**Cooling System**

- Necessity of cooling --- Internal combustion engine --- Air cooling and water cooling (Sea water cooling and fresh water cooling) --- Heat exchanger for fresh water cooling

**Unit 9**

**Starting System**

Cold starting and Hot starting --- Hand, Electric and Air starting --- Air compressor

**Unit 10**

**Transmission System**

- Direct drive ---- reduction drive --- reduction and reverse gear --- propeller shaft ---- intermediate shaft coupling --- shaft bearings --- stern tube --- stern gland --- shaft alignment --- principles of installation

# PLANNING

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## **Introduction**

To make the subject maintenance and operation of marine engines more activity based, we have to provide more learning experiments that would help to develop process skills and components of multiple intelligence. No matter whether these skills are attained inside or outside the class room, but the teacher must bear in mind, the fact that they are to be completed in a time bound manner. In order to achieve this the teacher may make necessary plans in terms of learning activities. The teacher must prepare at least three planning documents.

- Year plan
- Unit plan
- Daily plan

## **Year Plan**

The year plan will include the total number of units to be transacted through the three terms, units to be covered during each month end, the number of periods required for each unit.

## **Unit Plan**

Teacher may prepare unit plan before the actual transaction of the unit in the class room. This plan must make clear the curriculum objectives intended, periods required for transaction of these objectives, instructional strategies to be used and material required. Unit analysis for each unit given in the sourcebook may be utilized for preparing unit plan.

## **Daily Plan**

The daily plan includes curriculum objectives to be transacted during class periods, learning activities, learning aids and feedback.

## YEAR PLAN

Unit	Name of unit	Hours	Month planned to teach	Activity/ Suggestion
1	Fundamental concepts of Thermodynamics	18	June-July	Experiment, Group discussion, Assignment, Calculation, Demonstration, Project, Observation
2	Basics of Internal Combustion Engines	14	July-August	Demonstration, Group discussion, Assignment, Observation, Experiment, Project, Seminar
3	Spark Ignition Engines	12	August-September	Demonstration, General discussion, Identification, Assignments, Debate, Chart preparation, Project
4	Compression Ignition Engines	16	September-October	Discussion, Demonstration, Identification, Assignment, Chart Preparation
5	Diesel Engine - Parts, Functions and Materials	13	October-	Demonstration, Group discussion, Identification, Chart preparation, Experiment, Field trip
6	Fuel System	15	October-November	General discussion field trip, group discussion, demonstration, chart preparation, project presentation
7	Lubricating System	14	November	Seminar, Chart preparation, Specimen collection
8	Cooling System	13	December-January	Discussion, Seminar, Chart preparation, Project
9	Starting System	16	January	Discussion, Experiment, Field trip
10	Transmission System	12	January-February	Field trip, Model making, Discussion, Chart preparation

## UNIT PLAN

### UNIT 1 - FUNDAMENTAL CONCEPTS OF THERMODYNAMICS

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation	Time hours allotted
<ul style="list-style-type: none"> <li>Thermodynamic system</li> </ul>	System, surroundings boundary Open system Closed system Isolated system	Experimentation Communicating Participation	Experiment Group discussion	Vessel, thermometer Spring balance	Report on experiment	2 hours
<ul style="list-style-type: none"> <li>Properties of thermodynamics system</li> </ul>	Pressure, volume, temperature, specific volume, density	Experimentation, calculating, discussing	Experiment Group discussion Assignment Calculation	Aluminium, Copper, Steel Sheets, weighing machine, steel rule	Report on experiment Submission of assignment, Submission of calculated results	5 hours
<ul style="list-style-type: none"> <li>Heat, Power and Energy</li> </ul>	Heat - conduction, convection, Radiation Energy - Kinetic energy, Potential energy Power - IHP, BHP, FHP	Observations, Communicating	Demonstration Group Discussion	Metal rod, Thermometer Brick, Steel rule	Knowledge of concept, performing activities	6 hours
<ul style="list-style-type: none"> <li>Law of thermodynamics</li> </ul>	Zeroth, 1st and 2nd laws	Project, Observation, Discussion	Project, observation, Discussion	Vessels, Thermometer	Project report observing participating	5 hours

## DAILY PLAN

### UNIT 1 FUNDAMENTALS OF THERMODYNAMICS

Name of Teacher	: .....	Class	: .....
Name of School	: .....	Strength	: .....
Subject	: .....	Duration	: .....
		Period	: .....

**Topic : Thermodynamic System**

#### Curriculum Objectives

To develop the idea about the thermodynamic system, surroundings, boundary through experiments.

<p><b>Concept and Ideas</b> System, Surroundings, Boundary</p> <p><b>Process Skills</b></p> <ul style="list-style-type: none"><li>• Experimentation</li><li>• Communicating</li><li>• Participating</li></ul> <p><b>Previous knowledge</b></p> <ul style="list-style-type: none"><li>• Concepts form the classes</li></ul> <p><b>Materials required</b></p> <ul style="list-style-type: none"><li>• Vessel</li><li>• Thermometer</li><li>• Spring balance</li></ul>	<p><b>Activity</b></p> <p><b>Experimentation</b></p> <ol style="list-style-type: none"><li>1 Take a vessel and fill with water. Measure the weight and temperature. By closing the vessel heat it for some time. Again measure the weight and temperature. Discuss the results.</li><li>2 Again boil the water, for 10 minutes removing the cover plate. Note down the difference between initial temperature, weight and final temperature and weight. Discuss the results.</li></ol>
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#### Responses/ Feedback

- Report on experiment
- Participating

#### Consolidation

- System is on any region or quantity of matter where the attention is made for studying thermodynamic properties
- Anything outside the system is surroundings
- System and surroundings are separated by boundary

#### Work

- Note preparation

# EVALUATION

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## Introduction

As the curriculum is based on a particular vocation, evaluation becomes an inevitable procedure. Evaluation is done along with learning process throughout the course of study. In order to make an evaluation, the teacher should be able to understand the students, their scholastic and co-scholastic knowledge. Capacity building in the selected vocation is the most important part in vocational education and it should be evaluated accordingly. The technical skills, interest and devotion in the particular field, communication skills, analysis, organising and presentation skills etc. have to be evaluated. The personal and social qualities also have to be evaluated. Thus evaluation is an integral part of learning process which assesses the implementation of the curriculum.

## Need and importance of Evaluation

Evaluation is to assess the scientific knowledge of students and to recognise to what extent they have achieved the specified capabilities. A written examination at the end of an year which is purely based on a textbook is not of much use. “Evaluation is a systematic process of collecting, analysing and interpreting evidence of students’ progress and achievement both in cognitive and non-cognitive areas of learning for the purpose of taking a variety of discussions”.

The teacher can properly assess the level of the learner and can identify his/her strength and weakness. This will help each student to evaluate themselves and to improve their level of learning by taking necessary assistance from the teacher (self evaluation) classmates can evaluate themselves through interaction (peer group evaluation) Evaluation even help the teacher to analyse and improve their performance. Evaluation helps to integrate the teacher, learner and even the parents. Thus student who are socially useful and can perform productive work are created. This will improve the quality of our young generation.

## Features of Evaluation

- Evaluation should be humane in nature. It must help the students grow as social beings.
- Evaluation should be the responsibility of the teacher who teaches the students and is

responsible for developing the requisite healthy attributes in them.

- Evaluation should be consistent with its purpose and must provide a reliable and valid measure of the student's performance.
- Evaluation should reflect the outcome of each learning intervention and should provide all the students with equal opportunity to display their individual potential.
- Evaluation should take into account both the background and the prior experience of the students.
- Procedures for grading and their reporting should be appropriate and easily understood by one and all.
- Evaluation should restore the faith and trust of the masses by ensuring transparency in the procedure.

Theories of constructivism and multiple intelligence are the basis of modern learning. So evaluation strategies have also to be changed. Evaluation must be;

- Continuous and comprehensive
- Scholastic and co-scholastic
- Depending on grading system.
- Depending on a vocational or trade proficiency.

### **Continuous and Comprehensive Evaluation**

Most of our traditional evaluation methods are related only to the area of scientific knowledge or the memory of students. To eliminate the limitations of this method we are forced to evaluate the multi-dimensional competencies of the learner with respect to the practicability and nature of the subject.

Continuous and Comprehensive Evaluation is an essential ingredient of any learning process. It helps the learner to understand and evaluate his own progress and to develop adequate strategy for further improvement. Continuous Evaluation also helps us to measure the attained goals of formulated curriculum objectives.

#### **Merits of Continuous and Comprehensive Evaluation System are:**

1. Making student's learning regular
2. Provides for a variety of activities
3. Effective feedback is possible
4. Assess the all round development of the learner on a continuous basis through a variety of activities.
5. Remedial and diagnostic teaching is possible.
6. The process as well as the product is assessed.

Different tools are used to evaluate the multi dimensional competencies of the learners.

The Continuous and Comprehensive Evaluation (CCE) includes not only written test (class tests) but also oral tests, observation, interview, debates, discussions, seminars etc.

The learner proceeds through a variety of learning experiences. Therefore the level of progress should be evaluated in a comprehensive and continuous manner. More over, the learner is to be made aware of the findings and it helps him to measure his progress. Necessary help should be provided to them in time. As such we can generate the environment and opportunity for Continuous Evaluation.

In order to evaluate the multi- dimensional competencies of the learner, different tools and techniques have to be used. The multi- dimensional competencies of the learner include

- Class -room interaction
- Task orientation
- Creative expression
- Field/institutional interactions
- Knowledge assessment/ expression

### Continuous Evaluation Items

1. Assignment
2. Seminar
3. Class test
4. Project etc.

\* For continuous evaluation class test (CT) is made compulsory taking any two of the above said indicators. CT can be a written test, oral test (viva), Practical test.

CE Item	Evaluation Indicators	Weightage	Score
1. Assignment	1. Awareness of the content	4/3/2/1	20
	2. Comprehensiveness of the content	4/3/2/1	
	3. Systematic and sequential arrangement	4/3/2/1	
	4. Observation/suggestions/Views Judgements/ Evaluation	4/3/2/1	
	5. Timely Submission	4/3/2/1	
2. Seminar	1. Ability to plan and organise	4/3/2/1	
	2. Skills in the collection of data	4/3/2/1	
	3. Awareness of the content (presentation of the paper, participation in discussion, ability to substantiate the ideas and views)	4/3/2/1	

	4. Ability to prepare the report (sequence in the presentation of the concepts, authenticity and clarity of ideas/views/concepts)	4/3/2/1	
	5. Quality of Seminar Document	4/3/2/1	20
3. Project	1. Ability to plan (Selection of the method for solution of the problem, identifying suitable tools, planning the various activities to be carried out in each stage)	4/3/2/1	
	2. Ability to collect data (sufficiency and Relevance of data. Classification and arrangement of data for analysis, reliability and authenticity of the Collected data.)	4/3/2/1	
	3. Ability to analyse the elements and procedure (Structuring of elements and developing logic. Efficiency in using the package/tool. Recognising design errors and correcting them)	4/3/2/1	
	4. Ability to prepare the project report  (Reflection of the process skills. Communicability and authenticity of the report in relation with the Project diary)	4/3/2/1	
	5. Viva Voce (Knowledge of the content and Process)	4/3/2/1	20

**CE item calculation**

Subject		item: Assignment					Total Score (20)
Sl. No	Name	Evaluation Indicators					
		I (4)	II (4)	III (4)	IV (4)	V (4)	
1	Anand	2	3	4	4	4	17
2	Shibu	4	3	4	4	4	19

**Consolidated statement of CE**

**Class: 1st year**

**Stream : Fisheries**

**Subject : Maintenance and Operation of Marine Engines**

Sl. No	Name	CE Items			Total (60)	Total CE Out of 20  Score obtained $\times \frac{20}{60}$
		1 Class Test (20)	2 Assignment (20)	3 Seminar/ Project (20)		
1	Anand	18	17	19	54	18
2	Shibu	20	19	18	57	19

No minimum score for CE

**Terminal Evaluation (TE)**

Terminal Evaluation is in written form. The test should not be aimed to test the memory alone. The terminal evaluation questions give more emphasis on application level, analysis and synthesis. The questions are framed so that the students are able to apply their different mental process. The maximum score is 80 and the minimum score of TE is 24 (30%).

The terminal evaluation questionnaire should be capable of measuring

- Content validity
- Criterion validity
- Constant validity
- Reliability
- Class test, term evaluation and annual examination should be in tune with the new approach.
- Should not be prepared to test the rote memory.
- Questions asked should provoke the thinking abilities of students.
- Questions to test the competency of application analysis, synthesis and evaluation are to be given. In other words the questions should be framed in such a way that the students are able to apply their various mental processes.
- Questions should be based on the learning process and the new approach to each subject.

- Results should be scientifically analysed.
- Evaluation results should be analysed and follow up may be carried out at relevant levels (remedial measures).
- Eighty percent marks are set apart for the common examination as the part of the Term Evaluation

**The Question Paper must have**

- Application level questions
- Synthesis level questions
- Comparison of facts
- Challenging questions
- Scope for obtaining innovative ideas
- Giving creative thinking by the students
- Questions based on the objectives of learning activities
- Practical oriented questions
- Environment related questions
- Divergent thinking level questions

**Role of the Teacher in the Evaluation Process**

- Preparation for the effective execution of evaluation
- Preparation of daily planning notes (teaching manual) and helping learners in their activities.
- While learners are engaged in doing seminars/collections/assignments/ collections, conduct interim evaluation and provide necessary help.
- Consider assignment, seminar, collections etc. as learning activities and approach them as evaluation materials.
- Prepare a format to record continuous evaluation.
- Identify and evaluate the progress at different stage.
- Find out learner's difficulty by conducting feedback.
- Make use of the support mechanism fully, provided by the department of education.
- Make the parents aware of the new approach to curriculum and evaluation system through class P.T.A.
- Make use of the training programme for professional excellence and transparency in work.
- Make use of the Humanities Teachers Council for academic progress.

- Identify and make use of the possibility of action research to resolve classroom learning problems.

**Grading**

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

It is not scientific to assess the achievement of a student solely based on the marks in the terminal examinations. Marking system proved unscientific in evaluating the growth and development of students both in cognitive and non-cognitive areas. To overcome this shortcomings, a popular mode of evaluation based on students' performance- grading system- has been evolved. At the Higher Secondary stage, it is desirable to use a point absolute grading to co-ordinate and record the evaluation. After giving the score, they are changed into percentages and appropriate letter grades are awarded corresponding to each percentage. The score percentage and corresponding letter grade in Maintenance and Operation of Marine Engines is given below.

**Consolidated statement of CE & TE****Class: 1st year****Stream: Fisheries****Subject: Maintenance and Operation of Marine Engines**

Sl. No	Name	CE (20)	TE (80)	Total CE+ TE (100)	Grade
1	Anand	18	60	78	B+
2	Shibu	19	72	91	A+

The maximum score of CE+TE is 100 and the minimum score is 30. (30%)

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**Practical Evaluation (PE)**

PE is the important part of vocational practicals. The practical skills must be evaluated after completing all practical experiments in each term and at the end of the academic year. PE must cover all required indicators to evaluate the technical skill and practical knowledge of the different topics covered.

**Syllabus**

<b>Practical</b>	<b>Topic</b>	<b>Hours</b>
1	Study on Petrol Engines	90 hours
2	Study on Diesel Engines	120 hrs
3.	Study on Diesel Engine Auxiliary System	180 hrs
	Test	30 hrs
	Total	420 hours

**General and Specific Objectives**

- 1 Upon completion of the subject the student will be able to operate the engines by checking all auxiliary systems, starting, running and stopping etc.
- 2 To service engines by using proper tools, dismantling cleaning the parts, identifying the parts and assembling.
- 3 To study the working of auxilliary systems in engines, by drawing their sketches, identifying the parts, demonstrating the working and locating wear and tear in parts

**List of Experiments****Unit 1 Study on Petrol Engines**

- 1.1 To operate single cylinder petrol engine
- 1.2 To operate multi cylinder petrol engine
- 1.3 To dismantle single cylinder petrol engine
- 1.4 To assemble single cylinder petrol engine
- 1.5 To assemble multi cylinder petrol engine
- 1.6 To dismantle multi cylinder petrol engine
- 1.7 To demonstrate the working of battery coiling system
- 1.8 To service carburettor of a single cylinder petrol engine
- 1.9 To service carburettor of a multi cylinder petrol engine
- 1.10 To service fuel feed pump of a petrol engine

**Unit 2 Study on Diesel Engines**

- 2.1 To operate single cylinder diesel engine
- 2.2 To operate multi cylinder diesel engine
- 2.3 To dismantle single cylinder diesel engine
- 2.4 To assemble single cylinder diesel engine
- 2.5 To dismantle multi cylinder diesel engine
- 2.6 To assemble multi cylinder diesel engine
- 2.7 To operate the timing diagram of a diesel engine

**Unit 3 Study on Diesel Engine Auxilliary Systems**

- 3.0 To service
- 3.1 Fuel pump
- 3.2 Injector
- 3.3 Fuel Filter
- 3.4 Oil Filter
- 3.5 Starter motor
- 3.6 Water pump
- 3.7 To demonstrate the working of direct drive transmission system
- 3.8 To demonstrate the working of reduction drive transmission system
- 3.9 To service propeller shaft
- 3.10 To demonstrate the installation of transmission system

**Indicators for Practical Evaluation and their Score**

<b>No.</b>	<b>Indicators</b>	<b>Percentage</b>	<b>Score</b>
1	Procedure and demonstration	40%	60
2	Calculation	10%	15
3	Identification	20%	30
4	Spotters	10%	15
5	Record	10%	15
6	Viva-voce	10%	15
		<b>Total</b>	<b>150</b>

**Consolidated statement of Practical Evaluation**

**Class: 1st year**

**Stream: Fisheries**

**Subject: Maintenance and Operation of Marine Engines**

No	Name	Procedure and demonstration	Calculation	Identification	Spotters	Record	Viva	Total	Grade
		60	15	30	15	15	15	150	
1	Anand	40	10	20	10	12	13	105	B+
2	Shibu	55	13	25	13	13	13	142	A+

**How will you find out grade for PE**

Convert the total score into percentage and findout the grade

eg: Total score: 105, percentage  $\frac{105}{150} \times 100 = 70$  , Grade B+

The minimum score to be obtained is fixed at 40% that is 60 out of 150. Grade B

**Vocational Competency Evaluation**

Being a vocational course, a system to judiciously evaluate the required value addition and consequent capacity building in the selected vocational subject is highly essential. As the other evaluation components like CE, PE and TE cannot assess the vocational competencies and professional skills acquired by the students, an internship evaluation (IE) component has been introduced to meet this requirement.

Internship evaluation should be done based on the following components.

**I. Regularity and punctuality**

A regular presence and habit of time bound completion of task is a must for attaining maximum efficiency.

**Regularity and Punctuality can be evaluated by 5 Point scale.**

**Rating Scale**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1	Regularity	Never regular	Often regular	Usually regular	Most of the time regular	Always regular
2	Punctuality	Never Punctual	Often Punctual	Usually Punctual	Most of the time Punctual	Always Punctual

Regularity and punctuality can be assessed by using attendance of the student and time bound completion of tasks.

**II. Value addition**

Value addition can be evaluated through conducting field visits/survey. The experiences gained through field visit and survey increases the level of intrinsic motivation and positive attitude towards the vocational field and there by increase his value as a skilled semi- professional.

The aim of value addition is to measure the interest, devotion Group management, perseverance of the learner in specific areas Value addition can be evaluated from field visit, survey and simulated experiments.

**III. Capacity building**

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.

These components helps the students to practice the acquired skills in the real situation and there by increasing self confidence and promoting self reliance.

Capacity building is aimed at measuring the skills of the learner from OJT/ production cum training centre/ research and development/graded area exposure.

IE Item	Evaluation Indicators	Weightage	Score
<b>1. Regularity and Punctuality</b>			10
<b>2. Value addition</b>	<p><b>Field Visit</b></p> <p>1. Attitude and readiness towards the task.</p> <p>2. Capacity for observation.</p> <p>3. Data collection.</p> <p>4. Application of ideas.</p> <p>5. Documentation/ recording.</p> <p style="text-align: center;">OR</p> <p><b>Survey</b></p> <p>1. Planning.</p> <p>2. Data collection.</p> <p>3. Consolidation of data and analysis.</p> <p>4. Drawing inference.</p> <p>5. Reporting.</p>	<p>4/3/2/1</p>	20
<b>3. Capacity building</b>	<p><b>OJT/ Simulated Experiment/ Practical skill</b></p> <p>1. Involvement/ Participation.</p> <p>2. Skills in doing work/ Communication skill.</p> <p>3. Time bound action.</p> <p>4. Capacity for observation, analysis and innovation.</p> <p>5. Documentation, Recording and display.</p> <p style="text-align: center;">OR</p> <p><b>Performance in camp/ Exhibition/ clinic</b></p> <p>1. Ability for planning and organising.</p> <p>2. Mastery of subject.</p> <p>3. Ability for communication.</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>	20

IE Item	Evaluation Indicators	Weightage	Score
	4. Innovation. 5. Involvement/Social commitment. OR <b>Performance in production/ service cum training centre (PSCTC)</b>	4/3/2/1 4/3/2/1	
	1. Mastery of vocational skills. 2. Managerial capacity. 3. Promoting self confidence. 4. Innovative approach. 5. Promoting self - reliance.	4/3/2/1 4/3/2/1 4/3/2/1 4/3/2/1 4/3/2/1	

**Vocational Competency Items for Internship Evaluation**

Items	Score
Regularity & Punctuality	10
Field visit/survey (any one)	20
OJT/simulated experiment/ Practical Skill/ Performance- Camp/exhibition/Clinic Performance- PSCTC (any one)	20
<b>Total</b>	<b>50</b>

A minimum of 80% attendance is required for promotion to the second year. Those who have shortage of attendance should repeat first year. Those who have 80% and above attendance but failed to achieve 30% of Internship Evaluation (IE) will be promoted to the second year. He has to improve the component in which he performed poor. He has to attain the minimum by improving the particular component to get eligible for appearing second year public examination.

**Consolidated statement of IE**

**Class: 1st year**

**Stream : Fisheries**

**Subject : Maintenance and Operation of Marine Engines**

<b>SI No</b>	<b>Name</b>	<b>Regularity &amp; Punctuality</b>	<b>Field visit or survey</b>	<b>OJT or Practical skill</b>	<b>Total Score</b>	<b>Grade</b>
		<b>10</b>	<b>20</b>	<b>20</b>	<b>50</b>	
1	Anand	5	12	10	27	C+
2	Shibu	6	15	16	37	B+





## **PART II**

# 1. FUNDAMENTAL CONCEPTS OF THERMODYNAMICS

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## Introduction

Thermodynamics is a branch of Science which deals with heat and work. The word “thermo” related to “heat” and “dynamics” to “movement”. So thermodynamics means flow of heat energy. In our day to day life we come across thermodynamics in various fields. Eg. when the sun rises, the heat from the sun flows to the earth.

In this chapter we are dealing with the basics of thermodynamics such as pressure, temperature, volume, energy etc. The teacher can make the students to understand these terms properly by providing them with proper examples and chances for observation.

## Curriculum Objectives

- To develop the idea of thermodynamic system, surroundings and boundary through experiments.
- To refresh the idea about pressure, temperature, volume, specific volume and density through experiments and observations.
- To understand clearly the concepts of heat, power and energy through discussion.
- To understand Zeroth Law, 1<sup>st</sup> Law and 2<sup>nd</sup> Law of thermodynamics through observation.
- To understand heat engines, IHP, BHP and FHP

## Syllabus

- Fundamental concepts of thermodynamics
- Pressure - temperature - specific volume density - heat energy
- Power - First and Second Law of thermodynamics - heat engine. IHP - BHP - FHP

## 1.1 Thermodynamic System

### Activity 1.1.1 Experiments

- 1 Take a vessel and fill it with water. Measure the weight and temperature. Close the vessel and heat it for some time. Again measure the weight and temperature. Discuss the result.(Closed system)

- 2 Again boil the water for 10 minutes removing the cover plate. Note down the difference between initial temperature, weight and final temperature and weight. Discuss the results.(Open System)

### **Activity 1.1.2 Group Discussion**

- 1 Considering the classroom as an example, discuss closed system, open system and isolated system.
- 2 Discuss isolated system by taking the example of thermos flask.

## **1.2 Pressure, Temperature, Volume, Specific Volume, Density**

### **Activity 1.2.1 Group Discussion**

Students can recollect their knowledge of pressure, temperature, volume, specific volume, density etc.

### **Discussion points**

- Application of compressed air (pressurised air) in spray paintings.
- Measurement of pressure w.r.t. a different datum, i.e. absolute, vacuum, atmospheric and gauge pressure
- Pressure - measuring instruments such as Bourden tube, pressure gauge, barometer, vacuum pump etc. through demonstration
- Different temperature scales
- Conversion between different temperature scales
- Difference between length, breadth, volume

### **Activity 1.2.2 Experiments**

- First blow air into your hand slowly and then strongly and feel the difference and discuss the results
- Touch and feel temperature
- Measure the length of benches and desks and note its units.
- Measure the area of the blackboard
- Measure the volume of tiffinbox, instrumentbox etc.
- Compare the specific volume of wooden block, brick etc.

### **Activity 1.2.3 Calculation**

- Do the calculation for the conversion of temperature from one scale to other scales.
- Calculate the volume, specific volume, density etc.

### Activity 1.2.4 Assignment

- Find out the specific volume of at least five different materials like aluminium, iron, copper etc.
- Find out the density of petrol, diesel, kerosene, coconut oil and water

## 1.3 Energy, Heat

### Activity 1.3.1 Group Discussion

With their previous knowledge, the students can discuss among themselves the law of conservation of energy.

#### Discussion points

- Conversion of energy in generators, engines etc.

### Activity 1.3.2 General Discussion

The teacher can guide the students in reaching their goal.

#### Discussion points

- Difference between heat and temperature
- Heat as a source of energy
- Units like calorie, BTU (British Thermal Unit), CHU (Centigrade Heat Unit)
- Modes of heat transfer

### Activity 1.3.3 Demonstration

- Heat transfer in metal rod

Take a metal rod and heat it at its one end. After some time we can feel the temperature at the other end.

- Heat transfer in liquids

Take some water in a container and heat it. Explain the mechanisms of heat transfer in liquids.

- Heat transfer in gases

Explain the heat transfer from the sun

## 1.4 Power

### Activity 1.4.1 General Discussion

#### Discussion points

- Force, displacement, work

The teacher can guide the students in understanding the terms clearly.

### **Activity 1.4.2 Demonstration**

- 1 Take a brick and place it on the table. Move it by applying force with your hand and note the distance
- 2 Take 5 blocks of bricks and move them together the same distance. Feel the difference in force. With these demonstrations explain displacement, force, work done and power.

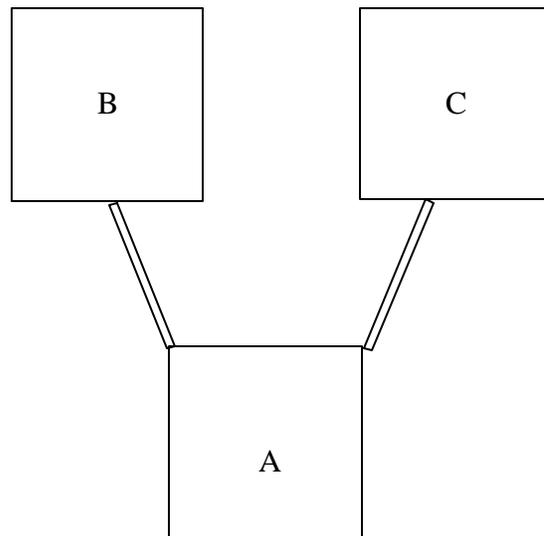
## **1.5 Zeroth Law of Thermodynamics**

### **Activity 1.5.1 General Discussion**

The teacher can make the proposition and explain it and explain the applications.

### **Activity 1.5.2 Project**

Take 3 vessels A, B and C. Join vessel A to vessel B and vessel C using pipes as shown:



Pour water into these vessels and heat the vessel A. Allow the system to attain equilibrium. Measure the temperature of vessels A, B, and C separately.

From this experiment, Zeroth Law of Thermodynamics can be explained properly.

## **1.6 1<sup>st</sup> Law of Thermodynamics**

### **Activity 1.6.1 Experiment**

- 1 Take a file and start filing a metal piece. Observe the generation of heat.
- 2 Boil water in a pot with a lid placed on it. (Owing to pressure developed inside the pot, the cover will move.) Observe.

### **Activity 1.6.2 Group Discussion**

Based on the above observation discuss the following:

- Conversion of heat into work
- Conversion of work into heat
- Limitations

## **1.7 2nd Law of Thermodynamics**

### **Activity 1.7.1 Observation**

- 1 Observe the overhead tank in the school. Find out how water reaches the tank from the well. (Clausius statement)
- 2 Try to find an instrument which receives energy and converts it completely into work without dissipating any form of energy (without producing any heat) (Kelvin Plank's statement)
- 3 Place a weight on an inclined plane. Analyse how it reaches down and how it can be moved back to the original position.

## **1.8 Heat Engines, IHP, BHP, FHP**

### **Activity 1.8.1 Group Discussion**

- Name some of the engines which are familiar.
- Classify them.
- Discuss how power is produced inside the cylinder (by burning fuel).
- Discuss whether the developed power is completely transferred to the output shaft.
- If not, what happens to the developed power.

**UNIT 1**  
**FUNDAMENTAL CONCEPTS OF THERMODYNAMICS**

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>Thermodynamic system</li> </ul>	System, surroundings, boundary Open system Closed system Isolated system	Experimentation Communicating Participation	Experiment Group discussion	Vessel, thermometer Spring balance	Report on experiment
<ul style="list-style-type: none"> <li>Properties of thermodynamics system</li> </ul>	Pressure, volume, temperature, specific volume, density	Experimentation, calculating, discussing	Experiment Group discussion Assignment Calculation	Aluminium, copper, steel sheets, weighing machine, steel rule	Report on experiment Submission of assignment, Submission of calculated results
<ul style="list-style-type: none"> <li>Heat, power and energy</li> </ul>	Heat —conduction, convection, radiation Energy — Kinetic energy, Potential energy Power — IHP, BHP, FHP	Observation, Communicating	Demonstration Group Discussion	Metal rod, Thermometer Brick, steel rule	Knowledge of concept, performing activities
<ul style="list-style-type: none"> <li>Law of thermodynamics</li> </ul>	Zeroth, 1st and 2nd Laws	Project, Observation, Discussion	Project, Observation, Discussion	Vessels, Thermometer	Project report Observing Participating

# 2. BASICS OF INTERNAL COMBUSTION ENGINES

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## Introduction

In the previous chapter, we came across the fundamentals of thermodynamics. An engine which converts heat energy into mechanical work is known as heat engine. In this chapter we will look at the classification of heat engines.

In an internal combustion engine the combustion of fuel takes place inside the engine cylinder. Owing to this reason the size of an IC engine is considerably reduced compared to an external combustion engine. The efficiency of an IC engine is also far better than the EC engine and hence IC engines are most commonly used in our day-to-day life.

## Curriculum Objectives

- To refresh the concepts of a heat engine and to study the classification
- To list out and hence to study the major parts of an IC engine
- To acquire a good knowledge of the working principles of an IC engine
- To study the terminology related to an IC engine like stroke length, dead centres, swept volume, clearance volume and compression ratio.

## Syllabus

- Types of heat engine - IC Engine - Parts and working principle - Stroke of piston - Dead centres - cylinder total volume - swept volume - clearance volume - compression ratio etc.

## 2.1 Heat Engines

### Activity 2.1.1 Group Discussion

The students are divided into 4 or 5 groups and the following points may be discussed. The students already have the idea about heat engines from the previous chapter. The teacher should guide the students by participating in the discussion.

### Discussion points

- Various types of heat engines

- Combustion of solid fuel, liquid fuel and gaseous fuels with examples
- Combustion of fuels like petrol and diesel
- Advantages of IC engine over EC engine

## **2.2 Internal Combustion Engines**

### **Activity 2.2.1 General Discussion, Chart Preparation**

This is a new topic for the students and so the teacher can guide the students to discuss the following points by grouping them. The students are asked to collect various types of engine figures and details and prepare a chart. The following points may be noted:

- basic engine design
- working cycle
- method of ignition
- number of strokes
- fuels used
- method of cooling
- cylinder arrangement
- valve and location

### **Activity 2.2.2 Assignment**

After the above discussion and data collection the students are to submit an assignment with sketches and examples.

## **2.3 Major Parts of an Internal Combustion Engine**

### **Activity 2.3.1 Observation**

The students are to identify the major parts of an engine and to draw the sketch of each part with a small description and to submit it as a report.

## **2.4 Operation of an Internal Combustion Engine**

### **Activity 2.4.1 Demonstration**

The teacher should demonstrate the working of an IC engine by using charts or cut models and the following should be explained.

- suction
- compression
- expansion
- exhaust

## 2.5 Dead Centres and Stroke Length

### Activity 2.5.1 Demonstration

Dead centres and stroke length can be easily demonstrated with the help of a cut model. After the demonstration the students should identify TDC and BDC and measure the distance between TDC and BDC using a steel rule.

### Activity 2.5.2 Experiment

Using a steel rule the students should roughly measure the stroke length by marking both dead centres.

### Activity 2.5.3 Experiment

By using adequate tools, measure the piston diameter and calculate the piston area

Piston Area =  $\frac{\pi D^2}{4}$  where D is the diameter. Also measure the cylinder bore and calculate the cylinder area.

## 2.6 Swept Volume, Clearance Volume, Cylinder Volume

### Activity 2.6.1 Experiment

The students have already measured the stroke length and found out cylinder area. Next they are to calculate the swept volume, clearance volume and cylinder volume, which can be found out very easily.

## 2.7 Compression Ratio

### Activity 2.7.1 General Discussion

Through their previous experiments, the students are now aware of swept volume, cylinder volume and clearance volume. Now the teacher can give the idea of compression ratio. This can be done with suitable demonstration also. The following points may be discussed:

- Compression ratio
- Comparison of C-R in petrol and diesel engines.

### Activity 2.7.2 Seminar

The working principles of IC Engines

**UNIT 2**  
**BASICS OF INTERNAL COMBUSTION ENGINES**

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>• Internal Combustion Engine</li> </ul>	Classification of IC engine Major parts Working principle Stroke length Dead centres Swept volume Clearance volume Compression ratio	Demonstration Communication Solving problems Drawing inferences Measuring Calculating	Demonstration Group discussion Assignment Observation Experiment Project Seminar	IC engine Cut model of engine Steel rule Outside and inside calipers	Problem-solving Report on discussion Participating in discussion Project report Assignment Process skills Participation in seminar Presenting the seminar

# 3. SPARK IGNITION ENGINES

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## Introduction

In the previous chapter we discussed the classification of Internal Combustion Engines. The main classification is based on the ignition of fuel inside the engine cylinder. Spark Ignition Engine is one of the most important classification of Internal Combustion Engines. In these type of Engines spark plug is used for the ignition process.

In this chapter we will go through the Spark Ignition Engine parts, cycle of working, working of two stroke and four-stroke engines and the comparison between these two types of engines. Types of ignition system used in Spark Ignition engines are Battery coil ignition system and Magneto ignition system. The carburettor is the main component in an SI engine. The function and working principles and various parts are also discussed in this chapter.

## Curriculum Objectives

- To understand the working of spark ignition engines.
- To develop the concept of cycle of operation of petrol engine
- To provide an idea about the main parts of two stroke engines
- To give a thorough knowledge of the working of two - stroke SI engines.
- To understand the main parts of a four stroke petrol engine and its working
- To introduce the working of Battery coil ignition system and Magneto ignition system
- To give elementary idea about the working and parts of a carburettor

## Syllabus

- SI Engines, parts --- cycle working --- two-stroke and four-stroke --- ignition system components and working (battery coil, magneto) --- Carburettors etc.

## 3.1 Spark Ignition Engines

### Activity 3.1.1 Demonstration

The teacher should give a basic idea of the cycle of operation by charts. Then demonstrate

the working of a Spark Ignition Engine. Here the teacher should stress the importance of a spark plug and also Carnot cycle is explained. After the demonstration the students are to prepare a chart with diagram and this should contain

- suction stroke
- compression stroke
- expansion stroke
- exhaust stroke

A cut model of a spark ignition engine is to be demonstrated in the classroom.

### **Activity 3.1.2 General Discussion**

Through general discussion the students must acquire the knowledge of

- 1 Carnot cycle, explained with the help of chart and diagrams
- 2 Reversible, Irreversible, Adiabatic and Isothermal cyclic process. (These can be explained with the help of PV diagrams , charts can also be used.)
- 3 Explain Otto cycle with the help of a PV diagram or chart.

## **3.2 Main Parts of a Two Stroke Petrol Engine**

### **Activity 3.2.1 Identification**

The students identify the main parts of a two-stroke petrol engine. Thereafter the teacher explains the importance of each parts in a petrol engine. Finally, the students should prepare a chart by drawing figures. They can also list the various figures and types of two-stroke engines used in our day- to - day life.

### **Activity 3.2.2 Assignment**

The important parts of a two - stroke petrol engine are drawn and a small description is given.

## **3.3 Working of Two Stroke Petrol Engine**

### **Activity 3.3.1 General Discussion**

Through a general discussion students can develop the concept of the working of a two stroke petrol engine. The teacher should stress the importance of each stroke such as suction, compression, expansion and exhaust.

### **Activity 3.3.2 Assignment**

An assignment is given on the working of a two - stroke petrol engine, with neat sketches.

## **3.4 Main Parts of a Four Stroke Petrol Engine**

### **Activity 3.4.1 Identification**

The students can identify the main parts of a four - stroke petrol engine. Thereafter the teacher demonstrates the importance of each part.

### **Activity 3.4.2 Assignment**

The important parts of a four stroke petrol engine are drawn and a brief description is given. They can also mention various types of four - stroke petrol engines used in our day- to- day life.

## **3.5 Working of a Four Stroke Petrol Engine**

### **Activity 3.5.1 General Discussion**

Through a general discussion the students develop the concept of the working of a four petrol engine. The teacher also mentions the suction stroke, compression stroke, expansion stroke and exhaust stroke.

### **Activity 3.5.2 Assignment**

An assignment is given on the working of a four - stroke petrol engine, with neat figures.

### **Activity 3.5.3 Debate**

The students are divided into two groups and a debate is conducted on the advantages and disadvantages of two - stroke petrol engines.

### **Activity 3.5.4 Debate**

Again debate is conducted on the advantages and disadvantages of four stroke petrol engines.

## **3.6 Ignition System**

### **Activity 3.6.1 General Discussion**

A general discussion is to be made on the importance of an ignition system. The teacher should note that the following points are also included for the discussion:

- First of all, discuss the need for an ignition system in petrol engines
- Discuss the two important types of ignition systems i.e., Battery Coil Ignition System and Magneto Ignition System.
- The components are explained and their importance is stressed

### **Activity 3.6.2 Project**

A project can be given to two groups. One group has to deal with Battery Coil Ignition System while the other group has to deal with Magneto Ignition System. A still model has to

be prepared by using thermocole, straws, wires etc.

### **3.7 Carburettor**

#### **Activity 3.7.1 General Discussion**

Through a general discussion the working of a carburettor should be explained. The students must get a solid idea about the functions, working principles and components of a carburettor. This can be done with the help of charts and by demonstration.

#### **Activity 3.7.2 Group Discussion**

After the demonstration the students are divided into groups and they should discuss the importance of a carburettor in a petrol engine. The discussion should include the following points:

- Need for needle valve and float
- Need for choke
- Need for throttle valve
- The shape of the air-fuel passage in a carburettor

The teacher should consolidate the above ideas by relating the above facts with our modern types of carburettors.

#### **Activity 3.7.3 Assignment/ Seminar**

The students are to draw the figure of a simple carburettor and label its parts. The working of a simple carburettor should also be included.

## UNIT 3 SPARK IGNITION ENGINES

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>• Spark Ignition Engine</li> </ul>	Working of Spark Ignition Engine Cycle of operation Major parts Working of two stroke and four stroke	Observation Sharing of experiments Application in new situations Comparing two-stroke and four-stroke Communicating Chart preparation	Demonstration General discussion Identification Assignments Debate Chart preparation	2-stroke petrol engine 4-stroke petrol engine Charts Cut models	Assignment report Participation in discussion Participation in debates Chart preparation Identification in Spark Ignition engine parts
<ul style="list-style-type: none"> <li>• Ignition System</li> </ul>	Battery coil ignition Magnetto ignition	Using the concept in new situations, observations Communication Chart preparation Project preparation	Demonstration General discussion Project	Still models Thermocol Straws Wires, switch	Project submission Participation in discussion Chart preparation
<ul style="list-style-type: none"> <li>• Carburettor</li> </ul>	Working principle Parts Need in Spark Ignition Engine	Observations Assignment preparing Communications Seminar presentation	Demonstration Group discussion Assignment General discussion	Carburettor	Participation in discussion Assignment submission Seminar

# **4. COMPRESSION IGNITION ENGINES**

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## **Introduction**

In the previous chapter we came across compression ignition engines. As the name implies, the ignition in these types of engines takes place by compressing air to a very high pressure and also the fuel is injecting into it at a very high pressure. So compression ignition engines should have stronger cylinder to resist high temperature and pressure. Naturally, a diesel engine will have more weight than a petrol engine.

In this chapter we are dealing with the working of the CI engines. The working of both two stroke and four stroke CI engines is explained here. Thus we can make a comparison between CI engines and SI engines and list out their advantages and disadvantages.

## **Curriculum Objectives**

- To understand the cycle of operation of compression ignition engines
- To identify the major parts of a CI engine
- To have a thorough knowledge of the working principle of a two - stroke diesel engine and to identify its important parts.
- To have a thorough knowledge of the working principle of a four-stroke diesel engine and to identify the major parts.
- To distinguish the low compression, high compression and medium compression engines, with suitable examples
- To have an idea about improving the engine performance
- To have a clear idea about the process of supercharging

## **Syllabus**

- CI engines, parts - cycle working - two stroke and four stroke - low medium and high compression engines - methods of improving engine performance, supercharging etc.

## **4.1 Cycle of Operation of Compression Ignition Engine**

### **Activity 4.1.1 Discussion**

With the help of a chart the teacher can explain the diesel cycle (PV diagram or TS diagram can be used)

### **Activity 4.1.2 Demonstration**

Using a working model, the reciprocating motion of the piston and hence the four strokes

- 1 suction stroke
- 2 compression stroke
- 3 expansion stroke
- 4 exhaust stroke

## **4.2 Main Parts of a Compression Ignition Engine**

### **Activity 4.2.1 Demonstration/ Identification**

Students are taken to the compression ignition engine and are asked to identify the parts. Students can be divided into groups and can prepare diagrams and notes on the uses of each component. One among the group can make it as a presentation in the class.

## **4.3 Two - Stroke Engines---Working, Parts**

### **Activity 4.3.1 Discussion**

Using proper diagrams, the teacher can explain the working principle of two-stroke engines.

### **Activity 4.3.2 Demonstration/ Identification**

Teacher can show the students to a two-stroke engine and ask them to identify various parts. Students can be divided into groups and prepare notes on the working of each component. One among each group can make the presentation with necessary diagrams.

### **Activity 4.3.3 Group Discussion**

#### **Discussion points**

- Advantages of four stroke engines over two-stroke engines
- Comparison between two-stroke engines and four-stroke engines.

### **Activity 4.3.4 Assignment**

- List out two-stroke and four-stroke engines
- Working of a two-stroke and a four-stroke engine

## **44 Low, Medium, High Compression Engines**

### **Activity 4.4.1 Discussion**

With suitable examples and explanations, the teacher can make the idea of low, medium and high compression clear to the students.

## **45 Super Charging**

### **Activity 4.5.1 Discussion**

- The teacher can explain engine performance
- The methods available to increase the performance of low performance engines
- Super charging
- The advantages of super charging
- Different types of super chargers

### **Activity 4.5.2 Assignment**

Students may collect diagrams and explanations on super chargers from textbooks and magazines.

- Collect information on different types of super chargers from field

### **Activity 4.5.3 Project**

Making an oil filter by using metal sheets, drilled pipes, cotton, wire mesh etc.

## UNIT 4 COMPRESSION IGNITION ENGINES

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>• Compression Ignition Engine</li> </ul>	Working of Compression Ignition Engine Parts Low compression High compression Medium compression Two stroke Four stroke Improving engine performance	Communicating, Observing Sharing of experiments Comparing Chart preparing Identification	Demonstration Discussion Identification Assignments Chart Preparation	CI Engine 2 stroke and 4 stroke Cut model chart	Reports of discussion Participation of discussion Assignment Chart preparation Identification of parts
<ul style="list-style-type: none"> <li>• Super charging</li> </ul>	Super charger Turbo charger	Using the concept in new situations Comparing	Discussion Assignment	Textbooks and automobile magazines	Assignment Participation in discussion

# 5. DIESEL ENGINE - PARTS, FUNCTIONS AND MATERIALS

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## **Introduction**

All are familiar with diesel engines. But the working of the engine is not so familiar. So to understand the working of a diesel engine, one must go through the descriptions of the engine parts and its working. The teacher can give the students a clear picture about the working of the engine with suitable models.

## **Curriculum Objectives**

- To familiarise with diesel engine parts, their functions and materials for construction
- To understand cylinder block and cylinder head
- To understand the functions of crank case, sump
- To have a clear idea about piston, piston rings
- To develop a clear idea about crank shaft and connecting rod and their working
- To understand bearings and their functions
- To differentiate between push rod and rocker arm
- To study the working of valves and valve guides
- To have a proper understanding about oil pumps and fuel injectors
- To develop the idea about fly wheel
- To understand the function and importance of fly wheel
- To understand the functions of oil filters
- To understand the importance of super chargers

## **Syllabus**

- Cylinder block, Cylinder head - Crank case - sump - piston - piston rings (oil rings and scrapper and compression rings) - connecting rod - crank shaft - bearings - cam shaft - push rod - rocker arms - valves - valve guides - pumps - injectors - fly wheel - oil filters - super chargers - different types etc.

## **5.1 Diesel Engines---An Overview**

### **Activity 5.1.1 Demonstration**

The teacher takes the students to the workshop and dismantles a diesel engine. The students must follow the teacher's instructions for dismantling. The teacher can give them a clear idea about the various parts of diesel engines like cylinder block, cylinder head, valves, rocker arms, push rod, valve guide, tappet, connecting rod, crank shaft, piston, piston pin, crank pin, oil rings, compression rings, oil sump, cam shaft etc.

### **Activity 5.1.2 Group Discussion**

The students are divided into groups and they discuss all the parts of the engine and their functions. The teacher gives tips for discussion and mentions the materials used.

## **5.2 Cylinder Block and Cylinder Head**

### **Activity 5.2.1 Identification**

The demonstration of diesel engine in the workshop. The students identify the cylinder block, cylinder head.

### **Activity 5.2.2 Chart Preparation**

Students should prepare the figure of cylinder block and cylinder head.

### **Activity 5.2.3 Group Discussion**

Based on the above demonstration, identification and drawings, the groups discuss the following points:

#### **Discussion Points**

- 1 The function of the cylinder block
- 2 The material used for cylinder block
- 3 The function of the cylinder head
- 4 The material used for cylinder head

After that the students prepare the notes and submit them to the teacher.

## **5.3 Crank case, Sump**

### **Activity 5.3.1 Identification**

The students identify the crank case, sump of a diesel engine in the workshop after dismantling the engine.

### **Activity 5.3.2 Preparation for Drawing**

The figures of crank case and sump are prepared in a neat chart and produced to the teacher.

### **Activity 5.3.3 Group Discussion**

The groups discuss the following points based on the identification and drawings.

#### **Discussion points**

- The function of the crank case
- The material used for crank case
- The function of sump
- The material used for sump

The students should prepare the notes and one among them presents it.

## **54 Piston and Piston Rings**

### **Activity 5.4.1 Identification**

The students identify the piston, piston rings in the workshop.

### **Activity 5.4.2 Chart Preparation**

Students are to draw the figures of piston and piston rings and mark the parts.

### **Activity 5.4.3 Group Discussion**

Based on the identification and the chart, the groups engage in discussion.

#### **Discussion points**

- The function of pistons and various type of pistons
- The materials used for piston
- The function of piston rings, oil rings and compression rings
- The materials used for piston rings
- The terms TDC and BDC, stroke volume, stroke length etc.

### **Activity 5.4.4 Experiment**

In the demonstration of the engine, students locate the TDC and BDC and calculate the volume of cylinder by measuring the diameter of cylinder with various instruments. Also measure the stroke length, cylinder area etc. The readings are noted in a book. Then clearance volume, stroke volume and compression ratio are calculated.

## **5.5 Crank Shaft, Connecting Rod**

### **Activity 5.5.1 Identification**

Identify the crankshaft, connecting rod, crank pin and piston pin in the time of demonstration.

### **Activity 5.5.2 Chart Preparation**

After the identification, the students are to prepare the figure of crank shaft, connecting rod, crank pin, piston pin etc.

### **Activity 5.5.3 Group Discussion**

The students group discuss the points like :

#### **Discussion points**

- The function of crank shaft and its parts
- The material used for the crank shaft
- The function of connecting rod and its shape
- The material used for the connecting rod
- The function of crank pin and the material used
- The function of piston pin and the material used

## **5.6 Bearings**

### **Activity 5.6.1 Identification**

The different types of bearings used in the diesel engine are identified by the students in the demonstration.

### **Activity 5.6.2 Group Discussion**

The students group discuss the points

#### **Discussion points**

- The need of bearings
- The different types of bearing
- Material used for construction etc.

## **5.7 Push Rod, Rocker Arm and Camshaft**

### **Activity 5.7.1 Identification**

The push rod, rocker arm and camshaft are identified by the students in the workshop.

### **Activity 5.7.2 Drawing Preparation**

The drawings of push rod, rocker arm and camshaft are prepared by the students and submitted to the teacher.

### **Activity 5.7.3 Group Discussion**

After the identification and drawing presentation, the groups discuss the points.

#### **Discussion points**

- The function of the push rod and materials used
- The function of the rocker arm and materials used
- The function of the cam shaft and materials and parts used.

## **58 Valve and Valve Guides**

### **Activity 5.8.1 Identification**

At the time of demonstration, the valves in the 4 stroke engine and parts in the 2-stroke engine are identified by the students. In 4-stroke engine the valve guides are also identified. Identify various types of valves in the workshop or collect the different types of valves from the automobile or marine industry.

### **Activity 5.8.2 Chart Preparation**

The students should draw the various types of valves shown in the workshop or in the marine industry.

### **Activity 5.8.3 Group Discussion**

After the identification and chart preparation, the groups conduct a discussion.

#### **Discussion points**

- The functions and need of the valves and different names
- The different types of valves in marine engines
- The working of sodium cooled valves
- The materials used for construction
- The use of valve guide and material used

After the discussion the students should submit the notes and chart to the teacher.

## **59 Oil Pumps and Fuel Injectors**

### **Activity 5.9.1 Identification**

Students should identify the oil pumps and fuel injector of a diesel engine at the time of demonstration.

### **Activity 5.9.2 Drawing Preparation**

Draw the various types of oil pumps, injectors which are shown in demonstration and prepare a chart.

### **Activity 5.9.3 Group Discussion**

The groups discuss the oil pump and injectors. The teacher gives the tips.

#### **Discussion points**

- The necessity of oil pump in diesel engine
- The function of oil pump
- The different types of oil pumps
- The function of fuel injector
- The working of the injector

The students submit the chart and notes to the teacher.

## **5.10 Super Chargers**

### **Activity 5.10.1 Field Trip**

The teacher takes the students to any of the automobile workshops or a marine yard. The students identify the super charger, turbo charger etc.

### **Activity 5.10.2 Group Discussion**

The students group discuss the

- 1 The types of super charger
- 2 The function of super charger, turbo charger
- 3 The difference between the super charger and turbo charger etc.

The teacher moderate the discussion and give some idea about the super charger. The students prepare a report and present the report in the classroom.

## **5.11 Flywheel**

### **Activity 5.11.1 Identification**

Students should identify the flywheel at the time of demonstration.

### **Activity 5.11.2 Chart Preparation**

The students must draw the flywheel shown in the workshop.

### **Activity 5.11.3 Group Discussion**

After the identification and chart preparation, the groups discuss:

- 1 The function and need of the flywheel
- 2 The material used

**UNIT 5**  
**DIESEL ENGINE - PARTS, FUNCTIONS AND MATERIALS**

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>• Diesel Engines</li> </ul>	Parts and functions Materials used Cylinder block Cylinder head Crank case Sump Piston and Rings Crank shaft Connecting rod Bearings Push rod Rocker arm, Camshaft Valve Sodium cooled valve Valve guide	Observation Identification Drawing preparation Defining Calculating	Demonstration Group discussion Identification Drawing Preparation Experiment	2-stroke and 4-stroke diesel engine Chart Steel rule Outside and inside calipers	Participating in discussion Identifying the parts Drawing figures Problem-solving Experiment Participation
<ul style="list-style-type: none"> <li>• Fuel Injector</li> </ul>	Working principle Need Parts	Identification Observing Chart preparing Communicating	Demonstration Group discussion Chart preparation	Injectors Chart	Participating in discussion Chart preparation

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>Oil Pump</li> </ul>	Working principle Different types	Communicating Drawing preparation	Discussion Chart or drawing preparation Assignments	Figures Chart Assignment	Chart preparation Participating in discussion Performance Assignment submission
<ul style="list-style-type: none"> <li>Fly wheel</li> </ul>	Need and function Material used	Communicating Observing Identifying Drawing the figure	Group discussion Identification Drawing preparation	Flywheel Chart	Participating in discussion Performance Chart preparation

# 6. FUEL SYSTEM

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## Introduction

A heat engine is a device which converts heat energy into mechanical work. Heat energy is obtained from chemical energy of the fuel when it is burnt. The main source of engine fuel is crude petroleum. The fuels used in IC Engines are diesel, petrol, CNG, kerosene etc. For storing and supplying the fuel to the engine, storage tank, service tank etc. are required.

## Curriculum Objectives

- To develop a general idea about the fuel system used in diesel engines
- To get familiarised with the various components like storage tank, service tank, fuel feed pump etc.
- To have an idea about fuel injection system like solid injection system and air injection system
- To understand the working of different types of fuel injectors like blast injector, mechanically operated injectors, automatic injectors
- To have a clear understanding about different types of nozzles like single-hole nozzle, multi-hole nozzle, pintle nozzle, pintaux nozzle
- To develop an idea about fuel lines

## Syllabus

- Storage tank, service tank - fuel feed pump - fuel filters - fuel injectors (different types of fuel injectors and principles of working)

## 6.1 Fuel System

### Activity 6.1.1 General Discussion

#### Discussion Points

- type of fuel used
- storage space
- filter
- pump, injector
- fuel line

Divide the students into groups, for group discussion. After general discussion, each group are to submit the discussion points.

### **Activity 6.1.2 Field Trip**

Take the students to an automobile workshop to make them familiar with the basics of fuel system in automobiles. Before the trip, the students should have a basic idea about storage tank, filter, pump, injectors and fuel lines. Divide the students into various groups and each group leader is to present each part of the fuel system in the classroom and finally the teacher is to consolidate about the functions of each part of a fuel system.

## **62 Type of Fuel Injection**

### **Activity 6.2.1 Group Discussion**

The students are divided into groups. Each group is assigned to prepare separate charts and the leader of each group will present the various types of fuel injections like solid injection, air injection. The teacher may suggest some reference books.

## **63 Fuel Injectors**

### **Activity 6.3.1 Demonstration**

A fuel injector is brought to the classroom and dismantled. The teacher demonstrates each part of the injector and the students draw each part and prepare a short note on its working.

### **Activity 6.3.2 Group Discussion**

The students are divided into groups and the following points are discussed --- various components of fuel injectors and their functions, students prepare short notes, make presentation.

## **64 Nozzles**

### **Activity 6.4.1 Chart Preparation**

Divide the students into groups. The teacher may suggest proper references. Each group can prepare drawings on different types of nozzles like single hole nozzle, multihole nozzle, pintle nozzle and pintaux nozzle.

## **65 Fuel Line**

### **Activity 6.5.1 Chart Preparation**

Divide the students into groups. The teacher can guide the students. Using the charts, each group can explain the fuel line and the students can prepare notes

### **Activity 6.5.2 Project**

Using straws and any other suitable material, the students must prepare a still model of the fuel system.

**UNIT 6**

**FUEL SYSTEM**

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>• Fuel System</li> </ul>	General idea Storage tank Service tank Solid injection Air injection Blast injector Mechanically operated automation injector Single hole nozzle Multihole nozzle Pintle nozzle Pintaux nozzle Fuel line	Using the concept in a new situation Communicating Sharing of experience Observing	General discussion Field trip Group discussion Demonstration Chart preparation Presentation Project	Chart Straws Thermocol Wires	Field report Project report Participation in discussion Chart discussion

# 7. LUBRICATING SYSTEM

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## Introduction

Lubrication system is one of the most important parts of an engine. The engine cannot run smoothly without the lubricating oil. The main function of the lubricating system is to keep the moving parts sliding freely past each other and thus reduce the engine friction, wear and tear and also minimise the power loss and provide cooling and cushioning effect. It also includes cleaning and sealing action.

## Curriculum Objectives

- To understand the necessity and functions of lubrication system.
- To study the properties of lubricating oil like viscosity, viscosity index, flash point, pour point, cloud point, fire point, cleanliness, colour, specific gravity etc.
- To go through various types of lubricating systems like petrol, splash, dry sump, semi pressure and full pressure system.
- To familiarise with different types and working of lubricating pumps and filters.

## Syllabus

- Need for lubrication ---- dual effect of lubrication ---- qualities of lubricating units ---- lubricating pump ---- lubricating oil filters

## 7.1 Necessity and Functions of Lubricating System

### Activity 7.1.1 Experiment

Take two flat metal pieces and rub them against each other. Notice the increase in temperature and wear and tear. Discuss the above result. The increase in temperature is due to the friction between the two metal pieces. Do the same experiment by applying water, oil and grease between the metal parts. Notice the changes in the results and compare the results with the result obtained previously.

### **Activity 7.1.2 Experiment**

A bicycle pump without lubricating oil (between the washer and cylinder) is pumped several times. Here the temperature of the cylinder increases. We are not getting the required pressure. But when the lubricating oil is applied to the washer, the oil will act as a sealing between the washer and cylinder resulting high air pressure inside the cylinder, by eliminating leakage.

### **Activity 7.1.3 General Discussion**

After the completion of the above experiments the teacher can have a general discussion with the students. The need and function of lubrication system in an engine can be discussed. The students will write down the discussed points and submit them to the teacher.

## **7.2 Properties of Lubricating Oil**

### **Activity 7.2.1 General Discussion**

The teacher must explain the various properties of lubricating oil like viscosity, viscosity index, flash point, pour point, cloud point, fire point, cleanliness, colour, specific gravity etc. The students should prepare a note based on the above discussion.

## **7.3 Types of Lubricating System**

### **Activity 7.3.1 Chart Preparation**

The students are divided into groups. Each group will prepare a chart of lubricating system like petrol, dry sump, semi pressure, full pressure, splash etc. by using various colours. One among the group should present their activity in the classes and discuss it with the other groups. The advantages and disadvantages, uses etc. of each system should be summarised and checked by the teacher.

## **7.4 Lubricating Pump and Filters**

### **Activity 7.4.1 Chart Preparation**

Groups are created and each group should prepare a chart of the following pumps like gear pump, crescent type- gear pump, rotor pump, plunger pump, and vane pump. (Ref. book: Kripal Singh, *Automobile Engineering*, Volume 2).

### **Activity 7.4.2 Seminar**

A seminar is conducted based on chart preparation above by the group leader. A questionnaire is also prepared by the students and discussed after the seminar.

## **7.5 Oil Filters**

### **Activity 7.5.1 Specimen Collection**

The students should collect the various 'used oil filters' which are used in our automobile industry. They clean the filters and identification of the parts is done with the help of the teacher. Discussion is held and the figures are drawn and submitted to the teacher.

## UNIT 7 LUBRICATING SYSTEM

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>Necessity, functions of lubrication system and lubrication oil properties</li> </ul>	Viscosity Viscosity index Flash point Fire point Pour point Cloud point Cleanliness Colour Specific gravity Need of lubrication system	Experimentation Discussion Observation Communicating	Experiment General discussion	Metal pieces Oil Grease Water Bicycle pump New washer -(2 No's)	Report on discussion Participation in discussion Performing experiments
<ul style="list-style-type: none"> <li>Type of lubricating system</li> </ul>	Petroil splash dry sump semi-pressure full pressure	Communicating Sharing of experience Chart preparation	Group discussion Chart preparation	Charts	Participating in discussion Chart preparation
<ul style="list-style-type: none"> <li>Oil filters and pumps</li> </ul>	Gear pump Crescent pump Rotor pump Plunger pump Vane pump Need of oil filter	Defining Collecting specimen Sharing experience Communicating	Chart preparation Specimen collection Seminar Referencebooks	Chart	Seminar presentation Chart preparation Specimen collection

# 8. COOLING SYSTEM

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## Introduction

Around 20% heat produced by the combustion of fuel in the engine cylinder is converted into useful power at the crank shaft.

Useful work at the crank shaft = 20%

Loss to the cylinder walls = 35%

Loss in exhaust gases = 35%

Loss in friction = 10%

A certain percentage of this heat will increase the temperature of the engine. This increase in temperature will decrease the lubricating properties of the oil. Due to this reason damage to the piston and cylinder will occur resulting in piston seizure. To avoid this problem or to maintain the temperature of the engine in a certain limit, the cooling system is used.

## Curriculum Objectives

- To understand the need for cooling in an internal combustion engine.
- To know the difference between air cooling and water cooling (Sea water cooling and fresh water cooling)
- To have an elementary idea of heat exchanges in marine vessels

## Syllabus

- Necessity of cooling — Internal combustion engine — Air cooling and water cooling (Sea water cooling and fresh water cooling) — Heat exchanger for fresh water cooling

## 8.1 Necessity of Cooling

### Activity 8.1.1 Discussion

The teacher can guide the students to understand the need for cooling in IC engines, citing examples from our day-to-day life.

**Discussion points**

- Home appliances like mixer grinder, electric motor etc. are switched off when it is overheated.
- Overheating of the engine will cause the piston to expand and ultimately the seizure of the piston occurs.

**82 Air Cooling and Water Cooling****Activity 8.2.1 Experiment**

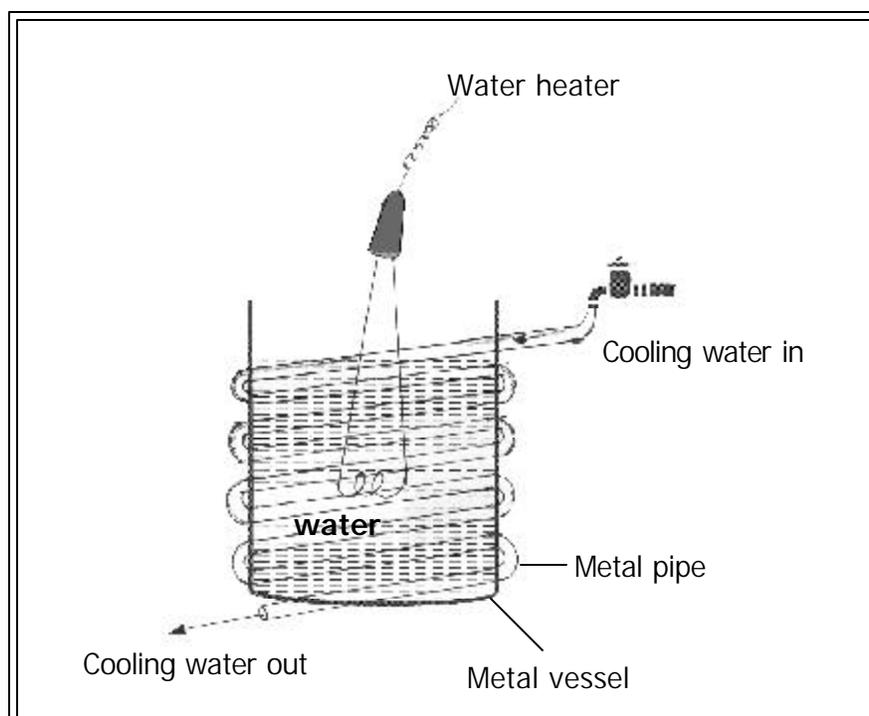
When a hot cup of tea is kept open in the air, it gets cooled gradually. If it is surrounded by water it gets cooled quickly.

**Discussion points**

In water cooling, quantity of heat transferred is more in a shorter period of time. For the same amount of heat transfer in air cooling it will take more time. So in heavy duty engines water cooling and in light duty engines air cooling system are used.

**83 Types of Water Cooling System****Activity 8.3.1 Experiment**

Metal vessel surrounded with metal pipe. One end of the metal pipe is connected to a water tap and other end is opened to outside. Half of the vessel is filled with water. Note down the initial temperature of the water. Then using the water heater, heat water and take temperature readings at 5 minutes' intervals say, 4 readings without using cooling water. Allow the water to cool to attain initial temperature.



Now open tap and allow the cooling water to circulate through the metal pipe. Then heat the water and take 4 reading in 5 minutes' intervals. Using these set of readings, plot a temperature - time graph and discuss the necessity of cooling.

### **Activity 8.3.2 Discussion**

#### **Discussion points**

- Thermo syphon cooling
- Forced or pump cooling
- Cooling with thermostatic regulator
- Pressurised water cooling
- Evaporative cooling

### **Activity 8.3.3 Chart Preparation**

The teacher can divide the students into five groups and each group can prepare a diagrammatic representation of the above systems and one among the group can make a presentation.

## **84 Heat Exchanger**

### **Activity 8.4.1 Discussion**

Discuss parallel flow heat exchanger and counter flow heat exchanger using diagrams.

### **Activity 8.4.2 Project**

Make a model of parallel flow and counter flow heat exchanger using metal pipes of different diameters.

## UNIT 8 COOLING SYSTEM

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>• Cooling System</li> </ul>	Need Air cooling Water cooling Sea water cooling Fresh water cooling	Sharing of experience Observing Defining Chart preparation Experimentation	Discussion Seminar Chart preparation Experiment	Chart Metal pipe Tap Metal vessel Water heater Thermometer	Participation in discussion Seminar report Chart preparation Seminar presentation Participation in experiment
<ul style="list-style-type: none"> <li>• Heat exchanger</li> </ul>	Parallel flow Counter flow	Communicating Observing Chart preparation	Group discussion Project Chart preparation	Chart Metal pipe Thermocol	Project report Project presentation Participating in chart preparation

# 9. STARTING SYSTEM

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## Introduction

The purpose of the starting system is to bring an engine to the required rpm so as to get a continuous cycle of operation. There are mainly three types of starting systems such as hand starting, electric starting and air starting. In hand starting the human power is required for starting the engine. When starting is done with the help of electricity, it is called electric starting. In large marine engines, when both these are not possible, we use high pressure air for cranking. This is called air starting.

## Curriculum Objectives

- To understand various types of starting system used in engine
- To get a clear idea about the hand starting, electric starting and air starting
- To have a knowledge on cold and hot starting

## Syllabus

- Cold starting and Hot starting — Hand, Electric and Air starting — Air compressor

## 9.1 Various Types of Starting System

### Activity 9.1.1 Experiment

Take the students into the workshop and start an engine by rotating crank shaft by using a handle. Before rotating the diesel engine the crank shaft, the decompression lever must be in engaged position. When the engine attains required rpm, decompression lever is disengaged, and the engine starts working continuously. Ask the students to write down the detailed step by step procedure for hand starting and submit the work to the teacher.

### Activity 9.1.2 General Discussion

The teacher divide the students into groups and discuss the various types of hand starting of diesel engine and petrol engine.

### **Discussion points**

- Why the decompression lever is used in diesel engine and not in petrol engine.

#### **Activity 9.1.3 Field Trip**

Field trip to an automobile workshop. Students are taken to an automobile workshop, where starting of both petrol and diesel engine is demonstrated to them. A detailed report and comparison are to be submitted to the teacher.

#### **Activity 9.1.4 Field Trip**

Field trip to marine vessels where air starting is used. The students have to draw the layout of the starting system and explain various parts used in air starting. Mention the air compressor and its working. The report is to be submitted to the teacher and the group leader presents this in the class room.

## **92 Cold and Hot Starting**

### **Activity 9.2.1 Group Discussion**

The students are grouped into two, one group discusses cold starting and the other group hot starting. The teacher gives the guidelines or important points for discussion.

**UNIT 9**  
**STARTING SYSTEM**

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>• Starting system</li> </ul>	Hand starting Electric starting Air starting Cold and Hot starting	Experimentation Defining Comparing Sharing of experience Communicating	Discussion Experiment Field trip	4 stroke hand starting engine 2 stroke hand starting engine Handle	Field trip report, Report of discussion, Knowledge from experience and experiments

# 10. TRANSMISSION SYSTEM

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## Introduction

It is a mechanism that transmits the power from the engine crankshaft to the propeller. There are two types of drives, i.e. Direct drive, Reduction drive etc. In direct drive the speed of the propeller is same as the speed of the crankshaft and the arrangement are in line. But in the case of reduction drive the speed of the propeller is reduced by using a reduction gear at one end of the shaft. The engine shaft and the propeller shaft arrangement is not in the same line. The transmission system consists of propeller shaft, stern tube, stern gland, propeller, intermediate shaft etc.

## Curriculum Objectives

- To understand various methods of transmission of power in marine motor such as direct drive, reduction drive and reduction and reverse drive
- To be familiarised with the components and functions of transmission system
- To understand the installation of transmission system

## Syllabus

- Direct drive - reduction drive - reduction and reverse gear - propeller shaft - intermediate shaft coupling - shaft bearings - stern tube - stern gland - shaft alignment - principles of installation

## 10.1 Direct Drive, Reduction Drive & Reduction and Reverse Drive

### Activity 10.1.1 Field Trip

Field trip to the nearby dockyard, boat yard etc. where the students can get a clear picture of various drives used.

### Activity 10.1.2 Model Making/ Seminar

Students should make a still model/ seminar of what they have seen in the field trip. One among the group makes a presentation.

**Activity 10.1.3 Discussion**

Discuss the components and their functions. Students can be divided into groups and the teacher can guide the students in their discussion topics like propeller shaft, intermediate shaft, coupling, shaft bearing, stern tube, stern gland, propeller leaf types etc. The students make notes and submit them to the teacher.

**10.2 Shaft Alignment**

**Activity 10.2.1 Field Visit**

Observe various types of shaft alignments. Students write down the step by step procedure of installation of transmission system.

**UNIT 10**  
**TRANSMISSION SYSTEM**

Curriculum Objectives	Ideas/ Concepts	Process skills	Activity	Materials/ Learning Aids	Evaluation
<ul style="list-style-type: none"> <li>• Transmission system</li> </ul>	Direct drive Reduction drive Reduction and reverse drive Components and functions Installation	Defining Comparing Interpreting Communicating Model making Chart drawing Presentation	Field trip Model making Discussion Chart preparation	Discussion in chart	Field visit report presentation, Participation in discussion. Seminar presentation Seminar Preparation

**PART III**

# SAMPLE QUESTIONS

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- 1 Suppose you are asked to design two engines with the same engine capacity. One engine must have more power not considering mileage. Other engine must have more mileage not considering power. How can it possible?
- 2 You are dismantling an engine, you cannot find valves in that engine. State the reasons.
- 3 You are driving a marine vessel, suddenly you are noticing that the engine temperature rises. Try to find out the reasons.
- 4 You are given two engines with the same engines with same capacity. One engine having a lighter flywheel and the other engine having a heavy flywheel. State the reasons.
- 5 When you are driving a vehicle, suddenly engine stops due to piston seizures. Try to find out the reasons.
- 6 If you are dismantling the boat transmission system, you can see that the transmission shaft was made of different materials. Give the reasons.

## **Suggested Assignment Topics**

- 1 Finding out the specific volume of at least five different  
(a) materials like Al, Fe, Cu, etc.  
(b) Finding out the density of petrol, diesel, kerosene, coconut oil and water
- 2 Classification of IC Engines
- 3 Important parts of four-stroke petrol/ diesel engine
- 4 Working of four-stroke petrol/ diesel engine
- 5 Important parts of two-stroke petrol/ diesel engine
- 6 Working of two-stroke petrol engine/ diesel engine
- 7 Simple carburettor
- 8 Superchargers - various types
- 9 The working of different types of oil pumps
- 10 The parts and their functions of fuel injectors
- 11 Different types of lubricating system
- 12 Starting system - various types
- 13 Different types of cooling systems
- 14 Different types of transmission systems

## **Suggested Seminar Topics**

- 1 Modern Marine Engines :- parts
- 2 Carburettors
- 3 Superchargers
- 4 Latest oil pumps
- 5 Fuel injectors
- 6 Lubrication systems
- 7 Various starting systems
- 8 Recent transmission systems

## **Suggested Project Topics**

- 1 Zeroth Law
- 2 Battery coil ignition system
- 3 Compare the result obtained by Battery coil and Magneto coil system
- 4 Cut model of diesel engine (wooden)
- 4 Fuel system by using thermocol and straws etc.
- 5 Transmission system - (Direct drive, Reduction drive and Reduction and Reverse Gear drive). Compare engine speed with different types of drive, and direction of rotation propeller shaft.
- 6 Study oil filter by using different filter materials.

## **Reference Books**

- Automobile Engineering Vol I and II : Kripal Singh
- Internal Combustion Engines : Mathur and Sharma
- Fishing Craft & Gear Technology : Y.Sreekrishna & Latha Shenoy