6.1 EARTH MOVING EQUIPMENT

RATIONALE

A diploma holder in Automobile Engineering has to deal with repair and maintenance of heavy earthmoving vehicles. The subject provides basic understanding of such special vehicles.

DETAILED CONTENTS

1. Earth Moving Equipment (12 hrs)

   Function, classification, constructional features and applications of the following earth moving machinery: Excavator, scrapper, ripper, dragline, grader, shovel, trailer, loader, dozer. Equipment used - drill, ripper, crusher, feeder, compressor, snow remover. Tractor types. Difference in each type of engine used, features of clutch, power transmission, track chains, sprockets, springs and blades.

   Working principal and design considerations of different systems involved like power system, transmission system, final drive, lubrication system, electrical system, braking system, steering system and pneumatic and hydraulic control circuits of earth moving equipment.

2. Hoisting Equipment (10hrs)

   Description of hoist winch, part lines, hoisting chains, slings, fork-lift truck, cranes (hand operated type electric overhead travelling type), Jacks (hydraulic, mechanical), bucket elevators. Factors affecting the selection of hoisting equipment.

3. Rollers (8 hrs)

   Types of rollers, type of engines used for rollers. Chassis, power transmission, steering, braking and other features.
4. **Pneumatic Equipment**

(8 hrs)

Function and salient features of pneumatic tools-rock drill, hammer, chipper. Air operated grease gun and spray gun

5. **Calculation of hire charges for various types of earth moving equipment** (10hrs)

Practicals:

Students have to visit and collect the data from workshops or authorized service centers where these heavy earth moving equipments are repaired and/or constructional sites where these equipments are used.

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RATIONALE

The tractor is an important source of power on the farm and is used to perform various agricultural operations. The students need to be fully familiar with the various components, sub-assemblies, their operations, their location on the tractor and their importance to the tractor. The subject will equip the students with complete understanding of the tractor and enable them to handle these effectively and efficiently. This subject will also help the students to run the tractor and machinery system whether state owned or as a part of custom-hiring centre.

DETAILED CONTENTS

- Introduction (2 hrs)
  Classification and types of tractors for farm operations such as orchards, row crops etc., two and four wheel drives

- I.C. Engines (20 hrs)
  Principle:

  Valve system: Types of valve, function of different parts of valve system, effects of incorrect valve timing, valve clearance and its adjustment. Scavenging system ratio and efficiency.

  Fuel supply system: System of fuel supply in petrol and diesel engines, and their components, construction and working of simple compensating and Zenith carburetor, adjustments in carburetor, specific fuel consumption.

  Fuel injection: Method of injection, construction and working of fuel injection pump, injector, atomizer, type of nozzles

  Air cleaner: Importance of clean air in engine, characteristics of air cleaner, type of air cleaner, their construction and working, maintenance of air cleaner

  Ignition system: Ignition method, electric spark ignition, battery and
System of Tractors
Components of electrical systems viz. battery, starter switch, self starter, motor, dynamo: their construction, functions, operation; maintenance and care of the battery.

Economics, Selection and Safety of Tractors (5 hrs)
Various factors affecting the right selection of a tractor. Safety measures in the operation of tractor, cost analysis of use of tractors.

Tractor Testing (5hrs)
Traction, Terms related to traction- Traction efficiency, coefficient of traction, rolling resistance, slip, rim pull. Tractor testing stations, test conditions, general requirements for testing a tractor. Type of tests. BIS and ISO standards.

2.7 Governing system: Governing hit and miss system, throttle system, centrifugal and pneumatic governor, governor hunting and governor regulations

2.8 Lubricating system: Importance, function and quality of lubricant. Types of lubricants used in engine, sources of lubricants, selection of lubricants, splash system internal forced feed and splash system, oil filter

2.9 Cooling system: Importance and method of cooling system and function of thermostat valve.

3. Power Transmission System of Tractors (10 hrs)
Functions and various components of power train. Clutch; functions of clutch, type of clutch(single plate, dual plate and multi disc clutch). Gear box; function and working of gear box, types of gear boxes (sliding, constant mesh and synchromesh gears). Differential and differential lock; function and constructional details. Final drive; reduction gear and rear axle. Power take off shaft and drive to the PTO shaft.

4. Braking System (4 hrs)
Importance and function of brakes, various types of brakes viz. mechanical and hydraulic and their working.

5. Wheels and Tyres of Tractors (3 hrs)

6. Hydraulic System (6 hrs)
Principles and working of hydraulic system. Various components and working of hydraulic system of tractor. Position control, draft control and mix control. Various components of hitching system of tractors viz. 3-point linkage, drawbar

7. Steering System of Tractors  

Functions and components of steering systems. Types of steering gear boxes in different type of steering systems, power steering. Working of different types of steering systems. Familiarity with the concepts of toe-in, toe-out, camber angle, caster angle and king pin inclination.

8. Electrical System of Tractors

Components of electrical systems viz. battery, starter switch, self starter, motor, dynamo: their construction, functions, operation; maintenance and care of the battery.

9. Economics, Selection and Safety of Tractors

Various factors affecting the right selection of a tractor. Safety measures in the operation of tractor, cost analysis of use of tractors.

10. Tractor Testing

Traction, Terms related to traction- Traction efficiency, coefficient of traction, rolling resistance, slip, rim pull. Tractor testing stations, test conditions, general requirements for testing a tractor. Type of tests. BIS and ISO standards.

LIST OF PRACTICALS

1. Familiarization with different gauges and controls of tractors and pre starting checks

2. Study of components and working of engine: two and four stroke cycle engines

3. Study of valve arrangement, valve tuning and firing order, valve grinding and setting of valve timing

4. Study of diesel fuel supply systems, air bleeding

5. Study of battery, periodic battery care, ignition system and spark plug adjustment

6. Study of cooling system in tractors and stationary engines

7. Study and servicing of lubrication system

8. Study of carburetion


11. Brake and steering – dismantling and study of their components.

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RATIONAL

This is a practice-oriented subject, which will create the ability and develop the skill to carry out different agricultural operations for raising the crops using tractors and matching farm equipment. It will also enable the students to handle and operate the machines and implements used for crop production and carry out the minor repair and adjustments of machines for effective and efficient machinery usage.

DETAILED CONTENTS

1. Familiarization with different gauges and controls of tractors, pre operational checks and precautions
2. Tractor driving practices without implements in limited space like L shape, Circle, “8” etc.
3. Tractor trolley reversing in limited space and turning.
4. Operation of primary tillage equipment in field. Controlling the speed of operation, gear selection, adjustments in the machine for different operations
5. Operation of secondary tillage equipment, seed bed preparation, gear selection, adjustments in machine desired results.
6. Operation of sowing and planting equipment, gear selection, adjustments in the machine for proper seed placement, calibration for proper seed and fertilizer application and care of machines.
7. Operating various plant protection equipment, adjustments, nozzle calibration, and care of equipment and precautions
8. Familiarization of power tillers and their controls, operations of equipment with power tillers with care of machines and precautions.
9. Measurement of speed, slip, draft, field efficiency, field capacity & fuel consumption of tractor during field operations.
6.4 PRODUCTION TECHNOLOGY-II

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RATIONALE
This subject provides knowledge of various metal forming processes viz. press working, forging, rolling, modern machining processes, jig and fixtures, plastic processes, coating processes and finishing processes which is required for mechanical diploma holders to work in manufacturing industries.

DETAILED CONTENTS

1. Metal Forming Processes
   1.1 Press Working
      1.1.1 Press working –
      Types of presses, type of dies, selection of press die, die material
      1.1.2 Press Operations-
      Shearing, piercing, trimming, punching, notching, shaving, gearing, embossing, stamping
   1.2 Forging
      1.2.1 Open die forging, closed die forging
      1.2.2 Press forging, upset forging, swaging, up setters, roll forging
      1.2.3 Cold and hot forging
   1.3 Rolling
      1.3.1 Elementary theory of rolling
      1.3.2 Types of rolling mills
      1.3.3 Thread rolling, roll passes
      1.3.4 Rolling defects and remedies
   1.4 Extrusion and Drawing
      1.4.1 Type of extrusion- Hot and Cold, Direct and indirect
      1.4.2 Pipe drawing, tube drawing

2. Modern Machining Processes
   2.1 Mechanical Process
      2.1.1 Ultrasonic machining (USM): Introduction, principle, process, advantages
   2.2 Electro Chemical Processes
      2.2.1 Electro chemical machining (ECM) – Fundamental principle, process, applications
      2.2.2 Electro chemical Grinding (ECG) – Fundamental principle, process, application
   2.3 Electrical Discharge Machining (EDM)
      2.3.1 Introduction, basic EDM circuit
      2.3.2 Principle, metal removing rate, dielectric fluid, applications
   2.4 Laser beam machining (LBM) – Introduction, machining process and applications
   2.5 Electro beam machining (EBM)- Introduction, principle, process
2.6 Plasma arc machining (PAM) and welding – Introduction, principle process and applications

3. Jigs and Fixtures
3.1 Importance and use of jigs and fixtures
3.2 Principle of location
3.3 Locating devices
3.4 Clamping devices
3.5 Types of Jigs – Drilling jigs, bushes, template jigs, plate jig, channel jig, leaf jig.
3.6 Fixture for milling
3.7 Advantages of jigs and fixtures

Plastic Processes
4.1 Injection moulding – working principle, advantages and limitations
4.2 Blow moulding – working principle, advantages and limitations
4.3 Compression moulding – Working principle, advantages and limitations

5. Metallic and Non Metallic Coating Processes
5.1 Metal spraying – Wire process, powder process, applications
5.2 Electro plating, anodizing and galvanizing
5.3 Organic coatings- oil base paint, rubber base coating
5.4 Properties and uses of varnishes, paints including primers and enamels

Metal Finishing Processes
6.1 Purpose of finishing surfaces.
6.2 Surface roughness-Definition and units
6.3 Honing Process, its applications
6.4 Description of hones.
6.5 Brief idea of honing machines.
6.6 Lapping process, its applications.

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Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given for a group. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry may be preferred.

Each teacher is expected to guide the project work of 5-6 students.

- Projects related to repair and maintenance of automobiles
- Projects related to increasing productivity
- Projects related to quality assurance
- Projects related to estimation and economics of production
- Projects connected with repair and maintenance of plant and equipment
- Projects related to identification of raw material thereby reducing the wastage
- Any other related problems of interest of host industry

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Performance criteria</th>
<th>Max. marks</th>
<th>Rating Scale</th>
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<tr>
<td></td>
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<td>Excellent</td>
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<td>1.</td>
<td>Selection of project assignment</td>
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<td>2.</td>
<td>Planning and execution of considerations</td>
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<td>3.</td>
<td>Quality of performance</td>
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<td>4.</td>
<td>Providing solution of the problems or production of final product</td>
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<td>5.</td>
<td>Sense of responsibility</td>
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<td>6.</td>
<td>Self expression/communication skills</td>
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<td>7.</td>
<td>Interpersonal skills/human relations</td>
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The overall grading of the practical training shall be made as per following table

<table>
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<th>Range of maximum marks</th>
<th>Overall grade</th>
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<tr>
<td>i) More than 80</td>
<td>Excellent</td>
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<tr>
<td>ii) 65-80</td>
<td>Very good</td>
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<td>iii) 50-64</td>
<td>Good</td>
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<td>iv) 41-49</td>
<td>Fair</td>
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<tr>
<td>v) Less than 40</td>
<td>Poor</td>
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In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance of undergoing 8-10 weeks of project oriented/project work professional training in the same industry and re-evaluated before being disqualified and declared “not eligible to receive diploma”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

**Important Notes**

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organizations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.
6.6 EMPLOYABLE SKILLS

RATIONALE

Diploma holders are required to not only possess subject related knowledge but also soft skills to get good jobs and to rise steadily at their workplace. This subject is included to develop employability skills amongst the students.

DETAILED CONTENTS

1. Industrial Scenario Engineering Education and expectations of competences from an engineer by employer (04 periods)

2. Personality types, characteristic and features for a successful engineer (04 periods)

3. Professional Engineer desirable values and ethics and their development. Relation between engineering profession, society and environment (04 periods)

4. Managing project (16 periods)
   • Leadership
   • Motivation
   • Time management
   • Resource management
   • Computer Software
   • Interpersonal relationship
   • Engineer economics and fundamentals

5. Effective Communication (08 periods)
   • Listening
   • Speaking
   • Writing
   • Presentation Technique/Seminar
   • Group discussion

6. Preparing for Employment (08 periods)
   • Searching for job/job hunting
   • Resume Writing
   • Interview technique in personal interview telephonic interview, panel interview, group interview, video conference

7. Managing Self (06 periods)
- Managers body, mind, emotion and spirit
- Stress Management
- Conflict resolution

8. Continuing professional development (04 periods)
   - Organising learning and knowledge
   - Use of computer for organising knowledge resource

9. Creativity, Innovation and Intellectual property right (06 periods)
   - Concept and need in present time for an engineer

10. Basic rules, laws and norms to be adhered by engineers during their working (04 periods)

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