CURRICULUM REVISION PROJECT

2012

TEACHER GUIDE FOR

MATERIALS AND MANUFACTURING PROCESSESS (17306)

THIRD SEMESTER AUTOMIBILE ENGINEERING

JUNE 2013

MAHARASHTRA STATE
BOARD OF TECHNICAL EDUCATION, Mumbai

I N D E X

1. APPROACH TO CURRICULUM DESIGN

1.1 Background:

MSBTE is introducing the revised curriculum from the academic year 2012-13.

There are many institutions in the state running different diploma courses. In order to ensure uniform and effective implementation of the curriculum it is necessary that every teacher is aware of approach for curriculum design, educational principles to be adopted, learning resources to be used and evaluation methods. The teacher guide prepared for each subject will provide the inputs related to above mentioned aspects to achieve uniform and effective implementation of curriculum of various subjects.

1.2 CURRICULUM PHILOSOPHY

MSBTE has adopted systems approach while designing the scientific based curriculum since 1995. The same approach has been adopted while revising the curriculum in semester pattern.

Fig. No. 1 shows the systems diagram. This diagram provides the holistic view for curriculum designing, development, implementation and evaluation

The input to polytechnic education system is the students having 10+ qualifications. The teaching learning process occurs in the institution for six/eight semesters. The output of the system i. e. Diploma pass out is normally the input to industries. (Some students do go for higher education). While designing the curriculum the expectations of the industries play a major role. Due to globalization and competition the industries expect that pass outs have generic and technological skills along with right attitude.

To fulfill the needs derived from systems approach following conceptual framework is considered:

1.3 Curriculum:

"Curriculum is an educational program designed and implemented to achieve specified educational objectives"

This definition takes into account the fact that

- Education is purposeful
- There is an organized plan of action contemplated
- Such a plan is translated into action through appropriate strategies of implementation.

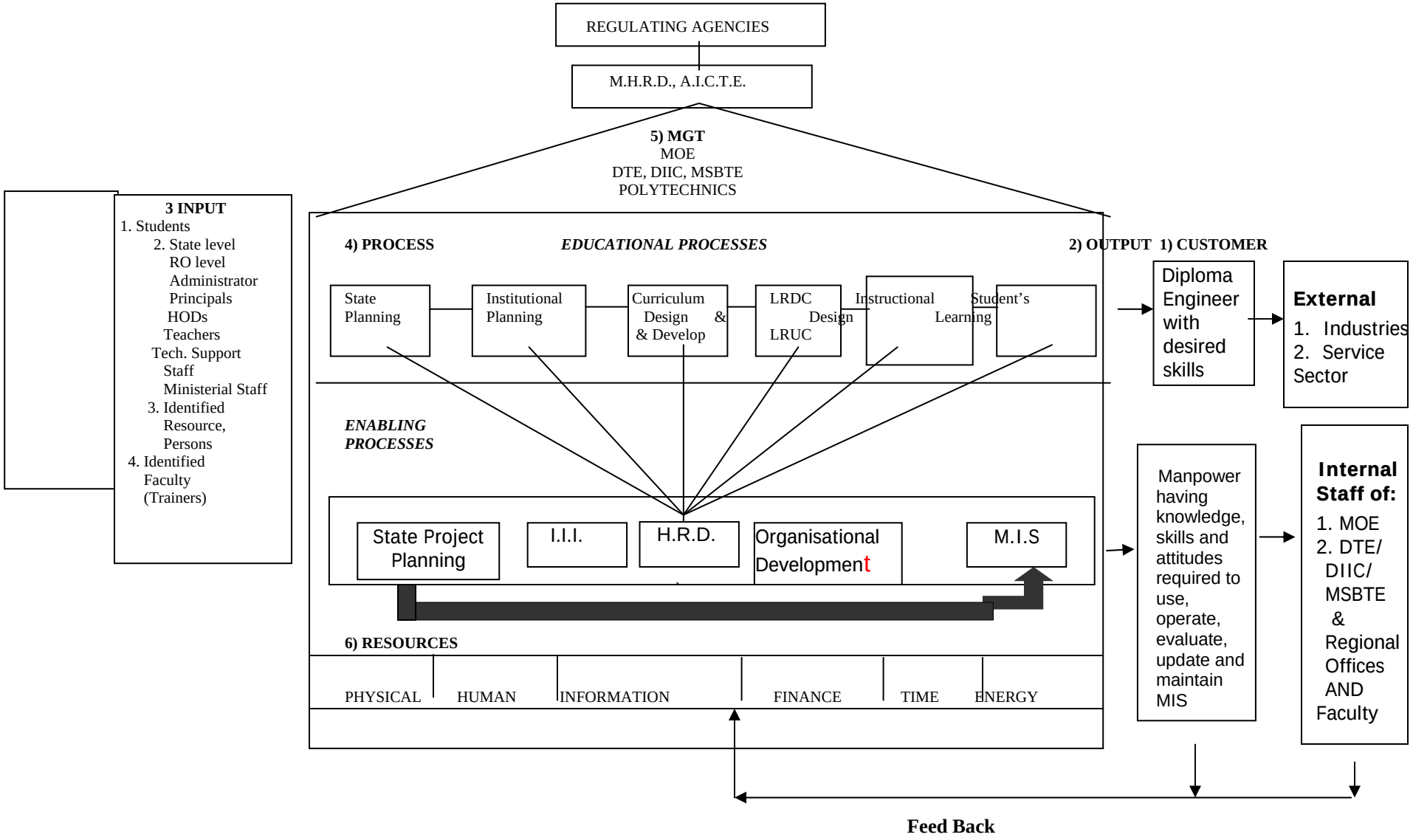


Fig 1 Systems Approach

1.4 Curriculum goals

1. To develop confidence in students by providing more exposure to industry experience and world of work at global level.
2. To provide conceptual knowledge and develop analytical ability
3. To develop communication skill with good English by providing sufficient practice
4. To enhance latest technical knowledge industry interaction and media
5. To develop learning to learn skills and life skills to cope up with industrial culture
6. To impart managerial skills by providing appropriate theoretical inputs
7. To develop problem solving ability through technical projects.

DESIRED SKILLS

Industries expect from the diploma engineer the abilities and skills of general nature and specific to the job performance. The curriculum aims at developing life skills and technological skills so that the diploma pass outs would be suitable for industry. The skills are listed below:

Life Skills:

- Search information from various sources
- Develop communication ability
- Develop Presentation skill
- Work as a member of a team/group and as leader
- Collect field data
- Develop Learning to learn
- Write report for given task/work/project
- Develop computer proficiency
- Develop observation skills

Technological Skills:

Diploma engineers should possess following Technological skills in order to satisfactorily perform duties assigned to them:

A) **Intellectual Skills**:

- Reading and interpretation of production drawings
- Planning for materials, tools, processes and quality control techniques.
- Use of Operation and Maintenance Manuals
- Operation of new equipment, machinery and instruments like CNC, PLC, controllers, Robotics, EDM, ECM, laser cutting/welding, etc
- Use of CAD for 2D drawings and familiarity with CAD software like Idea, Catia, Pro-E etc (Awareness level)
- Use of Moderns manufacturing techniques used in industry like 5S, Six sigma, TQM, TPM, ZD, JIT, Kanban, Poka-Yoke, Quality Control Charts, Reliability engineering, etc.
- Design of Machine Element
- Problem solving skills
- Cost Reduction techniques
- Use of standards (ISO-9000, QS14000, etc)

B) Motor Skills:

- Maintenance of modern equipments and machineries
- Develop drafting Skills
- Operate Lathes, Drilling Machines, CNC Machines, Milling amd Shaping Machines, Grinding Machines,
- Test Machine Performance
- Draw sketches of Civil engineering structures
- Carry out In process gauging
- Setting up of Automatic machines

1.5 Salient Changes in the curriculum:

❖ For First Semester Basic Science is divided into two parts- Basic Physics and Basic Chemistry. Theory examination of both parts as well as practical examination of both parts will be conducted on separate days. Sum of theory marks of both parts shall be considered for passing theory examination of Basic Science. Similarly it is applicable to practical examination. It is mandatory to appear for theory and practical examination of both parts. Candidate remaining absent in any examination of any section will not be declared successful for that exam head.

❖ For second semester Applied Science is divided into two sections- Applied Physics and Applied Chemistry where the theory examination of 50 marks each and practical examination of 25 Marks each will be conducted separately and the minimum passing marks

for Engineering Science will be the combination of both the sections. . It is mandatory to appear for theory and practical examination of both parts. Candidate remaining absent in any examination of any section will not be declared successful for that exam head.

- The components of Development of Life Skills were taught in two semesters. In Development of Life Skills –I the topics related to personal development, such as Learning to Learn Skills, personality development, presentation skills etc. were included. In Development of Life Skills – II the topics related to Team Building, Leadership, group behavior etc. were covered. In the revised curriculum the scope of development of life skills has been broaden to include behavioral science component. Therefore the subject Development of Life Skills – II has been renamed and it is now included at Vth Semester in the revised curriculum under the title Behavioral Science.
- The subject of Professional Practices was introduced to integrate the skills acquired in Development of Life Skills, through technical subjects from second to sixth semester. The experience in implementing the contents of the subject shows that there are limited activities possible in second semester as the technical knowledge given to the students is very limited. Also at sixth semester the student are doing projects in which they are performing many activities included in the Professional Practices and therefore it is proposed that the subject of Professional Practices be prescribed only for three semesters vis. Third, fourth and fifth semesters.
- Introduction of Environment Engineering at fourth Semester for all courses
- From the experience of implementation of Elective Subjects at V and VI semesters in last five years, it is proposed to have only one elective either at the fifth and sixth semesters for all courses. However the specialized courses like Medical Electronics, Electronics and Video Engineering will not have provision for electives. For elective, student will have to choose one from the given two/three subjects.
- While revising the curriculum redundant /obsolete topics/sub topics are being replaced by new/advance technology topics/sub topics.
- In Mechanical Engineering Group CADD, 3D Modelling, CNC Machines, Engine Maintenance (AUTO) are introduced as independent subjects.

2. OBJECTIVES

2.1 Introduction

Objectives are the statements which describe the expected learning outcome. Such statements enable teachers to plan instructional process with appropriate resources. These objectives also provide a direction to frame proper questions to assess the learning outcome.

During last decade there has been research on cognitive approach in psychology. This approach is based on biological structure of brain and meta-cognitive knowledge dimension. Important elements of this approach which form basics of learning are explained below.

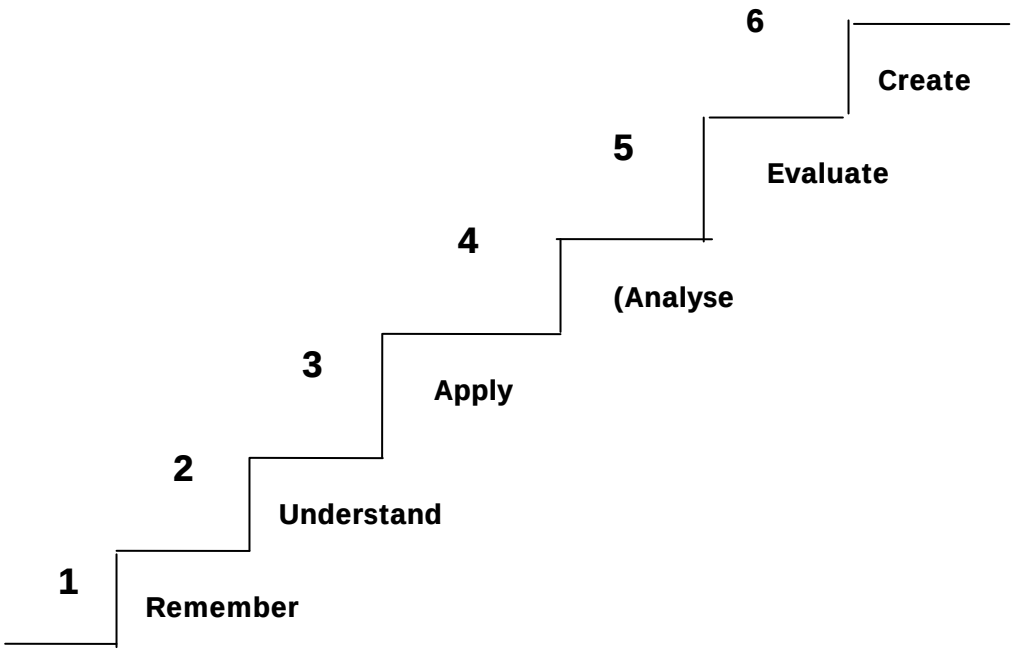
2.4 LEVELS OF LEARNING:

Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for the purpose of writing objectives and assessment. Dr. Bloom's revised taxonomy is based on cognitive psychology and is two dimensional. First dimension is cognitive process dimension ad other is knowledge dimension. Details of these two dimensions are given below.

2.4.1 Cognitive Domain:

Dr. Benjamin Bloom (1956) analysed questions asked in various examinations in American situation and proposed a hierarchical arrangement of instructional objectives (Intellectual abilities) tested by these questions.

The lowest level of cognitive learning achieved by a student is demonstrated by the recall of information that the student retrieves from his long term memory. So, the storage and retrieval of specific facts, concepts, principles, laws, definitions, properties, procedures etc. directly from memory was classified as a knowledge level objective. Thus questions testing memory of students were treated as at the lowest level of the hierarchy of intellectual abilities. The other levels of hierarchy proposed by Dr. Bloom in 1956 relate to the degree of information processing required in the brain needed to provide answer to a question. The various levels in the cognitive hierarchy proposed by Dr. Bloom in 1956 and further revised in 2001 are given below in the diagrammatic form.



Following are the details of each level which indicate the general and specific objectives. Further appropriate verbs are given which are useful in setting good questions. In this table only four levels are considered for diploma students.

Description of the Major Levels in the cognitive Domain (Bloom's Taxonomy)	Illustrative General Instructional Objectives	Illustrative verbs for stating specific learning outcomes
Remember – Knowledge is defined as the remembering of previously learned material. This may involve the recall of a wide range of material, from specific facts to complete theories, but all that is required to mind of the appropriate information. This represents the lowest level of learning outcomes in the cognitive domain	Knows common terms, specific facts, basic concepts, principles, methods & procedures	Define, describe, identify label, list, match, name, outline, reproduce, select, state
Understand – This is defined as the ability to grasp the meaning of material. This may be shown by translating material from one form to another (words or numbers) by	Understands fact, principles Interprets verbal material, Interprets charts, tables,	Convert, distinguish estimate, explain, extend, generalize,

interpreting material (explaining or summarizing), and by estimating future trends (predicting consequences or effects). Draw sketches these learning outcomes go one step beyond the simple remembering of material and represent the lowest level of understanding.	graphs. Translates verbal material to mathematical formula. Estimates consequences implied in data. Justifies methods & procedures.	give examples; infer, paraphrase, predict, rewrite, summarize, draw labeled sketches.
Apply – Application refers to the ability to use learned material in new and concrete situations. This may include the application of such things as concepts, principles, rules, methods, laws and theories. Learning outcomes in this area require a higher level of understanding than those under the level described earlier.	Applies principles to new situations. Applies theories to practical situations. Solves mathematical problem. Construct charts, graphs Demonstrates correct usage of a procedure	Change, compile, demonstrate, discover manipulate, modify operate, predict, prepare, produce, show, solve, use.
Analyze – Analysis refers to the ability to break down material into its component parts so that its organizational structure may be understood. This may include the identification of the parts, analysis of the relationship between parts, and recognition of the organizational principles involved. Learning outcomes here represent a higher intellectual level than "understand" and apply because they require an understanding of both the content and the structural form of the material.	Recognizes unstated assumptions and logical fallacies in reasoning. Distinguishes between facts and inferences. Evaluates relevance/ adequacy of data.	Breakdown, diagram, differentiate, discriminate, distinguish, identify illustrate, infer, outline, point out, relate, select, separate, subdivide.

2.4.2 Categories of Knowledge Dimension

After considering the various designations of knowledge types, especially developments in cognitive psychology that have taken place since the original framework of Bloom's taxonomy, knowledge is categorised in 4 types – Factual , Conceptual, Procedural and Meta-cognitive.

Factual Knowledge (A) is knowledge of discrete, isolated content elements. It includes knowledge of terminology and knowledge of specific details and elements. In contrast,

Conceptual Knowledge (B) is knowledge of "more complex, organised knowledge form". It includes knowledge of classifications and categories, principles and generalizations and theories, models and structures.

Procedural Knowledge (C) is "knowledge of how to do something". It includes knowledge of skills and algorithms, techniques and methods, as well as knowledge of

criteria used to determine and/or justify "when to do what" within specific fields and disciplines.

Meta-cognitive knowledge (D) is "knowledge about cognition in general as well as awareness of and knowledge about one's own cognition. It encompasses strategic knowledge, knowledge about cognitive tasks, including contextual and conditional knowledge; and self-knowledge".

Assessment is required to be done on the basis of categories of knowledge and levels of learning. Table below indicates the two dimensional grid based on Blooms Taxonomy for setting questions.

Knowledge Dimension	COGNITIVE PROCESS DIMENSION			
	1 Remember	2 Understand	3 Apply	4 Analyze
A. Factual Knowledge				
B. Conceptual Knowledge				
C. Procedural Knowledge				
D. Meta-cognitive Knowledge				

2.5 Components of Curriculum:

2.5.1 Rationale: It indicates the logical basis for the inclusion of the subject in the curriculum It also indicates the importance of the subject related to entire curriculum.

Importance of the subject is on two counts:

One the knowledge gained while studying the subject helps understand and develop further knowledge of the subject or understand and effectively learn the higher level subjects.

The other indicates how the knowledge gained can be used in the world of work to perform given tasks.

Rationale tells the students the connection of subjects related to study of higher level subjects and also the us in their job/profession.

2.5.2 Objectives: Objectives indicate what the student will be to do/perform after he completes the study of the subject. It also in other words indicate the scope of the subject.

Objectives indicate what is achievable and hence gives direction ot the student about how to study the subject, what important things are to be observed and performed during practicals.

Just as rationale indicates the use of the knowledge gained while studing the subject, objectives indicate how efficiently and effectively one can work if the objectives are fulfilled while studying the subject.

2.5.3 Learning Structure: It graphically/pictorially indicates the content of the curriculum of the subject and what is to be learnt in the subject. As you know that in Cognitive Domain knowledge is divided in four components Factual, Conceptual, Procedural and Metacognitive. Of this Factual, Conceptual and Procedural knowledge components are identified in the curriculum of the subject along with the applications. Learning structure gives broad idea of these components for a subject. It indicates the scope of the subject. Normally we first decide what we want to achieve by studying the subject, which forms the application component. Based on this we decide what procedures are required for these applications.

Facts, Concepts, Principles are used in developing procedures and applications. So these are given sequentially below procedure as Principles, Concepts and Facts in their order. Learning structure also provide an idea about how to develop the subject logically to achieve the objectives.

2.5.4 Contents: List of topics and subtopics to be included in the curriculum of the subject is given in the contents. This helps in achieving the rationale and objectives identified. Contents indicate the importance of the topics, sub topics in development of the subject and accordingly weightages in terms of Hours required to teach the subject components, so that the desired learning takes place. Marks to be allotted while testing the knowledge gained by the student are also indicated.

One has to be careful in allotting the hours required to teach the topics looking at the importance of the topic for development of the subject. There fore it is necessary to provide sufficient time to teach concepts and principles so that they are well understood by the students as they form the basis for development of the subject.

2.5.5 Practicals: While designing the curriculum the objectives are identified. To achieve these objectives students have to develop certain intellectual and motor skills. These skills are developed through well designed Practicals. So in the curriculum the list of the skills to be developed through Practicals is given. The list of Practicals is so developed that after performing the Practicals identified skills will be developed. Here it is necessary that the teacher gives enough opportunity to all the students to perform the practical properly to develop the skills in each one of them.

The skills will be developed if the students actually perform certain activities or tasks. Therefore it is necessary that any practical included in the curriculum necessarily involve some activities to be done by the students. So there should not be any study type experiment as it is nothing but repetition of what is taught in the theory class. So one has to think and innovate to modify the study experiments so that students will be asked to perform some activity. It could be in terms of identifying components, listing of materials used for manufacturing the components, stating importance of use of certain materials etc.

So any curriculum of a subject is so designed that it achieves the objectives of that subject as well fulfill the objectives of the entire curriculum.

3. CONTENT ANALYSIS

3.1 Components of Content Analysis:

As we have discussed earlier, any curriculum or syllabus of a SUBJECT given to the teacher is organised in terms of UNITS which include TOPICS or SUB-TOPICS as the case may be indicating the TIME in which it is expected to be taught to the students. Components of a topic or part thereof are analysed here at a micro level.

Before we begin actual teaching of any topic (lesson), we must carefully and critically analyse it so that we can plan for teaching - select appropriate media, methods and techniques of teaching and arrange the suitable resources to be required. This analysis of the content of a Topic results in identification of the following components of the content:

1. Facts
2. Concepts
3. Principles (rules, laws, theories)
4. Applications
5. Procedures
6. Skills (Psychomotor Skills), and
7. Attitudes (underlying affective behaviors as quite often these are not specifically mentioned in the curriculum, still they are to be developed lesson after lesson gradually).

When we undertake the exercise of content analysis, we ourselves understand the subject fully well and at the same time we become clear as to what we are going to teach. It also gives us an idea as to which methods of teaching and media of instruction we should prepare and use and also what resources including time we will require. This analysis will also enable us to design assignments as well as how we are going to assess students learning.

Since the nature of the components of content (I to 7) differs from one another. These are learned by the students differently as different mental processes are involved in learning these components. The immediate implication of this varying nature of components is that these need to be taught differently and assessed differently. For example, if you look at components I to 5 all of which belong to Cognitive Domain of Learning; Component 6 belongs to Psychomotor Domain and Component 7 belongs to Affective Domain (cannot be taught as these attitudes are caught), you will find that these differ from one another. The classification of human behaviors (activities) into the above three domains of learning entails the use of entirely different methods and media of instruction. Different locations of learning (classroom, laboratories, workshops, field visits) need to be selected.

Now we will discuss these components in some detail and see how each one of these should be taught and assessed differently.

3.1.1 FACTS:

These are universally accepted and commonly understood items about which there cannot be much argument and discussion. These are required only to be informed. For example: The sun rises in east and sets in the west; names of scientists and the year in which their theories were propounded; the rules and regulations of admission and examination prescribed by the University are some of the examples of facts. Sometimes, they need not be emphasised in the class as the students already know them. But information can be passed on by word of mouth, if deemed necessary.

3.1.2 CONCEPTS:

A concept is an abstraction or an idea that permits the learner to classify a variety of related phenomena into a convenient and meaningful category. Concept of something is like a picture formation of that thing which helps in conceptualizing it. Gagne says that concept learning produces a certain fundamental change in human performance that is independent of subject or content. Concepts can be divided into the following two categories:

1. **Concrete Concepts:** those which can be seen, touched and manipulated e.g. Materials, Manufacturing Processes, Heat treatment processes, patterns, molding processes, casting processes, cutting tools, and machine tools .

2. **Abstract Concepts:** those which cannot be seen and touched and handled but can only be imagined e.g. working principle of casting, working principle of lathe including shear of metal. Teaching of concrete concepts is not that difficult because the teacher can show the object physically or its picture. On the contrary, teaching of an abstract concept offers difficulty to the teacher as well as for students to understand. These concepts can be learned by heart without understanding as children mug up Nursery Rhymes without understanding even a single word. But at the stage of higher tearing, this type of rote learning is not desirable. Adolescents (teenagers) and adults do not accept things without understanding.

3.1.3 Concept Attributes:

We identify a concept and understand it, once we are told about its qualities characteristics, and features. They are technically called concept attributes. While teaching a concept to our students we must spell out as many attributes as possible for better understanding of the concept.

Example: The Concept **of Pattern**

Attributes:

1. Replica of component to cast
2. Suitable material for pattern to be selected depending upon complexity involed.
3. Selection of pattern depending upon its size, shape and orientation.
4. Pattern allowances
5. Colour coding of pattern

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The following questions pertaining to a concept (object or process) will be helpful in writing concept attributes:

1. What is it?
2. What are its constituent parts?

3. How it works?

4. How it is similar to and different from other known concepts?

5. What are its uses?

3.1.4 PRINCIPLES:

A principle is a statement of relationship between two or more concepts. Principles are sometimes called rules, laws or generalizations. In others words, relationship between two or more concepts which is scientific and universally true is called a Principle.

For Example: (related concepts are underlined)

1. Working principle of Lathe – Principle of working of lathe is that a material is removed from a rotating job by a single point cutting tool which past the workpiece.

2. Principle of heat treatment – The material is heated to certain desired temperature and is allowed to cool in different media so as to change mechanical properties

.

3.1.5 APPLICATIONS:

Whatever principles, laws and theories have been learned are only academic exercises unless these are applied to solve a practical problem. In other words, we call this application transfer of learning to a new situation. If you recall, the process of learning dealt with in Theme Paper 2, you will appreciate that the litmus test of learning having occurred is its application in a new situation or solving a new problem.

For example:

1. Casting used in automobiles, pumps, hardware etc.

2. Turned components like pins, shafts, flanges, etc.

3. Holes made in various engineering components or jobs

.

3.1.6 PROCEDURES:

While analysing the content of a topic you might come across certain standard procedures which are prescribed to perform an operation or a given task. These procedures should be clearly identified and taught with engineering and technological aspects of that procedure. We should not pre-suppose that the students understand them. We cannot afford to take these things for granted. We should try our best to show live

demonstration / VDO clip if possible. (Some clips and animations are available on official website of NPTL)

For Example:

1. Sequential procedure of casting
2. Procedure of setting of single point cutting tool on tool post of lathe
3. Procedure to operate a lathe.

3.1.7 SKILLS (PSYCHOMOTOR):

A skill is an ability to perform a task expertly and well. The skilled performance; must meet a pre-specified standard of acceptable performance. A skill has the following three characteristics:

1. It represents a chain of motor responses;
2. It involves the co-ordination of hand and eye movements, and
3. It requires the organization of chains into complex response patterns.

Skills could be intellectual (thinking, understanding); interactive (communication skills) and social (socialising, mixing up with others) also. But normally when we use the word skills, it refers to psychomotor skills.

For Example:

1. Making of pattern from given material with the help of carpentry tools ,
2. Setting of a lathe to turn the given job
3. Confirmation of dimensions of the component with dimensions on the drawing.
4. Turning a job on a lathe machine.

Laboratories and workshops of Polytechnics are the locations where these skills are developed among the students under the guidance of expert instructors or operators. Drill and practice are the main methods of teaching and learning these skills through model demonstrations and careful observations thereof.

Alongside developing these skills, desirable attitudes like cooperation, team work, leadership, safety, cost consciousness are also developed.

3.2 TEACHING OF CONCEPTS;

In order to teach concepts effectively the following steps have been suggested by De Cecco & Crawford (1974).

Steps Suggested:

1. Describe the performance expected of the student after he has learned the concept.
2. Reduce the number of attributes to be learned in complex concepts and make important attributes dominant.
3, Provide the student with verbal indicators (explanation).
4. Provide positive and negative examples (non-examples) of the concept.
5. Present the examples in close succession or simultaneously.
6. Provide occasions for student responses and the reinforcement of these responses, and
7. Assess the learning of the concept.

3.3 TEACHING OF PRINCIPLES:

De Cecco & Crawford (1974) has suggested the following steps for teaching principles effectively.

Steps:

1. Describe the performance expected of the student after he has learned the principle.
2. Decide and indicate which concepts or principles the students must recall in learning the new principle.
3. Assist the student in the recall of component concepts.
4. Help the student in the recall of component concepts.
5. Help the student to combine the concepts and put them in a proper order.
6. Provide for practice of the principle and for reinforcement of student responses.
7. Assess the learning of the principle.

3.4 CONCLUSION:

To sum up, it can be said that. it is essential for the teachers to develop the skills of 'Content Analysis' of their subjects. It brings content clarity among teachers themselves. More importantly, Content Analysis will be a pre-requisite for writing Instructional Objectives of the topic to be taught. You will study Instructional Objectives in a separate Theme Paper in detail. Teaching and learning process is bound to be effective once these crucial academic activities are undertaken.

Suggestions for effective teaching:

Following suggestions will be useful for effective teaching

- ✓ Teacher shall explain in the beginning the importance of Rationale, Objectives of this subject. Example in practical field and its information shall be shared by the teachers before the students so that they may relate the scope of subject in practical field at the beginning of their learning. Student shall be briefed about the importance of this subject in industry, learning structure, theory content, examination scheme, list of practicals, list of assignments, list of reference book etc in detail.
- ✓ Prepare and use transparencies / OHP/ for explaining difficult figures such as cutters, bench drilling machine, moulding tools etc. if possible
- ✓ Use of photographs, charts or power point presentations with photographs is more useful than plain text type power point presentation.
- ✓ Show different video clips related to topic that is the most effective to understand difficult concepts and students are aware about engineering principles in more depth.
- ✓ Actual demonstration on machine / equipment / tools shall be done wherever possible.
- ✓ Students shall be informed / motivated to visit near by workshop/foundry/industry to observe the process / environment / work culture in groups
- ✓ They shall be motivated to go through various reference books mentioned in the curriculum and read more and more other books also to enhance their knowledge in all respects rather than focusing on text books.
- ✓ Expert lectures shall be arranged related with the curriculum.

4. CURRICULUM:

Course Name : Diploma in Automobile Engineering

Course Code : ME/MH/MI/PG/PT

Semester : Third

Subject Title : Materials and Manufacturing Processes

Subject Code : 17306

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	25#	--	25@	150

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rationale:

Manufacturing process is a core technological subject in Automobile engineering course. The knowledge of materials, their properties and applications is essential for a diploma students engaged in engineering organizations. He should also be proficient in the selection and use of manufacturing processes. The knowledge of this subject is essential as prerequisite knowledge for other higher level subjects like Automobile component design and Automobile manufacturing process.

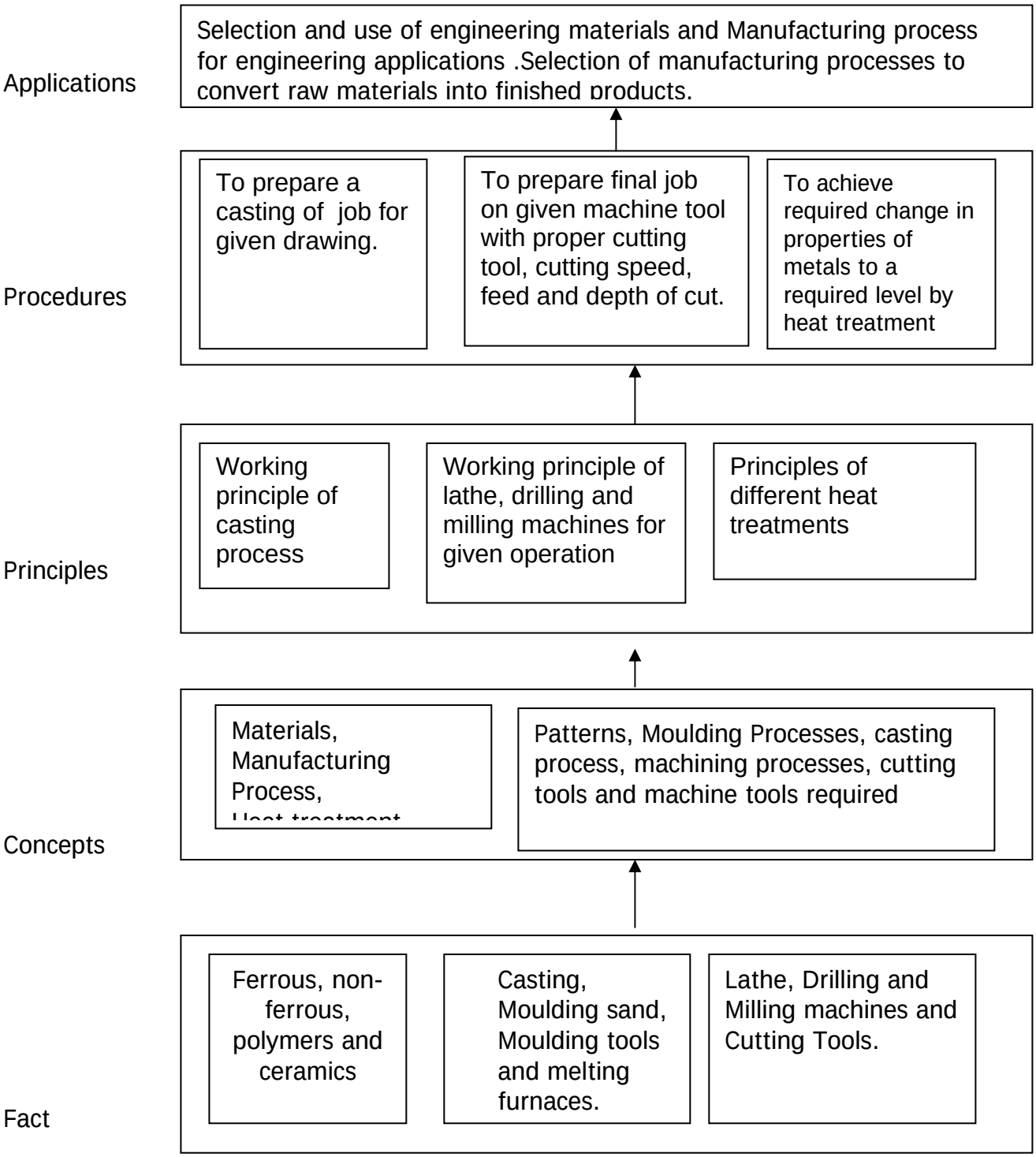
General Objectives:

The student will be able to:

1. Know various engineering materials, their properties and selection of these materials for different engineering applications.
2. Understand the different heat treatment processes and their applications.

3. Understand the foundry operations and able to prepare the patterns, moulds and castings.
4. Select and use different cutting tools in machining operation.
5. Understand the working and operational functions of basic machine tools like lathe, drilling and milling machines.

Learning Structure:



Theory Content:

Topic and Contents	Hours	Marks
1: Engineering Materials **20 Marks** Specific Objectives: ➢ Study the various Engineering materials and its Applications Contents: 1.1 Introduction: **08 Marks** • Classification of engineering materials. • Ferrous metal and their alloys: • Cast iron: types, composition and applications • Plain carbon steel: types, composition and applications • Effects of alloying elements like- Nickel, chromium, silicon, molybdenum and tungsten on the properties of steel • Alloy steels like stainless steel, Tool steels, their composition and applications 1.2 Non-ferrous metals and their alloys: **06 Marks** • Aluminium and its alloys: duralumin, 'Y' alloy, their composition, properties and applications • Copper and its alloys: brass, bronze, gun metal, Babbitt metal their composition, properties and applications 1.3 Other materials: **06 Marks** • Polymeric materials- properties and applications- Thermoplastics- Nylons and Polypropylene. Thermosetting Plastics-Epoxy resins and Polyesters Rubber – Natural and synthetic • Ceramic materials: Properties and application in automotive industry.	10	20
2: Heat treatment **12 Marks** Specific Objectives: ➢ Study various methods of Heat treatment processes as applied to automobile components ➢ Understand iron-carbon phase equilibrium diagram. Contents: 2.1 Introduction: **04Marks** • Concept of phase and phase transformations • Iron-Iron carbide phase (Fe-Fe3C) equilibrium diagram. 2.2 Common heat treatment processes and their applications **08 Marks** • Annealing, Normalizing, Hardening, Tempering. • Surface hardening processes: Case carburizing, Nitriding, Cyaniding, Induction and Flame hardening.	06	12
3: Foundry **28 Marks** Specific Objectives: ➢ Study of various foundry processes Contents: 3.1 Introduction **04 Marks** • Types of Foundries	13	28

• Advantages and disadvantages of foundry process. 3.2 Pattern Making: **08 Marks** • Pattern materials and their selection. • Types of pattern and their selection • Pattern Allowances. • Pattern colour coding. 3.3 Moulding: **08 Marks** • Moulding tools and flasks. • Moulding sand: Composition, Types and properties. • Classification of moulding processes. • Use of Core, core print and core boxes. 3.4 Casting: **08 Marks** • Gating and risers of sand castings • Types and processes and applications of Pressure Die casting, Shell moulding and centrifugal casting. • Defects in casting: causes and remedies.		
4: Fundamentals of machining: 12 Marks Specific Objectives: ➢ Study of different types of machining tools and parameters 4.1 Chip formation **04 Marks** • Mechanism of chip formation. • Types of chips • Orthogonal and Oblique cutting 4.2 Cutting tools and fluids **08 Marks** • Types of cutting tools: single and multi-point • Cutting tool materials: Selection, Properties and types • Single point cutting Tool nomenclature and tool signature. • Cutting fluids: Properties, types	06	12
5: Basic Machine tools 28 Marks Specific Objectives : ➢ To understand basic concept of Conventional Machine tools 5.1 Lathe: **10 Marks** • Classification of lathes. • Major parts of Centre lathe machine with block diagram. • Lathe specifications. • Accessories used on lathe. • Operations performed on lathe – Turning, Taper turning by swiveling compound rest, Facing, Knurling and Threading. 5.2 Drilling: **08 Marks** • Classification of drilling machines. • Major parts of bench drilling machine with block diagram • Operations performed on drilling machines – drilling, reaming. 5.3 Milling: **10 Marks** • Classification of milling machines. • Major parts of column and knee type universal milling machine • Standard milling cutters	13	28

• Milling operations like face milling, Gang milling, Key-way milling and End milling.		
Total	**48**	**100**

Practical:
Skills to be developed:
Intellectual Skills:

1. Develop concept of pattern making.
2. Understand the safety aspects to be followed on the shop floor.
3. Understand the different types of patterns and compare them.
4. Know the different types of sands used in sand moulding.

Motor Skills:

1. Prepare solid pattern.
2. Use pattern for preparing moulds.
3. Operate and control lathe machine.
4. Operate and control drilling machine.
5. Use safety precautions and equipment on the shop floor.

List of Practicals:

1. Prepare one wooden solid pattern per student as per given drawing.
2. Develop one pattern for a given job considering all aspects of pattern making for group of 4 to 6 student. Job shall involve spit pattern with core, core print.
3. Prepare a sand mould for any one of the above patterns. Estimate the cost for the casting using the above pattern and mould.
4. Visit to a foundry and observe the moulding and casting processes and prepare a report.
5. One job for each student involving following operations:
   Facing, taper turning, step turning, threading, knurling operations on lathe machine; and reaming operation using drilling machine.

Notes:

1] The workshop instructors should prepare specimen job in each shop as demonstration practice before the student (as per the drawing given by subject teacher/ workshop superintendent).

2] Theory behind practical is to be covered by the concerned subject teacher/ workshop superintendent.
3] Workshop diary should be maintained by each student duly signed by respective shop instructors.
4] Assignments are to be assessed by the concerned subject teacher / workshop superintendent.

List of Assignments:

1. Prepare the operation sheet for the machining processes carried out under practical number five.
2. Prepare the Process sheet in casting process of a simple component
3. Draw Nomenclature of Single point cutting tool and tool signature.

Learning Resources:

1. **Books:**

Sr. No	Author	Title	Publication
1.	S. K. Hajra Choudhury. A. K. Hajra Choudhury.	Elements of Workshop Technology Vol. - I and II	Media Promoters and Publishers
2.	H. S. Bawa	Workshop Technology Vol. - I and II.	Tata McGraw-Hill Publishing
3.	R. K. Jain	Production technology	Khanna Publishers. Delhi.
4.	Ostwald	Manufacturing process and Systems	Wiley India Pvt. Ltd.
5.	H.M.T.	Production Technology	H.M.T.
6.	Serope Kalpakjian Steven R. Schmid	Manufacturing Engineering and Technology	Pearson

2. **CDs, PPTs Etc.:**
   Electronics Trades and Technology Development Corporation (A Govt. of India undertaking), Akbar Hotel Anex, Chankyapuri, New Delhi-110 021.

   Learning Materials: Transparencies, CBT packages developed by N.I.T.T.E.R., Bhopal.

3. **IS, BIS and International Codes:**

4. **Websites:**
   www.youtube.com
   www.npkauto.com

5. IMPLEMENTATION STRATEGY:

5.1 Planning of Lectures for a Semester with Content Detailing:

Topic 1	**Name: Engineering Materials** Facts: Metal, ferrous and non ferrous metals, polymers and ceramics, rubber Concepts: Alloy steel Principles: Principle of alloying Give sample specific objectives for the topic mentioned above for example **Sample Objectives**; 1] Student should able to define and state examples of ferrous/ non ferrous and alloys. 2] Students shall identify and state applications of different types of Polymers and ceramic and rubber compounds. Teachers shall bring the small samples of different ferrous/ non ferrous and alloys in class room and tell their specific application in practical field /industry Teacher may also assign the activity of collection of samples of above elements Reference Material: Books: Title: 1) Production Technology by R.K.Jain 2) Manufacturing Engineering and Technology by Kalpakjian Teaching Aids: Black board / White board PPT with Sample: Introduction to Engineering Materials Websites – NPTL
Lecture No.	**Topic/ Subtopic to be covered**
1	1.1 Introduction to Engineering Materials – Classification of engineering materials metals, alloys, glass and ceramics, polymers. Introduction to ferrous materials and their alloys
2	Introduction to cast iron – types composition and applications Introduction to plain carbon steel

3	Effect of alloying element like Nickel, Chromium, Silicon, Molybdenum, Tungsten on the properties of steel.
4	Alloy Steels like stainless steels, types of stainless steel, their composition and applications, tool steels, types of tool steel their composition and applications
5	1.2 Introduction to non – ferrous metals and their alloys – aluminum and its alloys, Duralumin, Y alloy, their composition properties and applications
6	Copper and its alloys – Brass, bronze, gun metal, Babbitt metal their composition, properties, and applications
7	1.3 Other Materials – Polymeric materials – Properties and applications – thermoplastics, Nylon, & polypropylene
8	Thermosetting plastics – Epoxy and polyesters Properties and applications
9	Rubber – Natural and synthetic properties and applications
10	Ceramic materials – types, properties, and applications in automotive industries
Topic 2	**Name: Heat treatment** Facts: Hardness, toughness, malleability, ductility, machinability, heat Concepts: heat treatment, quenching media, critical temperatures, Fe –C (Iron Carbon diagram) Principle – Principle of heat treatment processes, Principle of cooling, Procedure – Heat treatment processes to achieve required changes in properties of material. Applications – shafts, axels, crank pins, crank case, piston rings, connecting rods etc Give sample specific objectives for the topic mentioned above for example **Sample Objectives**; 1] Student should able to define different types of Heat treatment and its importance. 2] Students shall identify the material and its specific properties, like malleability ductility Teachers shall the PPTs of various equipments used for carrying out Heat treatment. Teachers shall reinforce the knowledge of need and importance of Different types of Heat treatment for different but desired applications Reference Material: Books: Title: 1) Production Technology by R.K.Jain Teaching Aids: Black board / White board, transparencies, charts,

	PPT with Sample: Introduction to heat treatment processes Websites – NPTL
Lecture No.	**Topic/ Subtopic to be covered**
1	2.1 Introduction to heat treatment processes – Purpose of heat treatment, structure of steel, Concept of phase and phase transformation
2	Iron – Carbon equilibrium diagram understanding of Iron – Iron carbide equilibrium diagram
3	Heat treatment process – annealing , normalizing applications, purposes etc
4	Heat treatment process - Hardening and tempering – applications purposes etc
5	Heat treatment process – Case carburizing and nitriding – applications purposes etc.
6	Heat treatment process – Cyniding, induction and flame hardening applications, purposes etc
Topic 3	**Name: Foundry** Facts: Pattern, mold, core, casting moulding tools etc Concepts: Pattern allowance, color code Principle – Principle of moulding, Principle of pouring molten metal Procedure – moulding processes, casting process, sand moulding, pressure die casting etc Applications – Engine bodies, brake levers, carburetors, Cover flanges, etc Give sample specific objectives for the topic mentioned above for example **Sample Objectives**; 1] Student should able to state different types of pattern. 2] Students shall able to prepare the moulding box by using suitable pattern and prepare gating system for it. Teachers shall the samples of simple castings, different patterns, sand cores in the class and make them aware about these things. Reference Material: Books: Title: 1) Production Technology by R.K.Jain 2) Work shop technology Volume I by H.S.Bawa Teaching Aids: Black board / White board, transparencies, charts, visit to foundry Demonstration with actual pattern of any industrial component and explanation

	with core and core box Websites – NPTL
Lecture No.	**Topic/ Subtopic to be covered**
1	types of foundries, advantages and disadvantages of foundry processes
2	Pattern making, pattern materials and their selection
3	Types of pattern and their allowances
4	Types of pattern and their color coding
5	Types of pattern
6	Types of pattern
7	Moulding tools and flasks
8	Moulding sand types and composition
9	Classification of moulding processes
10	Use of core, core print, and core boxes
11	Gating and risers of sand casting purpose
12	Types and processes and application of pressure die casting, shell moulding, and centrifugal casting
13	Defects in casting causes and remedies
Topic 4	**Name: Fundamentals of machining**
	Facts: cutting tool, work piece, chip, cutting fluid, etc Concepts: Chip formation, cooling of tool and work piece Principle – Principle of cutting oblique and orthogonal Procedure – single point tool cutting process, turning, boring and multipoint cutting tool process, milling drilling etc. etc Applications – turning components, pins, boring of job, milling of job, etc Give sample specific objectives for the topic mentioned above for example **Sample Objectives**; 1] Student should able to identify single point cutting tool and multi point cutting tool. 2] Student should able to explain the working principle of different machines like Drilling, Boring and Milling machines. Teachers shall expose the student directly on lathe machine/Drilling machine/ Boring machine and Milling machines and ask them to observe the various parts of these machines, draw figures and describe the function of each parts (Through assignments) Demonstration of each machines and different operations performed on these machines should be given to the students (Workshop Instructor shall perform simple operations on lathe machine for the students.

	Reference Material: Books: Title: 1) Production Technology by R.K.Jain 2) Production Technology by H.M.T. 3) Manufacturing process and systems by Amstead and Ostwald Teaching Aids: Black board / White board, transparencies, charts, visit to workshop actual working on lathe Websites – NPTL
Lecture No.	**Topic/ Subtopic to be covered**
1	Introduction to different types of cutting tools and parameter mechanism of chip formation
2	Types of chips
3	Orthogonal and oblique cutting
4	Types of cutting tools single and multipoint cutting tools, tool signature
5	Cutting tool materials selection properties, and types
6	Cutting fluids – properties, types and application
Topic 5	**Name: Basic Machine Tools** Facts: Machine tool, lathe, drilling machine, milling machine etc Concepts: turning, drilling milling Principle – Principle of lathe, Principle of drilling, Principle of milling Procedure – turning process, drilling process, boring, plain turning, milling process, gang milling etc Applications – shaft turning, drilling of bearing covers, etc Reference Material: Books: Title: 1) Production Technology by R.K.Jain 2) Work shop technology Volume I by H.S.Bawa 3) Production Technology by H.M.T. Teaching Aids: Black board / White board, transparencies, charts, visit to workshop or any industry Video clips of operations Websites – NPTL
Lecture No.	**Topic/ Subtopic to be covered**

1	Classification of lathes
2	Major parts of centre lathe with block diagram
3	Lathe specifications
4	Accessories used on lathe – major accessories used on lathe
5	Operations performed on lathe – turning and other turning operations
6	Taper turning and its types, threading operation
7	Classification of drilling machine
8	Major part of drilling machine with block diagram
9	Operations performed on drilling machine – drilling, reaming etc
10	Classification milling machine major parts of column and knee type and universal milling machine
11	Standard milling cutters
12	Milling operations – face milling gang milling etc
13	Milling operations – key way milling, end milling etc

5.2 Planning and Conduct of Test:- following guidelines should be followed

- There will be two tests each of 25 marks
- The tests will be conducted as per MSBTE schedule
- The schedule of test and portion shall be declared at least one week in advance.
- The model answers with marking scheme **FOR SAMPLE QUESTION PAPER** shall be displayed on the notice board
- Teacher shall give feedback to the students about their performance.

5.3 Details about conduct of practicals and assignments:

5.4

- The practicals shall be carried out exactly as mentioned in the syllabus as far as possible.
- Industrial visit shall be carried out as far as possible. If concerned industry / foundry are not located in the nearby area then at least video clips which are available on various website shall be shown to the students. (This should be the last choice not the first one)

5.4 Strategies for Conduct of Practical:

5.4.1 Suggestions for effective conduct of practical and assessment:

- Any other low cost method which will explain the concept may be followed so as to overcome infrastructural facilities. (Use of china clay, wax, wax moulds etc and other materials which are used in schools can be used to make understand the concept of pattern, mould, and casting. This should be the last choice not the first one)
- Each student shall be given opportunity at least once to grind tool on bench grinder and working on lathe for turning job. The instructor shall be warned not to assist the students in carrying out operations. He shall assist them only in case of

difficulty or wrong execution of process or in case of safety of machine tool and student.

- Additional assignments / extra practical for better motor skill can be done so as to enhance the knowledge of student.
- They shall be informed at introductory level about operation sheet / process sheet before assigning assignment on practical five i.e. on turning job. Sample process sheet can be displayed on notice board after proper explanation
- Any other related practice / work / job / can be done as an additional assignment

6. Mode of assessment:

6.1 Class Test:

It is proposed that there will be two tests each of 25 Marks. The tests will be conducted as per the MSBTE Schedule

6.1.1 Guidelines for Setting Class Test Question Paper – the following instructions should be followed strictly by the paper setter (Subject Teacher)

- The question paper should be set according to given sample Test Paper format
- Question paper for class test first should be based on approximately 40% of curriculum of subject and second test on 40% of remaining curriculum.
- The question no 1 will be of 9 (Nine) marks and the students has to attempt any three out of four bits. Each bit carry three marks and question 2 and 3 will be of 8 (Eight) marks each. The student has to attempt two bits out of three. Each bit carry four marks.
- Duration of class test is one hour.
- Instructions should be given at the top of question paper.

6.1.2 Sample Test Papers:

Sample Test Paper I

Roll No.				

17306

Institute Name:

Course Name: **Diploma in Mechanical Engg** Course Code: **AE**

Semester: **Third**

Subject**: Materials and Manufacturing Processes**

Marks: **25** Time: **1 hour**

Instructions:

1. All questions are compulsory
2. Illustrate your answers with neat sketches wherever necessary
3. Figures to the right indicate full marks
4. Assume suitable data if necessary
5. Preferably, write the answers in sequential order

Q1. Attempt any three only **9**

1. State any three types of ferrous and non ferrous metals
2. State any three types of C.I. and give applications of each
3. Give composition of brass and state any two uses of brass in engineering field
4. Why nickel is added in making alloy of steel?

Q2. Attempt any two **8**

1. Define hardening. State any two methods and explain any one
2. List any four pattern making allowances and explain any one with simple sktch
3. Compare annealing and normalizing with respect to a) Hardness b) stress relief

Q3. Attempt any two **8**

1. Explain with neat sketch, i) Sweep Pattern, ii) Match plate pattern.
2. List any four properties of moulding sand and explain any one
3. Explain function of core in moulding. Draw sketch of core and core box

Sample Test Paper II

Roll No.				

17306

Institute Name:

Course Name: **Diploma in Mechanical Engg** Course Code: **AE**

Semester: **Third**

Subject**: Materials and Manufacturing Processes**

Marks: **25** Time: **1 hour**

Instructions:

1. **All questions are compulsory**
2. **Illustrate your answers with neat sketches wherever necessary**
3. **Figures to the right indicate full marks**
4. **Assume suitable data if necessary**
5. **Preferably, write the answers in sequential order**

Q1. Attempt any three only **9**

1) Draw any three molding tools
2) Explain the function of runner and riser in case of molding
3) State any three major defects in casting
4) State three types of chips produced in machining and give names of materials of job which produces these chips

Q2. Attempt any two **8**

1) State any four accessories used on lathe and explain any one with sketch
2) Explain with sketch any two operations performed on drilling machine
3) Compare up milling and down milling with reference to
   i) Cutter direction ii) Surface finish iii) Chip thickness iv) Fixture requirement

Q3. Attempt any one **8**

1. Draw the neat sketch, of Bench drilling machine and give function of any one part in brief
2. State any four operations performed on drilling machine and explain with neat sketch the counter boring operation.
3. What is reaming? Why is it done?

6.2.3 Sample Question Paper:

Exam Seat No.									

17306

Maharashtra State Board of Technical Education, Mumbai

Course Name: Automobile Engineering **Course Code: AE**

Semester: Third

Title of the Subject: Materials and Manufacturing Processes **Subject Code: 17306**

Marks: 100 **Time: 3Hrs**

Instructions:

1. All questions are compulsory
2. Illustrate your answers with neat sketches wherever necessary
3. Figures to the right indicate full marks
4. Assume suitable data if necessary
5. Preferably, write the answers in sequential order

Q1a). Attempt any SIX of following **12**

1. State any four types of engineering materials.
2. What do you mean by C.I? Give one example with its composition.
3. State two engineering applications of Brass and Aluminum
4. What is 'Duralumin'? Where is it used?
5. What is Thermosetting plastic?
6. What are basic types of rubber? Give one application of each.
7. State any two properties of Polypropylene.
8. Give two different properties of Ceramic materials and two applications in the industry

Q2b) Attempt any TWO of following **8**

1. What is Plain carbon steel? State its types and composition of any one and also state where it is used.

2. What are different alloys of Copper? State its important characteristics? Discuss any two in brief.
3. What are properties of Thermoplastics? Explain any two in brief.

Q2. Attempt any FOUR of following 16

1. What is Phase-transformation diagram? What information it gives? Explain with sketch
2. What are different Heat treatment processes? State any four general purposes of heat treatment.
3. What is Annealing? Give its two main purposes
4. What is case Carburizing? Give four applications of case carburizing.
5. What are different types of foundries? Explain one in brief
6. What is Pattern? Why is it required?

Q3. Attempt any FOUR of following 16

1. Sketch any two types of Patterns and explain it in brief
2. What are different pattern materials? State any four factors for the selection of pattern material.
3. Draw any two moulding tool with simple sketch and explain its use
4. What are different types of moulding sands? Explain any one type of sand in brief
5. What are different moulding processes? Explain any one in detail
6. What is Pressure die casting? What are its types? Explain any one with sketch

Q4. Attempt any FOUR of following 16

1. What is purpose of Gating System in case of casting? Explain with sketch
2. Give any two defects in casting and explain why they occur and remedies to avoid them
3. What are different types of chips formed during machining? explain any one with sketch
4. What is orthogonal cutting? Explain with sketch and give example of orthogonal cutting.

5. What are different types of tool materials? State their specific use.
6. What are different types of cutting fluid? State any four properties of cutting fluid

Q 5. Attempt any FOUR of following 16

1. You are going to machine stainless steel on lathe. Which type of tool material you will select considering following parameters i) surface finish ii) ease in machining iii) long life of tool
2. How lathe machines are classified? What is working principle of lathe?
3. Draw a neat sketch of three jaw chuck and explain why is it more convenient than four jaw chuck
4. State any four accessories used on lathe? Explain with neat sketch use of faceplate
5. What are different operations performed on lathe? Give any four and explain one with neat sketch.
6. How drilling machines are classified? Explain drilling operation principle in brief.

Q 6. Attempt any FOUR of following 16

1. Draw neat sketch of bench drilling machine and name its parts. Write function of any two part in brief
2. What is the working principle of milling machine? Explain with neat sketch
3. Draw a neat sketch of column and knee type milling machine and explain function of any two parts in brief
4. What is plain milling? Which cutters are generally used in plain milling?
5. State any four different types of milling cutters and Draw a sketch of any one and give its application.
6. You are going to carry following operations on milling give which cutter you will use for them. a) key way b) slot c) gear tooth d) rounding of corner