CURRICULUM REVISION PROJECT

2012

TEACHER GUIDE FOR

(THEORY OF MACHINES: 17412)

FOURTH SEMESTER MECHANICAL ENGINEERING GROUP

DECEMBER 2013

MAHARASHTRA STATE
BOARD OF TECHNICAL EDUCATION, Mumbai
(Autonomous) (ISO 9001:2008) (ISO/IEC 27001:2005)

1. APPROACH TO CURRICULUM DESIGN

1.1 Background:

MSBTE is introducing the revised curriculum under 'G' scheme 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.

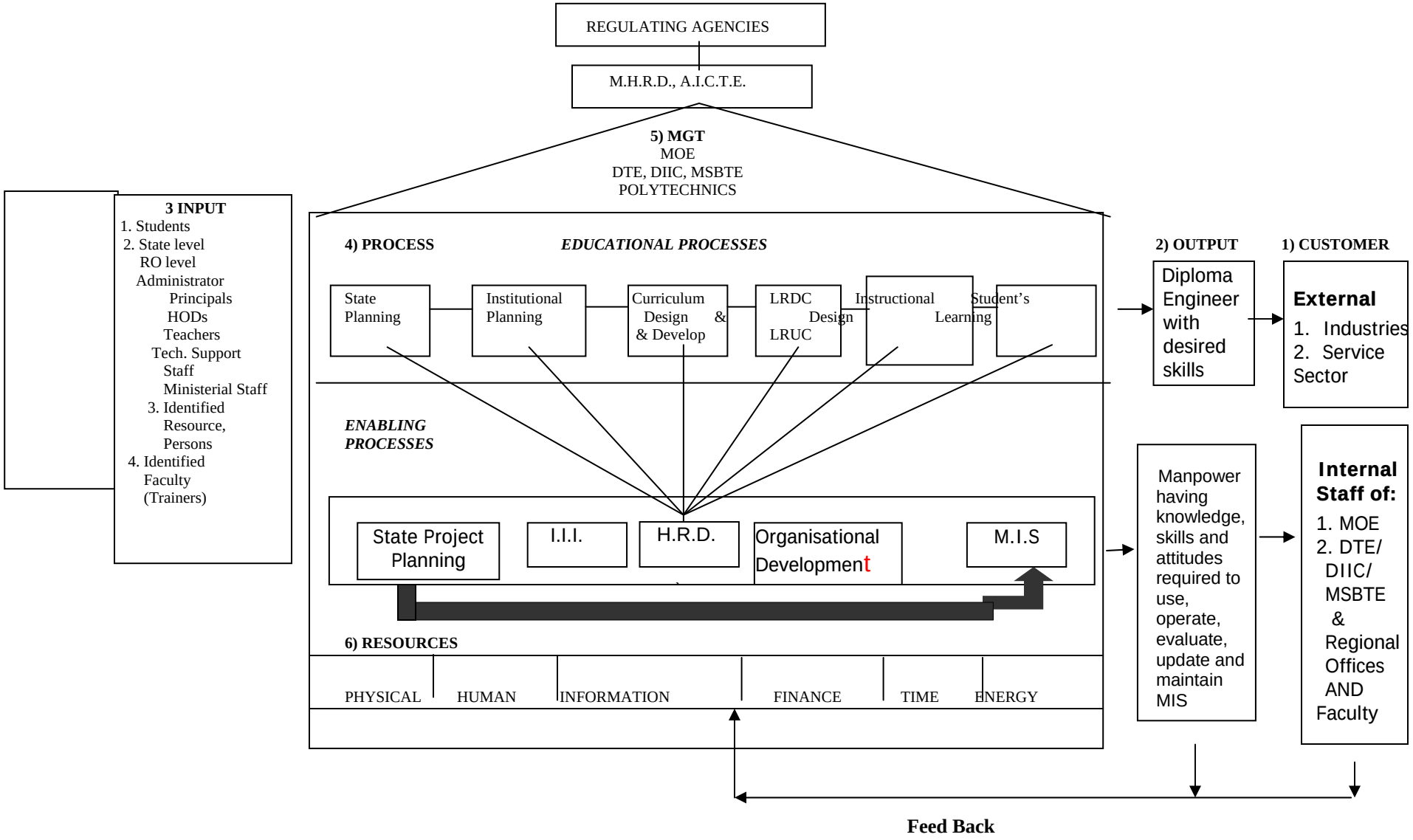


Fig 1 Systems Approach

1.4 Curriculum goals

1. To develop l. confidence in students by providing more exposure to industry experience and world of work at global leve
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.

1.5 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 intellectual and motor skills in order to satisfactorily perform duties assigned to them:

A) Intellectual skills.

1) Read and interpret Civil Engineering drawings.

2) Prepare estimates and bill of quantities.
3) Carryout Civil engineering survey.
4) Design simple civil engineering structures.
5) Prepare tender documents.
6) Plan, execution of various construction activities.
7) Test engineering materials, prepare reports and interpret them.
8) Use various civil engineering software.
9) Follow various standards and codes.
10) Maintain records in various formats.
11) Carry out building maintenance.
12) Prepare various building plans as per requirements by using appropriate byelaws.
13) Supervise construction work.
14) Select appropriate technique for quality control.

B) Motor Skills.

1) Prepare manual and Computer generated Civil engineering drawings.
2) Use survey instruments, plot survey data and prepare drawings.
3) Handle testing of equipments.
4) Lay out of Civil engineering structures.
5) Draw free hand sketches of Civil engineering structures.

1.6 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 Applied 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 Studies 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 at the sixth semester 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 Civil Engineering Group CAD and Building Materials have been added as an independent subject. Topics on Airport Engineering and Docks and Harbours have been added in the subject Transportation Engineering.

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.

2.2 Domains of Learning:

Learning is a process by which students develop relatively permanent change in mental associations through experience. This is how learning is defined by cognitive psychologists. Behavioral; psychologists define learning as a relatively permanent change in behavior.

There are following domains of learning:

A: Cognitive Domain relates to intellectual skills or abilities

B: Affective Domain relates to emotions, feelings, likes, dislikes etc.

C: Psychomotor Domain relates to manipulative skills of hands, legs. Eye-hand coordination in Engineering & Technology courses, endeavor is made to design curriculum with a focus on development of cognitive skills through classroom teaching. Where as manipulative (psychomotor) skills are developed in workshops, laboratories & seminars where students work individually or in a group. Development of affective skills attitudes and value is supposed to be acquired through projects and co curricular activities. These are also developed from the work culture or institutions.

How far a student has developed these abilities/skills especially from cognitive and psychomotor domains is assessed on the basis of suitable examinations. When classroom and laboratory teaching is viewed in this light, evaluation becomes an integral part of teaching – learning process.

2.3 LEVELS OF LEARNING:

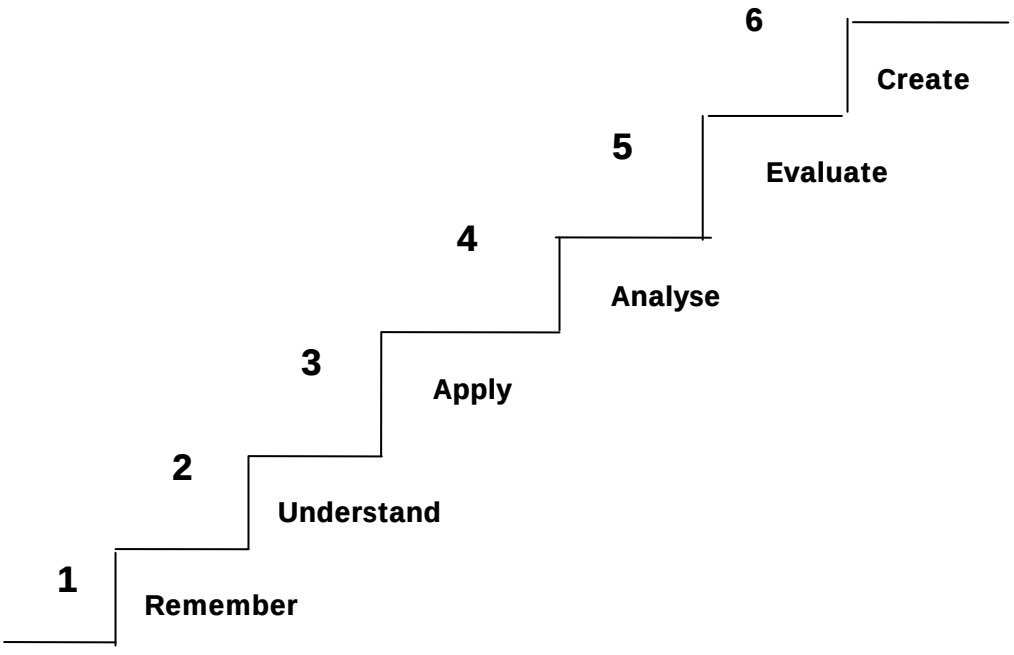
Question paper is a tool/ instrument designed to test the extent of learning of the student. Various questions set in a question paper should assess the abilities of students to respond to level of learning. Dr. Bloom a German educationist classified levels of learning in cognitive domain for

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 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.	Understands fact, principles Interprets verbal material, Interprets charts, tables, graphs. Translates verbal material to mathematical formula. Estimates consequences implied in data. Justifies methods & procedures.	Convert, distinguish estimate, explain, extend, generalize, 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.	Recognizes unstated assumptions and logical fallacies in reasoning. Distinguishes between facts and inferences. Evaluates relevance/	Breakdown, diagram, differentiate, discriminate, distinguish, identify illustrate, infer, outline,

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.	adequacy of data.	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.

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

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

Objectives indicate what is achievable and hence gives direction to 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 Cognitive Domain knowledge is divided in four components as mentioned in the Two dimensional grid. Of this Factual, Conceptual and Procedural knowledge components are identified in the curriculum of the subject along with the 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.

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 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 as 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 (1 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. house, book, table, chair, cat, dog, any machine or apparatus, overhead projector, chalkboard and duster.

2. Abstract Concepts: those which cannot be seen and touched and handled but can only be imagined e.g. force, work, fractions, decimal, bending moment, moment of inertia, friction, heat, and induction. 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 Friction**

Attributes:

1. Friction is a resistive force.
2. Frictional force acts in the direction opposite to the direction of the applied force.
3. Frictional force is more when the surfaces in contact are rough.
4. Smooth surfaces (perfect) have zero friction.
5. Frictional force is self-adjusting to a limit.

Towards the end of this Theme Paper a number of examples of concept attributes are given for your guidance.

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

1. What it is.
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. Actions and reactions are equal and opposite.
2. Ohm's law I = V/R is a principle, where I (Current), V (Voltage), and R (Resistance) are the concepts. While teaching a principle we must recall the concepts which it involves. These concepts might have been taught in the previous lesson. As you already know, concept learning is a prerequisite to Principle learning. Thus we recall the concepts of current, voltage and resistance by asking questions to the students. Only after that we must tell the relationship among these i.e. Ohm's Law.

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. Ohm's law can be applied to find out the unknown quantity (voltage, current, and resistance).
2. Design of a structure can be made based on related principles and theories.
3. Principles of learning and events of instruction can be applied in ‘Designing a lesson Plan' and 'Presenting the lesson in the classroom".
4, The above principles can also be applied while preparing textbooks, workbooks, learning packages and laboratory manuals to be used by the students.

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 accordingly not to be left to chance. We should not pre-suppose that the students understand them. We cannot afford to take these things for granted.

For Example:

1. Procedure of setting up of an apparatus.
2. Procedure to start an engine.
3. Procedure to operate a machine (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. Welding a butt joint,
2. Setting a theodolite at a station,
3. Making proper circuit connections, and
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 *of* 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.

4. CURRICULUM:

Course Name : Mechanical Engineering Group

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

Semester : Fourth

Subject Title : Theory of Machines

Subject Code : 17412

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	---	25@	125

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:

It is a core technology subject in Mechanical Engineering Discipline. Mechanical Engineers often come across various machines in practice. They should be able to identify and interpret various elements of machines in day to day life. In maintaining various machines, a diploma engineer should have sound knowledge of fundamentals of machine and mechanism. It will be helpful for them to understand the mechanisms from operational point of view in a better way. This subject imparts the kinematics involved in different machine elements and mechanisms like gear, cam-follower, follower, belt-pulley, flywheel, brake, dynamometer, clutch, etc.

Detailed knowledge of these aspects with deep insight into the practical applications develops a professional confidence in them to become successful Engineer.

This subject serves as a prerequisite for subjects like Machine Design to be learned in higher semester.

General Objectives:

The student will be able to:

1. Understand different machine elements and mechanisms.
2. Understand Kinematics and Dynamics of different machines and mechanisms.

3. Draw cam profile suitable to various displacement diagram.
4. Select Suitable Drives and Mechanisms for a particular application
5. Understand the function, operation and application of flywheel and governor.
6. Understand the function, operation and application of brake, dynamometer, clutch and bearing
7. Find magnitude and plane of unbalanced forces.

Theory:

Topic and Content	Hours	Marks
1. Fundamentals and type of Mechanisms Specific objectives**:** ➢ Define various terms related to mechanisms. ➢ Explain construction and working of various mechanisms 1.1 Kinematics of Machines:- Definition of Kinematics, Dynamics, statics, Kinetics, Kinematic link, Kinematic pair and its types, constrained motion and its types, Kinematic chain and its types, Mechanism, inversion, machine and structure. ----- 8 Marks 1.2 Inversion of Kinematic Chain • Inversion of four bar chain, coupled wheels of Locomotive, Beam engine, Pantograph. • Inversion of single slider Crank chain –Pendulum pump, Rotary I.C. Engine mechanism, Oscillating cylinder engine, Whitworth quick return mechanism. Quick return mechanism of shaper. • Inversion of Double Slider Crank Chain- Scotch Yoke Mechanism, Elliptical trammel, Oldham's Coupling ----- 8 Marks	07	16
2. Velocity and Acceleration in Mechanisms Specific objectives ➢ Draw velocity and acceleration diagram for given mechanism 2.1 Concept of relative velocity and relative acceleration of a point on a link, angular acceleration, inter-relation between linear and angular velocity and acceleration. 2.2 Analytical method (No derivation) and Klein's construction to determine velocity and acceleration of different links in single slider crank mechanism. ----- 8 Marks 2.3 Drawing of velocity and acceleration diagram of a given configuration, diagrams of simple Mechanism. Determination of velocity and acceleration of point on link by relative velocity method(Excluding Coriollis component of acceleration) ------ 8 Mark	08	16
3. Cams and Followers Specific objectives ➢ Define the terms related to Cam ➢ Classify Cams and Followers ➢ Draw cam profile as per the given applications 3.1 Concept, definition and applications of Cams and Followers. Cam	06	12

terminology 3.2 Classification of Cams and Followers. 3.3 Different follower motions and their displacement diagrams - Uniform velocity, Simple harmonic motion, uniform acceleration and Retardation. ---- 4 Marks 1.4 Drawing of profile of radial cam with knife-edge and roller follower with and without offset with reciprocating motion (graphical method) ---- 8 Marks		
4. Power Transmission Specific objectives ➢ Give **State** broad classification of Drives. ➢ Select Suitable Drives and Mechanisms for a particular application ➢ Calculate various quantities like velocity ratio, belt tensions, slip, angle of contact, power transmitted in belt drives 4.1 Belt Drives- flat belt, V-belt & its applications, material for flat and V-belt. Selection of belts, angle of lap, length of belt, Slip and creep. Determination of velocity ratio of tight side and slack side tension, centrifugal tension and initial tension, condition for maximum power transmission (Simple numericals) ------ 8 Marks 4.2 Chain Drives- Types of chains and sprockets, velocity ratio. Advantages & Disadvantages of chain drive over other drives, Selection of Chain & Sprocket wheels, methods of lubrication. ----- 4 Marks 4.3 Gear Drives – Classification of gears, Law of gearing, gear terminology. Types of gear trains, their selection for different applications. Train value & velocity ratio for simple, compound, reverted and epicyclic gear trains. .....8 Marks	10	20
5. Flywheel and Governors --------- 8 Marks Specific objectives ➢ Differentiate between flywheel and governor ➢ Explain with neat sketch the construction and working of various governors 5.1 Flywheel –Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C Engine (no Numericals) Coefficient of fluctuation of energy, coefficient of fluctuation of speed and its significance. 5.2 Governors- Types, concept, function and application & Terminology of Governors. 5.3 Comparison between Flywheel and Governor.	04	08
6. Brakes and Dynamometers. ---------- 10Marks Specific objectives ➢ List the differences between brakes and dynamometers ➢ Explain with neat sketch the construction and working of various brakes and dynamometers ➢ Calculate braking force, braking torque and power lost in friction in shoe and band brake	05	10

6.1Function of brakes and Dynamometers, Type of brakes & Dynamometers, comparison between brakes & Dynamometer. 6.2 Construction and working i) shoe brake, ii)Band brake iii) Internal expending shoe brake iv) Disc Brake 6.3 Numerical problems to find braking force and braking torque and power for shoe and band brake. 6.4 Construction and working of i) Rope brake Dynamometer ii) Hydraulic Dynamometer iii) Eddy current Dynamometer.		
7. Clutches and Bearings. Specific objectives ➢ Explain the difference between uniform pressure and uniform wear theories ➢ Explain with neat sketch, the construction and working of various clutches ➢ Calculate torque required to over come friction and power lost in friction in clutches and footstep bearings 7.1 Clutches- Uniform pressure and Uniform Wear theories. Function of Clutch and its application, Construction and working of i) Single plate clutch, ii) Multiplate clutch, iii) Centrifugal Clutch iv) Cone clutch v) Diaphragm clutch, (Simple numericals on single and Multiplate clutches). 7.2 Bearings- i) Simple Pivot, ii) Collar Bearing iii) conical pivot. Torque and power lost in friction. (Simple numericals)	06	12
8. Balancing Specific objectives ➢ Explain the concept of balancing ➢ Find balancing mass and position of plane, analytically and graphically. 8.1 Concept of balancing. Balancing of single rotating mass. Analytical/Graphical methods for balancing of several masses revolving in same plane.	02	06
Total	**48**	**100**

Practicals:
Skills to be developed:

Intellectual Skills:

1. Determine velocity and acceleration of links in a given mechanism.
2. Analyze balancing of rotating masses in a single plane.
3. Interpret interrelationship between components of various braking mechanisms.
4. Compare various power transmission devices.

Motor Skills:

1. Drawing of velocity and acceleration diagrams.
2. Dismantle and assemble given brakes and clutches.
3. Draw cam profiles for a given application
4. Draw velocity and acceleration diagram of the given mechanisms
5. Draw force polygon for unbalanced masses revolving in same plane

Note - The Term work shall consist of Journal / lab manual and A-3 size sketch book.

List of Practical:-

1. Sketch and describe working of quick return mechanism for a shaper. Find the ratio of time of cutting stroke to the return stroke to understand quick return motion in shaping operation.
2. Sketch and describe the working of the following mechanisms with its application,
   a) Bicycle free wheel sprocket mechanism
   b) Geneva mechanism
   c) Ackerman's steering gear mechanism
   d) Foot operated air pump mechanism
3. Determine velocity and acceleration of various links of the given two mechanism, by relative velocity method for analysis of motion of links.
4. Determine velocity and acceleration in an I. C. engine's slider crank mechanism by Kleins's construction.
5. Draw the profile of a radial cam for the given follower type to obtain the desired follower motion.
6. Determine slip, length of belt, angle of contact in an open belt drive to understand its performance.
7. Draw a schematic diagram of centrifugal governor and describe its working. Draw a graph between radius of rotation versus speed of governor to understand its function.
8. Dismantle and assemble mechanically operated braking mechanism of two wheelers. Sketch the two wheeler braking system and identify the functions of various components.
9. Dismantle and assemble multi-plate clutch of two wheeler. Draw neat sketch and state the functions of various components.
10. Determine graphically counterbalance mass and its direction for complete balancing of a system of several masses rotating in a single plane.

Learning Resources:

Books:

Sr. No.	Title	Author	Edition	Publication
01	Theory of Machines	Khurmi Gupta	--	Eurasia publishing House Pvt. Ltd. 2006 edition
02	Theory of Machines	S.S. Rattan	Third	McGraw Hill companies, II Edition
03	Theory of Machines	P.L. Ballaney	--	Khanna Publication
04	Theory of Machines	Jagdishlal	--	Bombay metro-politan book limited

05	Theory of Machines	Sadhu Singh	Second	Pearson
06	Theory of Machines	Ghosh – Mallik	--	Affiliated East west press
07	Theory of Machines	Thomas Bevan	Third	Pearson
08	Theory of Machines	J.E. Shigley	Third	Oxford

5. IMPLEMENTATION STRATEGY:

5.1 Planning of Lectures for a Semester with Content Detailing:

Topic 1

Name: **Fundamentals and Types of Mechanisms**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning more meaningful. e.g.

Knowledge Category	Example/s of category	Teaching methodology
FACT	**Link, Pair Chain Mechanism, Machine Structure**	Explanation with chalk& board initially. Actual demo of Link, Pair Chain Mechanism, Machine Structure through models
CONCEPT	**Inversion**	Explanation with chalk& board initially. Show the effect of change in fixed link to obtain different application / inversions by using models and charts
PRINCIPLE	**Constrained Motion**	Explanation with chalk& board initially. Then explain with the help of model/Charts
PROCEDURE	**Drawing and demonstration of Mechanism**	Explanation with chalk& board initially. Demonstrate through models/PPT/Actual components
APPLICATION	**Machines**	Explanation with chalk& board initially.Use of various mechanisms in machines using workshop / laboratory from mechanical engg.

			Department

Learning Resources:

Books:
Title: 1) Theory of Machines : Khurmi Gupta

2) Theory of Machines : S.S. Rattan

Teaching Aids: Models, Charts , Actual machines mechanisms Chalk Board

PPTs: Available Through Google search ; www.slidshare.com

Websites

Lecture No.	Topic/ Subtopic to be covered
1	**1.1 Kinematics of Machines.** Definitions of Kinematics, Dynamics ,Statics, Kinetics. Concept of Kinematic Link, Kinematic Pair, Kinematic Chain and their Types, Types of Kinematic Pairs
2	Concept of constrained motions. Types of Constrained Motions Concept and Definition of Mechanism. Concept and Definition of Inversion of Mechanisms.
3	Concept and Definition of Machine, Concept and Definition of Structure Comparison between machine and structure, Comparison between machine and Mechanism
4.	**1.2 :Inversions of Kinematic Chain:** Four bar Kinematic chain and its all inversions
5	Single Slider Crank Kinematic chain and its all inversions
6	Double Slider Crank Kinematic chain and its all inversions
7.	Revision Review Feedback and Question Bank for the Topic to be given by the teacher referring earlier question papers and some innovative questions.

Topic 2

Name: **Velocity and Acceleration in Mechanisms**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.
e.g.

Knowledge Category	Example/s of category	Teaching methodology
FACT	**Motion , Link, Chain, Mechanism**	Explanation with chalk& board initially.Citing examples

			from day to day life
	CONCEPT	**Displacement, Velocity, Acceleration (Linear, Angular and Relative)**	Explanation with chalk& board initially. Revision of previously learnt concepts
	PRINCIPLE	**Direction and Magnitude of Vectors like velocity and Acceleration**	Explanation with chalk& board initially. Explaining by giving examples use of ppt.
	PROCEDURE	**Analytical method** **Graphical methods** **Relative velocity Method** **Klein's Construction Method**	Explanation with chalk & board initially. Teaching step by step procedure for Analytical solution by using formulae. Also teach Graphical solution by Drawing as per laid down procedure.
	APPLICATION	**Determination of Velocity and acceleration of links in a mechanism**	Explanation with chalk & board initially. Solving problems and determining the various parameters as required
	Learning Resources:: Books: Theory of Machines : S.S. Rattan Theory of Machines : P.L.Ballaney Teaching Aids: Chalk Board, Drawing Instruments, Charts PPT : NOT EXPECTED/ RECOMMENDED TO BE USED FOR THIS TOPIC Websites: :		
Lecture No.	Topic/ Subtopic to be covered		
1	**2.1 Concept**		

	Concept of relative velocity / Acceleration of a point on link Concept of angular velocity / Acceleration of a point on link Inter relation between angular and linear quantities.
2	Analytical method and its application Simple numerical
3.	Klein's Construction Method and Graphical solution to simple problem on it.
4.	Relative velocity method to determine velocity. Simple Numerical
5.	Advanced Numerical on Relative velocity method to determine velocity.
6.	Relative velocity and acceleration method to determine acceleration . Simple Numerical
7.	Advanced Numerical on Relative velocity and acceleration method to determine acceleration
8.	Revision Review Feedback and Question Bank for the Topic to be given by the teacher referring earlier question papers and some innovative questions.

Topic 3

Name: **Cams and Followers**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.

Knowledge Category	Example/s of category	Teaching methodology
FACT	**Cam, Follower, cam shaft**	Explanation with chalk & board initially. Show the models of IC Engine camshaft etc,
CONCEPT	**Pressure angle , Pitch circle , Cam profile etc.**	Explanation with chalk & board initially. Make use of Charts, PPts, and Models
PRINCIPLE	**Follower motions like , Uniform velocity, SHM, Uniform acceleration Deceleration. Cam angles**	Explanation with chalk & board initially. Make use of Charts, PPts, and Models
PROCEDURE	**Laying out cam profile based on displacement diagram**	Explanation with chalk & board initially. Drawing Cam profile by using principle of cam Layout.

	APPLICATION	**Use in mechanism/ Machines to get desired output.**	Explanation with chalk & board initially. Demonstration by using model/actual machines.

Learning Resources::
Books: Theory of Machines : S.S. Rattan
Theory of Machines : P.L.Ballaney
Teaching Aids: Chalk Board, Drawing Instruments, Charts, Models
PPT :
Websites: :

Lecture No.	Topic/ Subtopic to be covered
1	Concept , Definition, Application, Types of cam and followers
2	Cam terminology , Types of follower methods and drawing them
3.	Displacement diagram, basics of laying out Cam Profile
4.	Laying out Cam Profile for different follower motion/ different followers
5.	Practice of Laying out Cam Profile
6.	Revision Review Feedback and Question Bank for the Topic to be given by the teacher referring earlier question papers and some innovative questions.

Topic 4

Name**: Power Transmission**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.

Knowledge Category	**Example/s of category**	**Teaching methodology**
FACT	**Belt, pulley, Chain, Gear**	Explanation with chalk & board initially. Make use of models of I.C. Engine, Line shaft Gear Box.etc
CONCEPT	**Belt Tension , Slip Creep, , Gear Train**	Explanation with chalk & board initially. Derivations of various formulae, Explanation by using Gear Box model.

	PRINCIPLE	**Velocity ratio, Law of gearing**	Explanation with chalk & board initially. Discuss the principal with simple problems to reinforce the concept.
	PROCEDURE	**Determination of Power Transmitted.**	Explanation with chalk & board initially. Solve Numerical by using relevant formulae, also give problems for practice at home.
	APPLICATION	**Belt Drives/chain drives / Gear drives**	Explanation with chalk & board initially then show demonstration on Models/ actual machine.
	Learning Resources:: Books: Theory of Machines : S.S. Rattan Theory of Machines : Khurmi, Gupta Teaching Aids: Chalk Board, Drawing Instruments, Charts PPT : Websites: :		

Lecture No.	Topic/ Subtopic to be covered
1	Concept of power transmission. Types of Drives, Belt , Chain , Gear
2	Application of Belt drives, Open Belt Cross belt drive, Belt Material for Flat belt and V belt Selection of Belt Drive
3.	Angle of Lap, Computing Length of Belt, concept of slip and creep.
4.	Determination of tension ratios, and its derivations.
5.	Numerical on topics in lectures No. 3 and No.4 above
6.	Concept of centrifugal tension, initial tension. Condition for maximum power transmission and numerical on it .
7.	Chain drive, its types, advantages, limitations, and applications. Comparisons with belt / Gear Drives.
8.	Gear drives , Gear terminology, law of gearing , classification of gears
9.	Gear train , Velocity ratio calculations , simple numerical
10.	Revision Review Feedback and Question Bank for the Topic to be given by the teacher referring earlier question papers and some innovative questions.

Topic 5

Name: **Flywheel and Governors**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.

Knowledge Category	Example/s of category	Teaching methodology
FACT	**Flywheel , Governor**	Explanation with chalk & board initially. Make use of models charts, test rig etc.
CONCEPT	**Turning Moment diagram, speed variation due to fluctuation of load.**	Explanation with chalk & board initially. Make use of models charts, etc.
PRINCIPLE	**Mass Moment of Inertia, Centrifugal forces in governor**	Explanation with chalk & board initially. Solve simple problems in class to reinforce the principle.
PROCEDURE	**Storage and release of kinetic energy in flywheels Stabilizing speed by controlling fuel supply by use of governors**	Explanation with chalk & board initially. Make use of working models charts etc.
APPLICATION	**Working of Governor and flywheel In IC engine Test Rig.**	Explanation with chalk & board initially. Reinforce the information by using and observing actual working of models/ test

			rigs etc

Learning Resources::
Books: Theory of Machines : Thomas L. Bevan.
Theory of Machines : P.L.Ballaney
Teaching Aids: Chalk Board, Drawing Instruments, Charts
PPT :
Websites: :

Lecture No.	Topic/ Subtopic to be covered
1	Concept, function and application of Flywheel . study of Turning moment diagram, coefficient of fluctuation of Speed/ Energy and its significance.
2	Concept of Governing , terminology related to governor, types of Governor its working and application
3.	Types of Governor , comparison between flywheel and governor.
4.	Revision Review Feedback and Question Bank for the Topic to be given by the teacher referring earlier question papers and some innovative questions.

Topic 6

Name: **Brakes and Dynamometers**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.

Knowledge Category	Example/s of category	Teaching methodology
FACT	**Brake and Dynamometer**	Explanation with chalk & board initially. Make use of working models Laboratory Set up of I.C. engine test rig.
CONCEPT	**Braking Force, Braking torque, Power lost in friction**	Explanation with chalk & board initially. Explain the concept by simple example.
PRINCIPLE	**Friction, Moment of force**	Explanation with chalk & board initially. Explain the concept by simple example.
PROCEDURE	**Construction & working of various brakes &**	Explanation with chalk & board initially. Make use of working models

		dynamometers	Laboratory Set up of I.C. engine test rig.
	APPLICATION	**In various motion bodies & Engine Test rigs**	Explanation with chalk & board initially. Make use of working models Laboratory engine test rigs, working turbine laboratory models

Learning Resources::
Books: Theory of Machines : S.S. Rattan
Theory of Machines Khurmi, Gupta
Teaching Aids: Chalk Board, Drawing Instruments, Charts
PPT :
Websites: :

Lecture No.	Topic/ Subtopic to be covered
1	Function of brake, Dynamometer, types of brakes& dynamometers, comparison of brake & dynamometer
2	Construction and working of different types of brakes ,calculation of braking force/torque and braking power for shoe brake
3.	Simple numerical on brakes.
4.	Construction and working of various types of dynamometer
5.	Revision Review Feedback and Question Bank for the Topic to be given by the teacher referring earlier question papers and some innovative questions.

Topic 7

Name: **Clutches and Bearings**.

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.

Knowledge Category	Example/s of category	Teaching methodology
FACT	**Clutch, Bearing**	Explanation with chalk & board initially. Make use of working models and charts
CONCEPT	**Uniform pressure , uniform wear**	Explanation with chalk & board initially. Make use of working models
PRINCIPLE	**Friction, Thrust, torque and power lost in friction**	Explanation with chalk & board initially.

			Reinforce the principle by solving simple problems in the class.
	PROCEDURE	**Construction and working of Clutches and Bearings.**	Explanation with chalk & board initially. Make use of working models and charts
	APPLICATION	**Automobile engines, and rotary shafts.**	Explanation with chalk & board initially. Show the models and charts to reinforce the learning.

Learning Resources::
Books: Theory of Machines : S.S. Rattan
Theory of Machines : P.L.Ballaney
Teaching Aids: Chalk Board, Drawing Instruments, Charts
PPT :
Websites: :

Lecture No.	Topic/ Subtopic to be covered
1	Concept of clutch, bearing, role of friction in its operation. Types of clutches
2	Construction and working of different clutches.
3.	Concept of uniform pressure and uniform wear, their derivations and simple numerical applied to clutches.
4.	Construction and working of different bearings
5.	Concept of uniform pressure and uniform wear, their derivations and simple numerical applied to bearings.
6.	Revision Review Feedback and Question Bank for the Topic to be given by the teacher referring earlier question papers and some innovative questions.

Topic 8

Name: **Balancing**

Teacher shall implement the methodology/ techniques mentioned in the following table while teaching the topics. Along with this teacher may use additional/alternative methods to make students learning meaningful.

Knowledge Category	**Example/s of category**	**Teaching methodology**
FACT	**Balancing mass, rotating machines**	Explanation with chalk & board initially. Make use of charts to understand the facts.
CONCEPT	**Vibration, balancing**	Explanation with chalk & board initially. Make

			use of charts to reinforce the concepts.
	PRINCIPLE	**Principle of balancing mass**	Explanation with chalk & board initially. Make use of charts to reinforce the principle
	PROCEDURE	**Analytical and graphical method to determine balancing mass**	Explanation with chalk & board step by step procedure. Make use of charts/ working models to make better understanding of students.
	APPLICATION	**Rotary machines.**	Explanation with chalk & board initially. Make use of charts / working models to make better understanding of students.

Learning Resources::
Books: Theory of Machines : Dr. Jagdish Lal
Theory of Machines : Khurmi Gupta
Teaching Aids: Chalk Board, Drawing Instruments, Charts
PPT :
Websites: :

Lecture No.	Topic/ Subtopic to be covered
1	Concept of balancing , need of balancing procedure of balancing Analytical method
2	Graphical Method and numerical on both methods. Review

5.2 Planning and Conduct of Test:

a) The time table and sample test paper for the test should be displayed minimum 10 days before the test.
b) Each test will be of 25 marks.
c) First test should cover about 40% of curriculum and second test should cover remaining curriculum.
d) Format for question paper should be as per the sample question paper supplied by MSBTE.

e) Guidelines for Setting Class Test Question Paper:

- Question no.1 Attempt any three out of four (3X3=9 Marks)
- Question no.2 Attempt any two out of three (2X4=8 Marks)
- Question no.3 Attempt any two out of three (2X4=8 Marks)

5.3 Details about conduct of assignments:

5.4 Strategies for Conduct of Practical:

5.4.1 Suggestions for effective conduct of practical and assessment:

1. The planning of machine/models should be should be ready well in advance before the date of practical.
2. A batch of 20 nos. of students shall be divided in five subgroups so the each subgroup will contain 4-5 students as per the present students.
3. Teacher should explain the construction and working of machine/model before starting the actual practical.
4. subject teachers shall check the tasks performed for each group separately and sign it.
5. At the end of practical teacher shall assess the individual student.
6. The teacher shall schedule the practical dates and display the same in advance.
7. Teacher shall explain the prior, new concepts and the concept Structure to the students before starting the practicals.
8. The continuous assessment i.e. weekly checking shall be done as per CIAAN Norm

5.4.3 Preparation for conduct of practical

The format of objective/readings to be prepare by student should be displayed well in advance by teacher .

6. Mode of assessment:

1.1 Class Test:

- There will be two tests each of 25 marks.
- The tests will be conducted as per the MSBTE schedule.
- Teacher should prepare model answer of class test question papers.
- After completion of test, subject teacher should display model answer on Department Notice Board.
- Teacher should show the answer paper of class test to the student and discuss about the mistakes.
- Teacher should maintain the record of class test as per MSBTE norms (CIAAN)

6.1.2 Sample Test Papers:

Sample Test Paper I

Roll No.				

17412

Institute Name:

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

Semester: IV

Subject**: Theory of Machines**

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 **3x3=09**

a) Define Kinematic Pair. List down types of pairs. What is meant by constrained motion
b) Define Inversion of a mechanism? List down at least four inversions of Single slider crank Chain
c) State two components of acceleration? How they are found out? Which component is not present in case of Crank rotating at uniform velocity?
d) Define i) Angular velocity ii) Linear velocity and state formulae to calculate each of them.
e) Give the classification of Cam and followers.

Q2. Attempt any Two **4x2=08**

a) Define i)pressure angle ii) angle of ascent iii) Angle of descent iv) Dwell with reference to Cam profile
b) Explain with suitable sketch how would you determine Velocity and Acceleration using Klein's Construction?
c) Explain with neat sketch Elliptical Trammel as an inversion of double slider crank chain.

Q3. Attempt any One **8x1=08**

a) With neat sketch explain working of crank and slotted lever Quick Return Motion Mechanism
b) In a single slider crank mechanism ABCD, crank AB=20 mm & connecting rod BC=80mm .Crank AB rotates with uniform speed of 1000rpm in anticlockwise direction. Find i) angular velocity of connecting rod BC ii) velocity of slider C. When crank AB makes an angle of 60 degrees with the horizontal. Draw the configuration diagram also.

Sample Test Paper II

Roll No.				

17412

Institute Name:
Course Name: **Diploma in Mechanical Engg** Course Code: ME
Semester: IV
Subject**: Theory Of Machines**
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 **3x3=09**

a) State the classification of drives used for power transmission.
b) State the classification of chains used for chain drive.
c) State the purpose of use of gear trains.
d) State the classification of governors.
e) List down different types of brakes & dynamometers.

Q2. Attempt any Two **4x2=08**

a) Differentiate between flywheel and governor.
b) Draw a neat sketch of two gear teeth in mesh & show any Eight terms of gear terminology on it.
c) Differentiate between flat belt drive & v belt drive

Q3. Attempt any One **8x1=08**

a) A band &block brake with 10 blocks subtending angle of 150 each at the centre of wheel. Determine maximum force require at the end of lever for the brake to absorb 250 kW at 280 rpm. Effective diameter of drum is 840mm, μ=0.35, a=300mm, b=40mm and l=300mm.The drum is rotating in clockwise direction

b) The ratio between tension on tight side and slack side of belt is 2.1 the belt is running at 16m/s.The safe stress in belt material is not to exceed 1.4MN/M2 .Determine width of belt to transmit 8.0kW. Density of belt material 1gm/cm3 and is 10mm thick.

Sample Question Paper:

Sample Question Paper

Exam seat No.							

17412

Maharashtra State Board of Technical Education

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

Semester: IV

Subject**: Theory Of Machines**

Marks: **100** Time:**3 hour**

Instructions – **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
6. Mobile Phone, Pager and any other Electronic Communication devices are not permitted in Examination Hall.

Q.1(A) Attempt any six 2x6=12

a) Define i) Kinematic Link ii) Kinematic Pair.
b) State two applications of Cam and Followers.
c) Define Slip and Creep with reference to Belt Drive.
d) List the material used for i) Flat Belt ii) 'V' Belt.
e) State the function of Governor in an IC engine.
f) Define i) Coefficient of fluctuation of Speed ii) Coefficient of fluctuation of Energy
g) State types of Dynamometers
h) State necessity of balancing of machines.

(B) Attempt any two 4X2=08

a) Define Constrained Motion State Types of Constrained Motions Explain them with neat sketch.

b) State function of clutch. State it's principle of working

c) Define (i) centrifugal tension (ii) Initial tension. State it's formulae. State the condition for maximum power transmission

Q.2: Attempt any Four 4x4=16

a) Differentiate between machine and mechanism on any four points

b) Explain with neat sketch the working of Whitworth Quick Return Mechanism

c) State the formulae for calculating i) Velocity and ii) Acceleration of Piston using analytical method. State the meaning of each term there in. Also state at what crank position the velocity and Acceleration will be maximum?

d) Explain with suitable sketch method to determine Velocity and Acceleration using Klein's construction?

e) Draw a neat sketch of Radial Cam with roller follower and show on it i) Base Circle, ii)pitch point, iii) pitch circle iv) Pressure angle v) prime circle vi) pitch curve vii) trace point viii) Cam profile.

f) Two shafts with centre to centre distance between them as 3 metres, are having two pulleys with radii equal to 240mm and 320mm respectively. Find the length for cross belt drive

Q.3: Attempt any Four 4x4=16

a) In a given four bar chain PQRS, length of different links are as follows. l(P,Q)=80mm, l(Q,R)=60mm, l(R,S) = 72mm and l(P,S)=100mm. Link PS is fixed and crank PQ rotates at 25rad/sec, in the clockwise direction. Determine Velocity of point R graphically by using Relative velocity method if Crank PQ makes angle of 600 with the horizontal. Draw the configuration diagram also.

b) In a single slider crank mechanism ABCD, crank AB=20 mm & connecting rod BC=80mm .Crank AB rotates with uniform speed of 1000rpm in anticlockwise direction.
Find i) angular velocity of connecting rod BC ii) velocity of slider C. When crank AB makes an angle of 60 degrees with the horizontal. Draw the configuration diagram also.

c) State the advantages & disadvantages of chain drive over the other drives.

d) Draw a neat labeled sketch of single plate clutch and state its working.

e) State and explain in brief the different forces which are required to be balanced in a rotating machine.

f) Define i) pressure angle ii) angle of ascent iii) angle of descent iv)dwell with reference to Cam profile.

Q.4: Attempt any Four 4x4=16

a) Find the diameter of driven pulley rotating at 500 rpm if the driver pulley is 250mm in diameter and rotates at 100 rpm by using a flat belt drive with 5% slip and the belt thickness is 5mm.

b) Explain with neat sketch Oldham's coupling as an inversion of double slider crank chain.

c) Describe the principle of working of a flywheel.

d) Explain with neat sketch construction & working of Proney brake dynamometer.

e) A multiplate clutch has six plates. It has to transmit 20kW of power at 600 rpm.

Inner & outer radii of clutch are 80 &120 mm respectively if coefficient of friction is 0.3 .Find the maximum intensity of pressure between the discs.

f) Four masses m1, m2, m3, m4 are 160kg, 300kg and 200kg respectively. The corresponding radii of rotation are 300mm, 250mm, 150mm and 200mm respectively. The angle between successive masses is 450,900 and 1350. Find the position & magnitude of balancing mass required. If it's radius of rotation is to be 200mm. Solve the problem by using graphical method only.

Q.5: Attempt any Two 8x2=16

a) Determine i) the velocity and acceleration of piston ii) Angular velocity of connecting rod iii) Angular acceleration of connecting rod of the configuration shown below by relative velocity method. When crank OA rotates with uniform speed of 20rad/s.

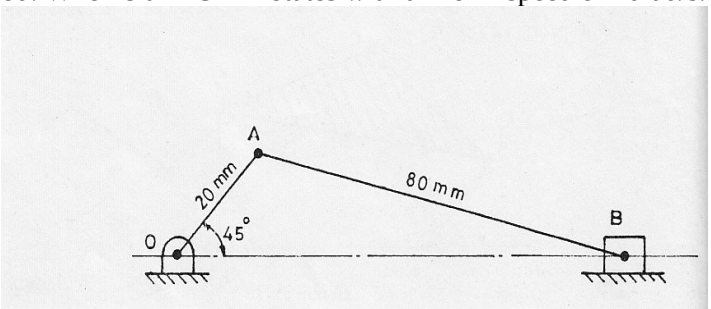


FIG PROB Q 5 (a)

b) A cam with 60mm as minimum diameter is rotating clockwise and has to give motions to a roller follower20mmdiameter as described below
i) Follower to complete outstroke of 24mm during900of cam rotation with uniform velocity motion.
ii) Follower to dwell for next 600of cam rotation
iii) Follower to return to its original position during next 1200 of cam rotation with SHM
iv) Follower to dwell for rest of the period.
Layout the profile of the cam if the roller follower axis passes through the axis of cam.

c) An open belt drive is used to transmit 2.5kW power the belt is running at 2.5m/s velocity over the pulleys .The angle of contact being 1650 and coefficient of friction being 0.3 What will be the effect on power transmission if
i) Initial tension in belt is increased by 8%
ii) Initial tension in belt is decreased by 8%

Q.6: Attempt any Two 8x2=16

a) i) Explain the types of gear trains with the help of neat sketch.
ii) Differentiate between flywheel and governor.

b) A band brake is used for winch. The band is wound over a drum 0.75m diameter .The two ends of band are attached to pins on opposite sides of fulcrum of brake lever of 25mm and 100mm from fulcrum. The angle of lap on the drum is 2400.The coefficient of friction is 0.25. If the load of 500N is applied at end of lever 1 m long; find the braking torque applied if the drum rotates in i) clockwise direction ii) Anti-clockwise direction

c) Find the power lost in friction in a conical pivot bearing supporting a vertical shaft 200mm in diameter subjected to axial load of 30kN .The cone angle is 1200 and coefficient of friction 0.025.The shaft is rotating at 200rpm.

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