

# **CURRICULUM REVISION PROJECT**

**2012**

**TEACHER GUIDE FOR APPLIED MATHEMATICS  
(17301)**

**THIRD SEMESTER  
(ALL BRANCHES)**

**JUNE 2013**



**MAHARASHTRA STATE  
BOARD OF TECHNICAL EDUCATION, Mumbai**

# CURRICULUM DEVELOPMENT CELL, MSBTE, MUMBAI.

## TEACHER'S GUIDE AND SAMPLE QUESTION PAPER

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# 1. APPROACH TO CURRICULUM DESIGN

## 1.1 Overview of Revised Curriculum:

**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.

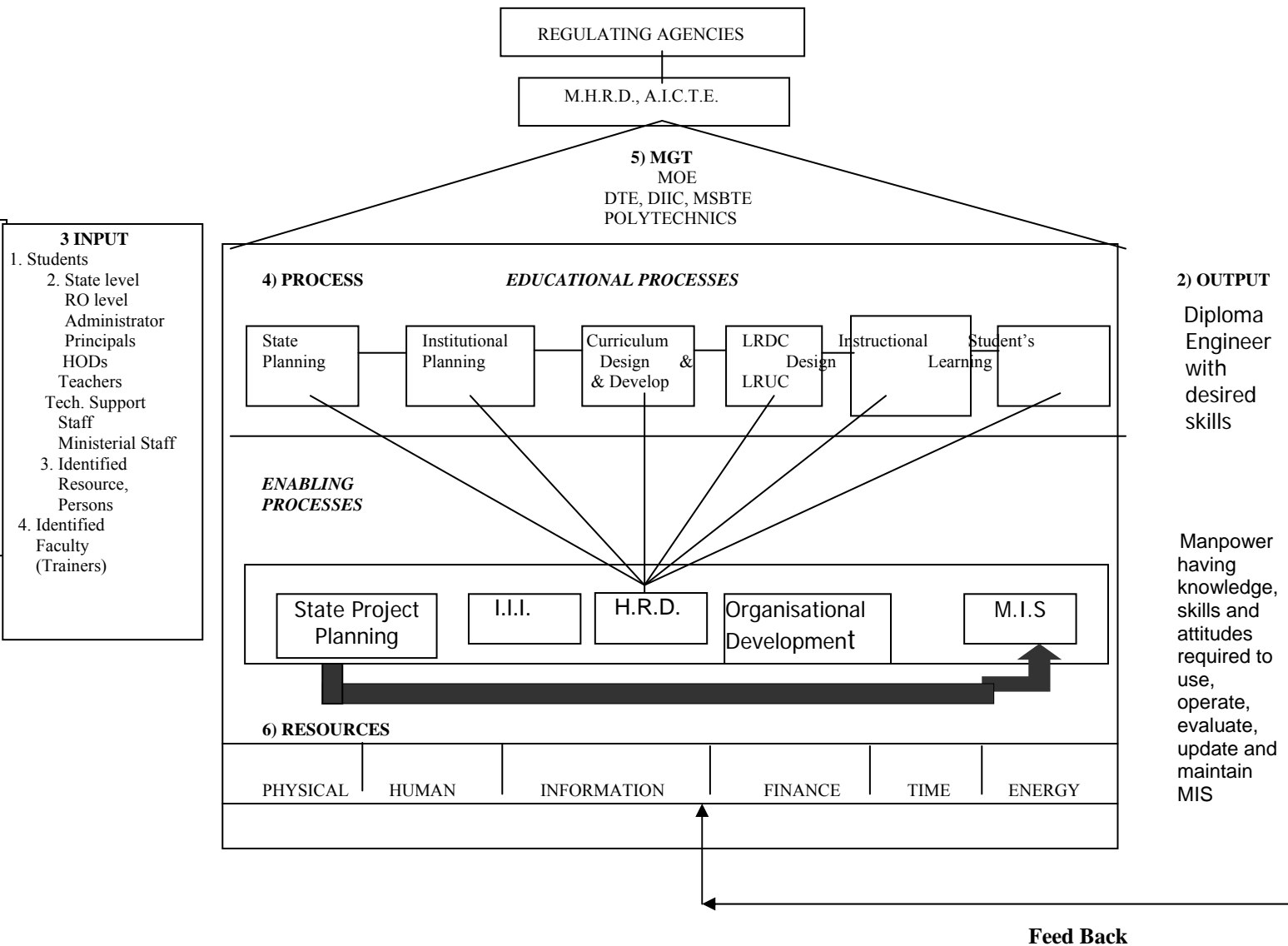
To fulfill the needs derived from systems approach following conceptual framework is considered:

### **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 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 skills*
- 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:

### **Intellectual Skills:**

- Use of data sheets, charts, handbooks, standards
- Interpret drawing, circuit diagrams, plant layouts, charts, performance analysis
- Select materials and components
- Locate faults and repairs of faults
- Analyse the data
- Prepare Estimate
- Design of simple components
- Use of computer software

### **Motor Skills:**

- Measure accurately different parameters
- Operate machines
- Calibrate instruments
- Repair Faults
- Install machines
- Draw plant layout and Prepare detailed drawing
- Conduct various tests and Draw characteristics

### **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 & practical examination of both parts. Candidates 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 & Applied Chemistry where the theory examination of 50 marks each and practical examination of 25 marks each will be conducted separately & the minimum passing marks for applied science will be the combination of both the sections. It is mandatory to appear for theory & practical examinations of both parts. Candidates remaining absent in any examination of any section will not be declared successful for that exam head.
- ❖ The component 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 be 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 the Development of Life Skills, through technical subjects from second to sixth semester. The experience in implementing the content 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 students are doing projects in which they are performing many activities included in the Professional Practices & 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 topic/sub topics.
- ❖ In Civil Engineering Group CAD and Building Materials have been added as an independent subjects. Topics on Air port 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.

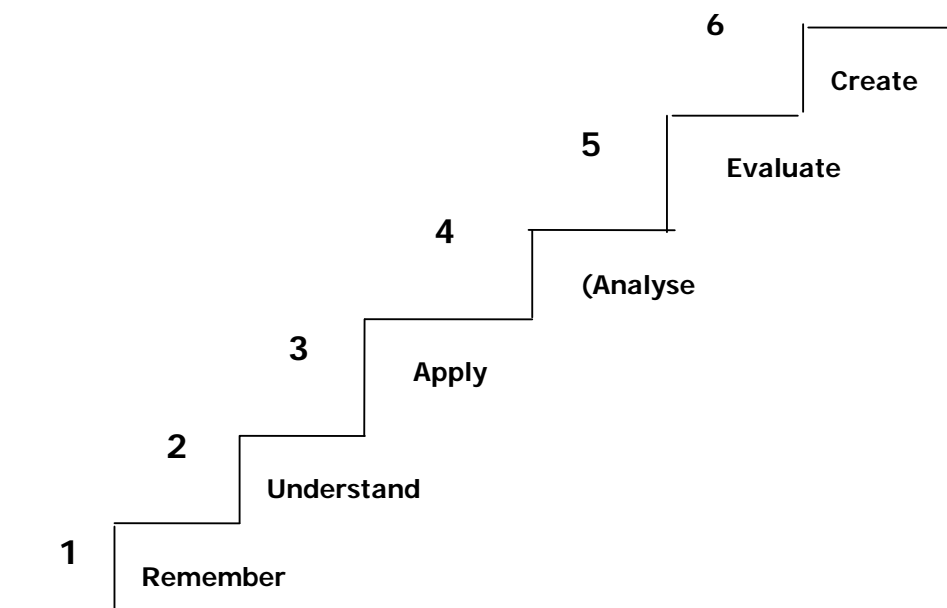
## **2.4 LEVELS OF LEARNING:**

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 and 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
<b>Remember</b> – 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
<b>Understand</b> – This is defined as the ability to grasp the meaning of material. This may be	Understands fact, principles Interprets	Convert, distinguish estimate, explain, extend,

<p>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.</p>	<p>verbal material, Interprets charts, tables, graphs. Translates verbal material to mathematical formula. Estimates consequences implied in data. Justifies methods &amp; procedures.</p>	<p>generalize, give examples; infer, paraphrase, predict, rewrite, summarize, draw labeled sketches.</p>
<p><b>Apply</b> – 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.</p>	<p>Applies principles to new situations. Applies theories to practical situations. Solves mathematical problem. Construct charts, graphs Demonstrates correct usage of a procedure</p>	<p>Change, compile, demonstrate, discover, manipulate, modify, operate, predict, prepare, produce, show, solve, use.</p>
<p><b>Analyze</b> – 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.</p>	<p>Recognizes unstated assumptions and logical fallacies in reasoning. Distinguishes between facts and inferences. Evaluates relevance/adequacy of data.</p>	<p>Breakdown, diagram, differentiate, discriminate, distinguish, identify, illustrate, infer, outline, point out, relate, select, separate, subdivide.</p>

## 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 the entire curriculum.

Importance of the subject is on two counts:

One is 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 use in their job/profession.

**2.5.2 Objectives:** Objectives indicate what the student will be to do/performance after he 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 studying 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 these Factual, Conceptual and Procedural knowledge components are identified in the curriculum of the subject along with the applications. Learning structure gives a 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 provides 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 as fulfill the objectives of the entire curriculum

## 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. Procedures
5. Applications
6. Skills (Psychomotor Skills), and
7. Attitudes (underlying affective behaviors as quite often these are not specifically mentioned in the syllabus, 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 1 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:

w.e.f Academic Year 2012-13

'G' Scheme

**Course Name : All Branches of Diploma in Engineering & Technology**

**Course Code : AE/CE/CH/CM/CO/CR/CS/CW/DE/EE/EP/IF/EJ/EN/ET/EV/EX/IC/IE/IS/  
ME/MU/PG/PT/PS/CD/CV/ED/EI/FE/IU/MH/MI**

**Semester : Third**

**Subject Title : Applied Mathematics**

**Subject Code : 17301**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	--	03	100	--	--	--	100

### NOTE:

<sup>3</sup>/<sub>4</sub> **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**

<sup>3</sup>/<sub>4</sub> **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:

Applied mathematics is designed for its applications in engineering and technology. It includes the topics integration, differential equation, probability distribution. The connection between applied mathematics and its applications in real life can be understood and appreciated.

Derivatives are useful to find slope of the curve, maxima and minima of function, radius of curvature. Integral calculus helps in finding the area. In analog to digital converter and modulation system integration is important. Differential equation is used in finding curve. Probability is used in Metrology and quality control.

The fundamentals of this topic are directly useful in understanding engineering applications in various fields.

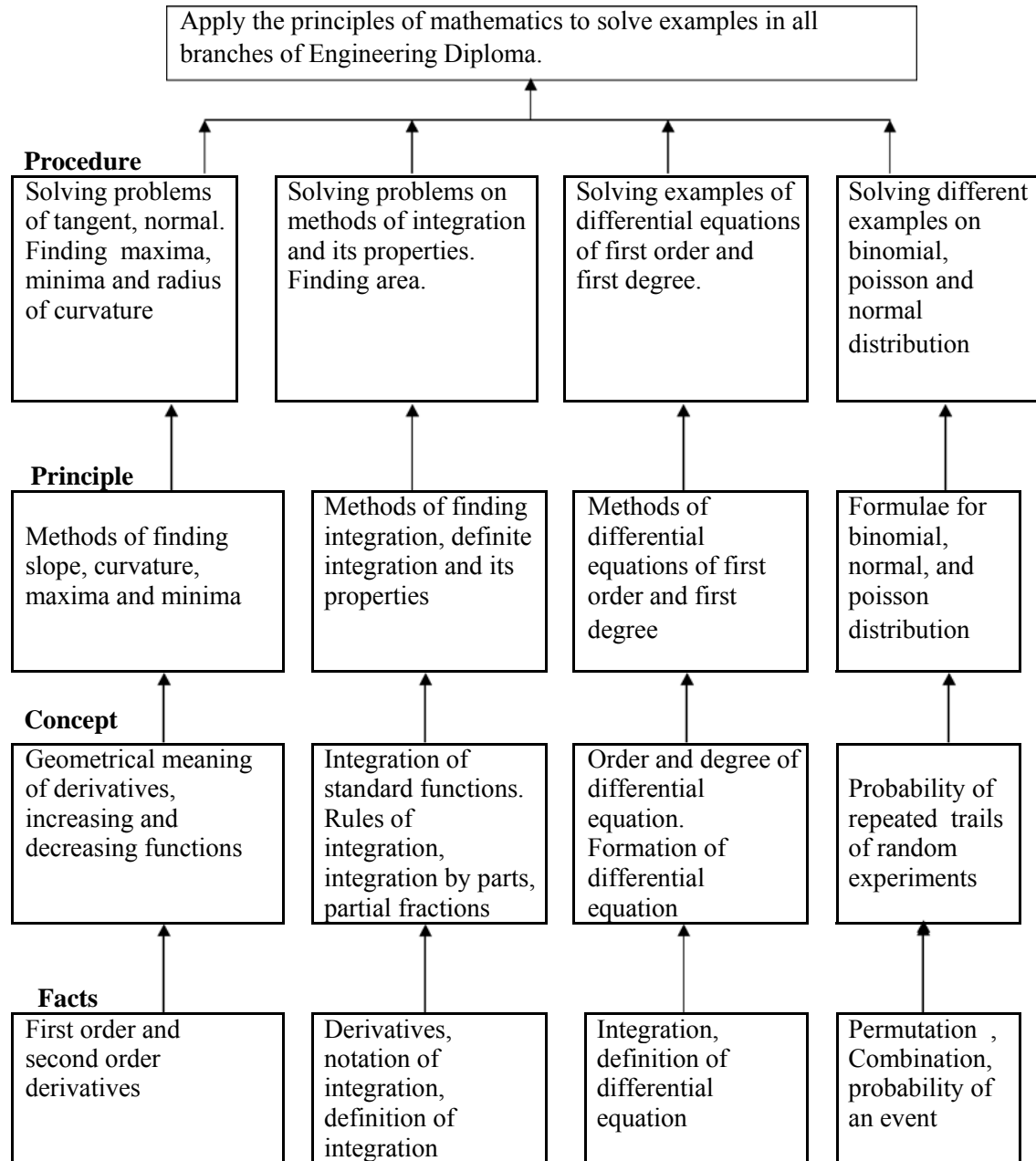
### General Objectives:

Students will be able to:

1. Apply derivatives to find slope, maxima, minima and radius of curvature.
2. Apply integral calculus to solve different engineering problems.
3. Apply the concept of integration for finding area.
4. Apply differential equation for solving problems in different engineering fields.
5. Apply the knowledge of probability to solve the examples related to the production process.

**Learning Structure:**

**Applications**



**Theory:**

Topic and Contents	Hours	Marks
<b>Topic-1 Applications of Derivative</b> <b>Specific objectives :</b> <input type="checkbox"/> <input type="checkbox"/> Find slope, curvature, maximum and minimum value of functions related to different engineering applications. <input type="checkbox"/> Examples for finding slope , equations of tangent and normal to the curve <input type="checkbox"/> Maxima and minima. <input type="checkbox"/> Radius of curvature.	06	16
<b>Topic-2 Integral Calculus</b>		
<b>2.1 Integration ----- 20</b> <b>Specific objectives :</b> <input type="checkbox"/> <input type="checkbox"/> Integrate function using different method. <input type="checkbox"/> Definition of integration as anti derivative, rules of integration. <input type="checkbox"/> Integration of standard functions <input type="checkbox"/> Methods of integration Integration by substitution. Integration by partial fractions. Integration by parts and generalized rule by parts.	14	44
<b>2.2 Definite Integrals ----- 16</b> <b>Specific objectives :</b> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Solve problems on definite integrals using the properties. <input type="checkbox"/> Definite integral- Definition, examples. <input type="checkbox"/> Properties of definite integrals without proof and simple examples.	08	
<b>2.3 Application of Definite Integrals -----08</b> <b>Specific objectives :</b> <input type="checkbox"/> Find area. 1. Area under a curve. 2. Area between two curves.	04	
<b>Topic 3 - Differential Equation.</b>		
<b>3.1 Differential equation</b> <b>Specific objectives :</b> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Solve the differential equation of first order and first degree <input type="checkbox"/> Solve different engineering problems using differential equation <input type="checkbox"/> Differential equation- Definition, order and degree of a differential equation. Formation of differential equation containing single constant. <input type="checkbox"/> Solution of differential equation of first order and first degree for following types Variable separable form, Equation reducible to variable separable form. Linear differential equation. Homogeneous differential equation. Exact differential equation.	10	20

<b>Topic 4 - Probability</b>		
<b>4.1 Probability</b> <b>Specific objectives :</b> ----- <b>08</b> <input type="checkbox"/> Solve different engineering problems related to probability process. <input type="checkbox"/> Definition of random experiment, sample space, event, occurrence of event and types of event (impossible, mutually exclusive, exhaustive, equally likely) <input type="checkbox"/> Definition of probability, addition and multiplication theorems of probability.	02	20
<b>4.2 Probability Distribution</b> ----- <b>12</b> <input type="checkbox"/> Binomial distribution <input type="checkbox"/> Poisson's Distribution <input type="checkbox"/> Normal distribution	04	
<b>Total</b>	<b>48</b>	<b>100</b>

**Learning Resources:**

**1) Books:**

<b>Sr. No</b>	<b>Title</b>	<b>Authors</b>	<b>Publication</b>
1	Mathematic for Polytechnic	S. P. Deshpande	Pune Vidyarthi Girha Prakashan' Pune
2	Calculus : Single Variable	Robert. T. Smith	Tata McGraw Hill
3	Higher Engineering mathematics	B. V Ramana	Tata McGraw Hill
4	Higher Engineering mathematics	H. K. Dass	S .Chand Publication
5	Higher Engineering Mathematics	B. S. Grewal	Khanna Publication, New Delhi
6	Applied Mathematics	P. N. Wartikar	Pune Vidyarthi Griha Prakashan, pune

**2) Websites :**

- i) [www.khan.academy](http://www.khan.academy)

## 5. IMPLEMENTATION STRATEGY:

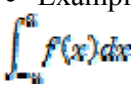
### 5.1 Planning of Lectures for a Semester with Content Detailing:

*[The methods used to explain the contents are just guideline. Any relevant methods can be used for better understanding of students and effective teaching learning process]*

Topic I	<p><b>Name: Application of derivatives</b></p> <p>Facts: List of formulae, <math>dy/dx</math> by first principle, role of <math>dy/dx</math> in higher order derivatives.</p> <p>Concepts: order of derivatives</p> <p>Principles: Finding the slope and equation of the tangent &amp; normal, the Radius of curvature and maxima &amp; minima.</p> <p><b>Reference Material:</b></p> <p>a. Books:            Title: 1) Mathematic for Polytechnic S. P. Deshpande            2) Higher Engineering mathematics H. K. Dass            3) Higher Engineering Mathematics B. S. Grewal</p> <p>b. Teaching Aids: Coin to show the maximum and minimum point</p> <p>c. Websites : <a href="http://www.khanacademy.com">www.khanacademy.com</a> , <a href="http://www.mathwords.com">www.mathwords.com</a></p>
Lecture No.	Topic/ Subtopic to be covered
1	<p><u>Tangent and normal:</u></p> <ul style="list-style-type: none"> <li>• Definition of tangent and normal</li> <li>• Role of <math>\tan\theta</math> in <math>dy/dx</math></li> <li>• Finding slope of tangent &amp; normal to the curve.</li> <li>• Examples of finding slopes of tangent &amp; normal of a curve.</li> </ul>
2	<ul style="list-style-type: none"> <li>• Different examples of finding slope and equation of a tangent and normal of a curve.</li> </ul>
3	<p><u>Maxima and Minima:</u></p> <ul style="list-style-type: none"> <li>• Definition of maxima and minima</li> <li>• Rules of finding maxima and minima</li> <li>a. Let <math>y</math> is a given expression</li> <li>b. Find <math>dy/dx</math> and <math>d^2y/dx^2</math></li> <li>c. Condition of maxima and minima (<math>dy/dx=0</math>)</li> <li>d. Using condition <math>dy/dx=0</math> finding the value of <math>x</math></li> <li>e. Substituting the values of <math>x</math> in <math>d^2y/dx^2</math> <ul style="list-style-type: none"> <li>➤ If <math>d^2y/dx^2 &lt; 0</math> then the function is maximum</li> </ul> </li> </ul>

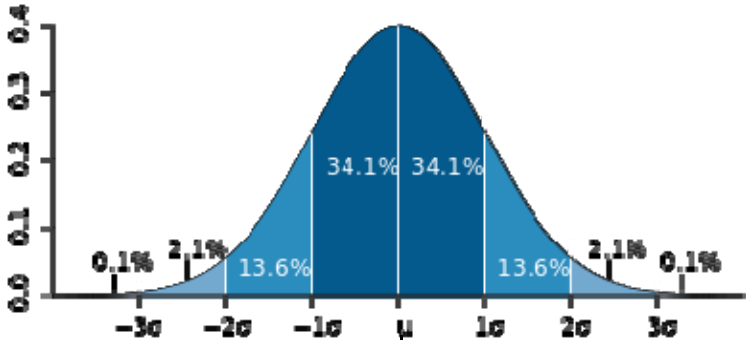
	➤ If $d^2y/dx^2 > 0$ then the function is minimum
4	• Different types of examples of finding maximum and minimum values
5	<p><b>Radius of curvature:</b></p> <ul style="list-style-type: none"> <li>• Notation of radius of curvature (<math>\rho</math>)</li> <li>• Definition of radius of curvature</li> <li>• Formula of radius of curvature</li> </ul> $\rho = \frac{[1 + (\frac{dy}{dx})^2]^{3/2}}{d^2y/dx^2}$
6	• Different types of examples based on above formula
Topic 2	<p><b>Name:</b> Integral calculus:</p> <p>Facts: Definition of derivatives as an anti-derivatives, interpretation of a process of summation because the word “ to integrate” means “to find the sum of list of integrals of various functions (using definite integral to find area under one curve and between two curves).</p> <p>Concepts: To find integrals of different functions</p> <p>Principles: Using integral find area between curves.</p> <p><b>Reference Material:</b></p> <p>a. Books:</p> <p>Title: 1) Mathematic for Polytechnic S. P. Deshpande  2) Higher Engineering mathematics H. K. Dass  3) Higher Engineering Mathematics B. S. Grewal</p> <p>b. Websites : <a href="http://www.khanacademy.com">www.khanacademy.com</a> , <a href="http://www.mathwords.com">www.mathwords.com</a></p>
Lecture No.	Topic/ Subtopic to be covered
2.1	<b>Indefinite Integral:</b>
1	<ul style="list-style-type: none"> <li>• Definition of integration (indefinite) as an anti-derivatives</li> <li>• Integration of standard functions</li> </ul>
2	<ul style="list-style-type: none"> <li>• Examples to find integrals of different functions</li> <li>• Integration of a composite function</li> </ul> <p>Rules of integration, <math>\int \frac{1}{ax+b} dx</math>, <math>\int \frac{1}{\sqrt{a^2-x^2}} dx</math>,.....</p>
3	<ul style="list-style-type: none"> <li>• Examples related to integrals of composite functions</li> <li>• Combine examples on simple functions and composite functions</li> </ul>
4	<ul style="list-style-type: none"> <li>• Methods of integration: <ul style="list-style-type: none"> <li>➤ Integration by substitution.</li> <li>➤ Integration by partial fractions.</li> <li>➤ Integration by parts and generalized rule by parts.</li> </ul> </li> <li>• Identify examples on substitution method</li> </ul>

	For eg: $\int (1 + \tan x) \cdot \sec^2 x dx$ , $\int \frac{\sec^2 x}{1 + \tan x} dx$ etc.
5	<ul style="list-style-type: none"> <li>Examples on formula <math>\int \frac{f'(x)}{f(x)} dx</math> , <math>\int \frac{f'(x)}{\sqrt{f(x)}} dx</math></li> <li>Examples on substitution method (simple examples)</li> </ul>
6	<ul style="list-style-type: none"> <li>Process to find completing squares</li> <li>By completing squares, solve examples using formulae <math>\int \frac{1}{a^2 - 2x} dx</math> , <math>\int \frac{1}{\sqrt{a^2 - 2x}} dx</math> , ....</li> </ul>
7	<ul style="list-style-type: none"> <li>Solve examples of type <math>\int \frac{1}{a \pm b \sin x} dx</math> , <math>\int \frac{1}{a \pm b \cos x} dx</math> by taking substitution <math>\tan \frac{x}{2} = t</math> &amp; solve by completing squares</li> </ul>
8	<ul style="list-style-type: none"> <li>Solve examples on type <math>\int \frac{1}{a \pm b \sin x} dx</math> , <math>\int \frac{1}{a \pm b \cos x} dx</math> , .... Using substitution <math>\tan x = t</math></li> </ul>
9	<ul style="list-style-type: none"> <li>Examples on <math>\int \frac{1}{a \pm b \sin^2 x} dx</math> , <math>\int \frac{1}{a \pm b \cos^2 x} dx</math> ..... by dividing <math>\cos^2 x</math> or <math>\sin^2 x</math> and apply substitution method</li> </ul>
10	<ul style="list-style-type: none"> <li>Integration by parts rule (explain)</li> <li>Examples on integration of multiplication of two functions, interpret using LIATE rule</li> </ul>
11	<ul style="list-style-type: none"> <li>Examples on integration by parts rule using substitution method also integral of function:  <math>\int \sec^2 x dx</math> , <math>\int \operatorname{cosec}^2 x dx</math> , <math>\int \log x dx</math></li> </ul>
12	<ul style="list-style-type: none"> <li>Integration by partial fractions (explain), examples on when denominator contains linear factors</li> </ul>
13	<ul style="list-style-type: none"> <li>Examples when denominator contains repeated factors, also when denominator contains non repeated quadratic factors</li> </ul>
14	<ul style="list-style-type: none"> <li>Examples by substitution convert example into partial fractions</li> </ul>
Lecture No.	Topic/ Subtopic to be covered
2.2	<b>Definite Integrals:</b>
1	<ul style="list-style-type: none"> <li>Definition of definite integral, rules of definite integrals for simple and composite function</li> </ul>
2	<ul style="list-style-type: none"> <li>Solve examples on definite integrals. (simple and composite functions)</li> </ul>
3	<ul style="list-style-type: none"> <li>Property of following definite integrals with explanation,  <math>\int_a^b f(x) dx = \int_a^b f(a + b - x) dx</math> &amp; <math>\int_a^b f(x) dx = \int_a^b f(a - x) dx</math></li> <li>Examples related to above properties of definite integrals</li> </ul>
4	<ul style="list-style-type: none"> <li>Examples related to following properties of definite integrals:  <math>\int_c^b f(x) dx = - \int_b^c f(x) dx</math> &amp; <math>\int_a^a f(x) dx = 0</math> , <math>\int_a^b f(x) dx = \int_a^c f(x) dx + \int_c^b f(x) dx</math> &amp;  <math>\int_c^b f(x) dx = \int_a^c f(x) dx + \int_c^b f(x) dx</math> where <math>a &lt; c &lt; b</math></li> </ul>
5	<ul style="list-style-type: none"> <li>Examples related to following properties of definite integrals:  <math>\int_0^{2a} f(x) dx = \int_0^a f(x) dx + \int_0^a f(2a - x) dx</math></li> </ul>

6	<ul style="list-style-type: none"> <li>• Examples on definite integrals using substitution method</li> </ul>
7	<ul style="list-style-type: none"> <li>• Examples on property:</li> </ul>  <p>For even and odd function.</p>
8	<ul style="list-style-type: none"> <li>• Mixed examples on definite integrals</li> </ul>
Lecture No.	Topic/ Subtopic to be covered
2.3	<b>Application of definite Integrals:</b>
1	<ul style="list-style-type: none"> <li>• Explain different types of curves</li> <li>• Formula to find area under one curve, also examples to find area of circle, ellipse etc</li> <li>• Also examples to find area of circle, ellipse etc</li> </ul>
2	<ul style="list-style-type: none"> <li>• Examples to find area of loop, sine curves etc</li> </ul>
3	<ul style="list-style-type: none"> <li>• Explain formula to find area between two curves. For example area between straight line &amp; parabola</li> </ul>
4	<ul style="list-style-type: none"> <li>• To find area between two parabolas</li> </ul>
Topic 3	<p><b>Name: Differential Equations:</b></p> <p>Facts: Derivatives, partial derivative &amp; integration</p> <p>Concepts: First and second order differential equation</p> <p>Principles: Order &amp; degree of differential equations &amp; formation of Differential equations</p> <p><b>Reference Material:</b></p> <p>a. Books:</p> <p>Title: 1) Mathematic for Polytechnic S. P. Deshpande 2) Higher Engineering mathematics H. K. Dass</p> <p>b. Websites : <a href="http://www.khanacademy.com">www.khanacademy.com</a> , <a href="http://www.mathwords.com">www.mathwords.com</a></p>
Lecture No.	Topic/ Subtopic to be covered
1	<ul style="list-style-type: none"> <li>• Concept of differential equations, order &amp; degree of differential equations and formation of differential equations</li> </ul>
2	<ul style="list-style-type: none"> <li>• Formation of differential equations by eliminating arbitrary constants.</li> </ul>
3	<ul style="list-style-type: none"> <li>• Types of differential equations: <ul style="list-style-type: none"> <li>a. <u>Variable separation method</u>: definition and identification of variable separation method and examples of variable separation method.</li> </ul> </li> </ul>

4	b. Reducible to variable separation form by using substitution (examples based on reducible to variable separation form)
5	<ul style="list-style-type: none"> <li>Homogeneous differential equations: Definition, identification on the basis of homogeneous function &amp; reducible into variable separation form</li> <li>Examples of solving homogeneous differential equations</li> </ul>
6	<ul style="list-style-type: none"> <li>Exact differential equations: definition, identification based on partial differentiation, condition &amp; working rule of exact differential equations</li> <li>Examples of solving exact differential equations</li> </ul>
7	<ul style="list-style-type: none"> <li>Linear differential equations: definition, identification, integrating factor, &amp; generalized rule of integration by parts &amp; working rule of solving linear differential equations</li> <li>Examples of solving linear differential equations</li> </ul>
8	<ul style="list-style-type: none"> <li>Identification of differential equations either by variable separable or by exact differential equations by using suitable methodology</li> <li>Examples of solving exact differential equations</li> </ul>
9	<ul style="list-style-type: none"> <li>Identification of variable separation, reducible to variable separation &amp; homogeneous differential equation by using suitable substitution</li> </ul>
10	<ul style="list-style-type: none"> <li>Revision of all types of differential equations by using identification of specific types of differential equation</li> </ul>
Topic 4	<b>Probability:</b>
4.1	<p><b>Name: Probability:</b></p> <p>Facts: Meaning of probability, set notations</p> <p>Concepts: Definition of probability, definition of various terms used in probability such as Trial or Experiment, Random experiment, Random variable, Sample space, event, occurrence of an event &amp; different types of an event</p> <p>Principles: Finding probability of an event by using addition &amp; multiplication theorem</p> <p><b>Reference Material:</b></p> <p>a. Books:</p> <p>Title:</p> <ol style="list-style-type: none"> <li>Higher Engineering mathematics H. K. Dass</li> <li>Higher Engineering Mathematics B. S. Grewal</li> </ol> <p>b. Websites : <a href="http://www.khanacademy.com">www.khanacademy.com</a> , <a href="http://www.mathwords.com">www.mathwords.com</a></p>
Lecture No.	Topic/ Subtopic to be covered
	<ul style="list-style-type: none"> <li>Concept of probability</li> <li>Definition of various terms such as trial or experiment, random experiment, random variable, sample space, event, occurrence of an event, types of an event such as impossible event, mutually exclusive events, exhaustive events, equally likely</li> </ul>

	<p>events</p> <ul style="list-style-type: none"> <li>• Definition of probability</li> <li>• Correlation of probability with engineering</li> </ul> <p>For example</p> <ul style="list-style-type: none"> <li>➤ A mechanism consist of 3 parts A, B &amp; C with the respective failure probabilities p, q &amp; r. The mechanism works if there is no failures in any of these parts then find the probability that the mechanism is working and also find the probability that the mechanism is not working. (Example of independent event)</li> <li>➤ A binary number is made up of n digits. If the probability of incorrect digit appearing is p &amp; that error in different digits are independent of one another then find the probability of forming an incorrect number.</li> </ul> <ul style="list-style-type: none"> <li>• Simple examples of finding the probability of an event in the trial of tossing of a coin, throwing of a die, selecting a card etc</li> </ul>
2	<ul style="list-style-type: none"> <li>• Definition of conditional probability with examples</li> <li>• Definition of additional theorem</li> <li>• Examples based on additional theorem</li> <li>• Definition of an multiplication theorem</li> <li>• Examples based on multiplication theorem</li> </ul>
Topic 3	<p><b>Name: Probability Distributions:</b></p> <p>Facts: Definition of probability distribution, types of probability distribution (discrete &amp; continuous)</p> <p>Concepts: Definition of Binomial, Poisson &amp; Normal distribution</p> <p>Principles: Applying Binomial, Poisson &amp; Normal distribution for finding the probability of an event</p> <p><b>Reference Material:</b></p> <p>a.Books:</p> <p>Title:</p> <ol style="list-style-type: none"> <li>1) Higher Engineering mathematics H. K. Dass</li> <li>2) Higher Engineering Mathematics B. S. Grewal</li> </ol> <p>b.Websites : <a href="http://www.khanacademy.com">www.khanacademy.com</a> , <a href="http://www.mathwords.com">www.mathwords.com</a></p>
Lecture No.	Topic/ Subtopic to be covered
1	<ul style="list-style-type: none"> <li>• Concept of probability distribution</li> <li>• Types of probability distribution such as discrete &amp; continuous probability distributions with examples</li> <li>• Meaning of probability distribution function (p.d.f.) with examples</li> </ul>
2	<ul style="list-style-type: none"> <li>• Definition of Binomial probability distribution</li> <li>• P.d.f. of Binomial distribution</li> <li>• Mean, variance &amp; std. deviation of binomial distribution</li> </ul>

	<ul style="list-style-type: none"> <li>Different types of examples based on binomial distribution</li> </ul>
3	<ul style="list-style-type: none"> <li>Definition of a Poisson distribution</li> <li>P.d.f. of poisson distribution</li> <li>Mean, variance &amp; std. deviation of Poisson distribution</li> <li>Different types of examples based on Poisson distribution</li> </ul>
4	<ul style="list-style-type: none"> <li>Meaning of Normal &amp; standard normal distribution</li> <li>Importance of normal distribution</li> <li>Concept of standard normal curve</li> <li>Area under the standard normal curve such as</li> </ul>  <ul style="list-style-type: none"> <li>i. The area between <math>x=m-\sigma</math> and <math>x=m+\sigma</math> is 68.27%</li> <li>ii. The area between <math>x=m-2\sigma</math> and <math>x=m+2\sigma</math> is 95.45%</li> <li>iii. The area between <math>x=m-3\sigma</math> and <math>x=m+3\sigma</math> is 99.73%</li> </ul> <ul style="list-style-type: none"> <li>Standard normal variate</li> </ul> $Z = \frac{x - \mu}{\sigma}$ <ul style="list-style-type: none"> <li>How to find the area by using standard normal variate</li> <li>Different types of examples based on normal distribution</li> </ul>

## 5.2 Planning and conduct of Test:

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

### 5.3 **Guideline for setting class test paper:**

The following instruction should be followed strictly by the paper setter (subject teacher):

1. The question paper should be set according to the given **Sample Test Paper format**.
2. Question paper for class tests first 7 second should be strictly based on the given syllabus.
3. Question 1 will be of 9 marks. The student will have to attempt any three out of four. This question will have each bit of 3 marks.  
Question 2 and 3 will be of 8 marks each. The student has to attempt any 2 out of 3. These questions will have each bit of 4 marks.
4. The teacher should ensure that the curriculum is covered by that time.
5. Duration of class test is one hour.
6. Instructions should be given at the top of the paper.

### 5.4 **Class Test-I**

#### **A) Syllabus for class test I:**

1. Application of derivatives
2. Integral Calculus:
  - 2.1 Integration
  - 2.2 Definite Integral.

#### **B) Class test Question paper format:**

**Q.1 Attempt any THREE of the following:** **(3x3=9)**

- a. Application of derivative
- b. Integration
- c. Integration
- d. Definite Integral

**Q.2 Attempt any TWO of the following:** **(2x4=8)**

- a. Application of derivatives.
- b. Integration
- c. Definite Integral

**Q.3 Attempt any TWO of the following:**

**(2x4=8)**

- a. Application of derivatives
- b. Integration
- c. Definite Integral

### **Class Test-II**

**A) Syllabus for class test II:**

2. Integral Calculus:
  - 2.3 Application of definite integral
3. Differential Equations
4. Probability
  - 4.1 Probability
  - 4.2 Probability distributions

**B) Class test Question paper format:**

**Q.1 Attempt any THREE of the following:**

**(3x3=9)**

- a. Application of definite integrals
- b. Differential Equations
- c. Probability
- d. Probability distribution

**Q.2 Attempt any TWO of the following:**

**(2x4=8)**

- a. Application of definite integrals
- b. Differential Equations
- c. Probability/ Probability Distribution

**Q.3 Attempt any TWO of the following:**

**(2x4=8)**

- a. Differential Equations
- b. Differential Equations/Probability
- c. Probability/Probability Distributions

**Note: While setting the question paper**

**40% questions should be based on Remember level.**

**40% questions should be based on Understanding level.**

**20% questions should be based on Application level.**

## Sample Test Paper : Class test -1

<b>Roll No.</b>				
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17301

Institute Name:

**Course Name: All Branches of Diploma in Engineering and Technology**

**Course Code: AE/CE/CH/CM/CO/CR/CS/CW/DE/EE/EP/IF/EJ/EN/ET/EV/EX/IC/IE/  
IS/ME/MU/PG/PT/PS/CD/CV/ED/EI/FE/IU/MH/MI**

Semester : III-G

Subject: **Applied Mathematics**

Marks: **25**

Time: **1 hour**

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### 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

**Q.1 Attempt any THREE of the following.**

**(3x3=9)**

a. Find the slope of the curve  $2x^2 - xy + 3y^2 = 18$  at the point (3,1). Also find the slope of the normal at this point.

b. Evaluate:  $\int \frac{(x+1)(x+2)}{x} \sin x$

c. Evaluate:  $\int \frac{1}{\sin^2 x + \cos^2 x} dx$

d. Evaluate:  $\int_{-1}^1 \frac{1}{x^2+1} dx$

**Q.2 Attempt any TWO of the following.**

**(2x4=8)**

a. Find the radius of the curvature of the curve  $y=x^3$  at (2,8)

b. Evaluate:  $\int \frac{e^{2x}(x+1)}{\sin^2(xe^{2x})} dx$

c. Evaluate:  $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$

**Q.3 Attempt any TWO of the following.**

**(2x4=8)**

a. Find the maximum and minimum value of  $x^3-9x^2+24x$

b. Evaluate  $\int \sin x \cdot e^{2x} dx$

c. Evaluate:  $\int_1^4 \frac{\sqrt{x}}{\sqrt{x} + \sqrt{2-x}} dx$

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## Sample Test Paper

<b>Roll No.</b>				
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17301

Institute Name:

**Course Name: All Branches of Diploma in Engineering and Technology**

**Course Code: AE/CE/CH/CM/CO/CR/CS/CW/DE/EE/EP/IF/EJ/EN/ET/EV/EX/IC/IE/  
IS/ME/MU/PG/PT/PS/CD/CV/ED/EI/FE/IU/MH/MI**

Semester : III-G

Subject: **Applied Mathematics**

Marks: **25**

Time: **1 hour**

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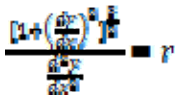
### Instructions:

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

**Q.1 Attempt any THREE of the following.**

**(3x3=9)**

- a. Find the area of circle  $x^2+y^2=a^2$  by integration.
- b. State the order and degree of the differential equation


$$\left(1 + \left(\frac{dy}{dx}\right)^2\right)^{3/2} = r$$

- c. From 20 tickets marked 1 to 20, one ticket is drawn at random. Find the probability that it is marked with multiple of 3 or 5.
- d. If a random variable has a Poisson distribution such that  $P(2)=P(3)$ , find  $P(5)$ .

**Q.2 Attempt any TWO of the following.**

**(2x4=8)**

- a. find the area bounded by the curve  $y=x^2$  & the line  $y=x$   
 b. Solve:  $(2xy+y-\tan y)dx+(x^2-y\tan^2 y+\sec^2 y)dy=0$   
 c. If  $P(A)=2/3$ ,  $P(B)=3/4$  &  $P(A/B)=4/5$  find  $P(A \cap B)$  &  $P(A/B)$

or

- c. If 20% of the bolts produce by a machine are defective. Determine the probability that out of 4 bolts drawn,  
 (i). one is defective                      (ii). At the most two are defectives

**Q.3 Attempt any TWO of the following.**

**(2x4=8)**

a. solve:  $(x+1)\frac{dy}{dx} - y = e^x(x+1)^2$

b. A husband and wife appear in an interview for two vacancies in the same post. The probability of husband's selection is  $1/7$  & that of wife's selection is  $1/5$ . What is the probability that

- (i). both of them will be selected    (ii). Only one of them will be selected and (iii). None of them will be selected

or

b. solve:  $\frac{dy}{dx} = e^{2x-3y} + 4x^2 e^{-3y}$

c. In a sample of 1000 cases, the mean of a certain test is 14 & standard deviation is 2.5. Assuming the distribution to be normal, find

- (i). how many students score between 12 & 15?  
 (ii). how many score above 18?

or

c. An urn contains 10 red, 5 white & 5 black balls. Two balls are drawn at random. Find the probability that they are not of the same colour.

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6.2.3 Sample Question Paper:

Exam Seat No.									
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17301
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Maharashtra State Board of Technical Education

Course Name: **All Branches of Diploma in Engineering/ Technology.**

Course Code: **AE/CE/CH/CM/CO/CR/CS/CW/DE/EE/EP/IF/EJ/EN/ET/EV/EX/IC/  
IE/IS/ME/MU/PG/PT/PS/CD/CV/ED/EI/FE/IU/MH/MI**

Semester: Third

Title of the Subject: Applied Mathematics

Subject Code: 17301

Marks: 100

Time: 3 Hours

**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

**Q.1 Attempt any TEN of the following**

**(10x2=20)**

- a. Find the point on the curve  $y=7x-3x^2$  where the inclination of the tangent is  $45^\circ$
- b. Find the radius of curvature of the curve  $y=x^3$  at (2,8)
- c. Evaluate:  $\int \frac{\sin(\log x)}{x} dx$
- d. Integrate w. r. t. x,  $\frac{\sin^3 x}{1+\cos x}$
- e. Evaluate:  $\int \log x dx$
- f. Evaluate:  $\int \frac{1}{(x+1)(x+2)} dx$
- g. Evaluate:  $\int_0^\infty e^{-x} dx$
- h. Find the area enclosed by curve  $y=3x^2$  and the line  $x=1$ ,  $x=3$  & x-axis.

i. Find order and degree of the following differential equation:

$$\frac{d^2y}{dx^2} = \left[ k + \left( \frac{dy}{dx} \right)^2 \right]^{3/2}$$

j. Verify that  $y = \log x$  is a solution of  $x \frac{d^2y}{dx^2} + \frac{dy}{dx} = 0$

k. An urn contains 10 black and 10 white balls. Find the probability of drawing two balls of the same colour.

l. An unbiased coin is tossed 6 times. Find the probability of getting 2 heads.

**Q.2 Attempt any FOUR of the following**

**(4x4=16)**

a. Find the equation of the tangent & normal to the curve  $x^2 + 3xy + y^2 = 5$  at (1,1)

b. A telegraph wire hangs in the form of a curve  $y = a \log \left[ \sec \left( \frac{x}{a} \right) \right]$  where 'a' is constant.

Show that the curvature at any point is  $\frac{1}{a} \cos \left( \frac{x}{a} \right)$

c. Find maxima and minima of  $y = 2x^3 - 3x^2 - 36x + 10$

d. Evaluate:  $\int \frac{1}{1 + \sin x} dx$

e. Evaluate:  $\int \frac{\sec x \cos x}{(\tan x)^2} dx$

f. Evaluate:  $\int \frac{x^2 + 6x - 8}{x^2 - 4x} dx$

**Q.3 Attempt any FOUR of the following**

**(4x4=16)**

a. Evaluate:  $\int_0^{\infty} \frac{dx}{a^2 + b^2 x^2}$

b. Evaluate:  $\int_0^{\pi/2} \frac{1}{1 + \sqrt{\tan x}} dx$

c. Find area bounded by the two curves  $y^2 = 4x$  and  $x^2 = 4y$

d. solve,  $\frac{dy}{dx} = (4x + y + 1)^2$

e. solve  $(x^2 + y^2) dx - 2xy dy = 0$

f. Solve:  $x \log x \frac{dy}{dx} + y = 2 \log x$

**Q.4 Attempt any FOUR of the following**

**(4x4=16)**

a. Evaluate:  $\int_3^9 \frac{\sqrt{9-x}}{\sqrt{9-x} + \sqrt{x}} dx$

- b. Evaluate:  $\int_0^{\pi} x \cdot \sin x \cdot \cos^2 x \, dx$
- c. Find area of the loop of a curve  $y^2 = x^2(1-x)$
- d. Solve:  $\frac{dy}{dx} = 1 + x + y + xy$
- e. Solve:  $(y \cdot e^{xy} - 2y^2)dx + (xe^{xy} - 6xy^2 - 2y)dy = 0$
- f. Show that  $y^2 = ax^2$  is a solution of  $x\left(\frac{dy}{dx}\right)^2 - 2y\frac{dy}{dx} + ax = 0$

**Q.5 Attempt any FOUR of the following**

**(4x4=16)**

- a. Three machines I, II and III manufactures respectively 0.4, 0.5 and 0.1 of the total production. The percentage of defective items produced by I, II and III is 2, 4 and 1 percent respectively. For an item chosen at random, what is the probability it is defective?
- b. If 10% of bolts produced by a machine are defective. Determine the probability that out of 10 bolts chosen at random
- i) one ii) none iii) at most 2 bolts will be defective.
- c. Fit a Poisson distribution to set of observations:

X	1	2	3	4	5
f	122	60	15	02	01

- d. Evaluate:  $\int \frac{dx}{2+4\cos x}$
- e. Evaluate:  $\int_0^{\pi/4} x \cdot \sec^2 x \, dx$
- f. Solve:  $\cos^2 x(x-2y) = 1 - 2\frac{dy}{dx}$

**Q.6 Attempt any FOUR of the following**

**(4x4=16)**

- a. If  $P(A)=2/3$ ,  $P(B)=3/4$  &  $P(A/B)=4/5$  find  $P(A \cap B)$  &  $P(B/A)$ .
- b. If the probability of a bad reaction from a certain injection is 0.001, determine the chance that out of 2000 individuals more than two will get a bad reaction. (Given  $e^2 = 7.4$ )
- c. A sample of 100 dry battery cells tested to find the length of life produced the following results. Assuming that the data are normally distributed what percentage of battery cells are expressed to have life i) more than 15 hrs. ii) less than 6 hrs. iii) between 10 hrs and 14 hrs.

- d. A metal 36 cm long is bent to form a rectangle. Find its dimensions when its area is maximum.
- e. find the equation of the tangent to the curve  $y = 9x^2 - 12x + 7$  which is parallel to the x-axis.
- f. Two points A(1,4) and B(9,12) are on the parabola  $y^2 = 16x$ . Show that area enclosed between the chord AB & the parabola is  $16/3$

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