# CURRICULUM REVISION PROJECT

# 2012

## TEACHER GUIDE FOR

(Subject- **Microcontroller** Code No.**17534**)

## FIFTH SEMESTER ELECTRONICS ENGINEERING GROUP

**JUNE 2014**

**MAHARASHTRA STATE**
**BOARD OF TECHNICAL EDUCATION, Mumbai**
**(Autonomous) (ISO 9001:2008) (ISO/IEC 27001:2005)**
**CURRICULUM DEVELOPMENT CELL, MSBTE, MUMBAI.**

## TEACHER'S GUIDE AND SAMPLE QUESTION PAPER

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# 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.

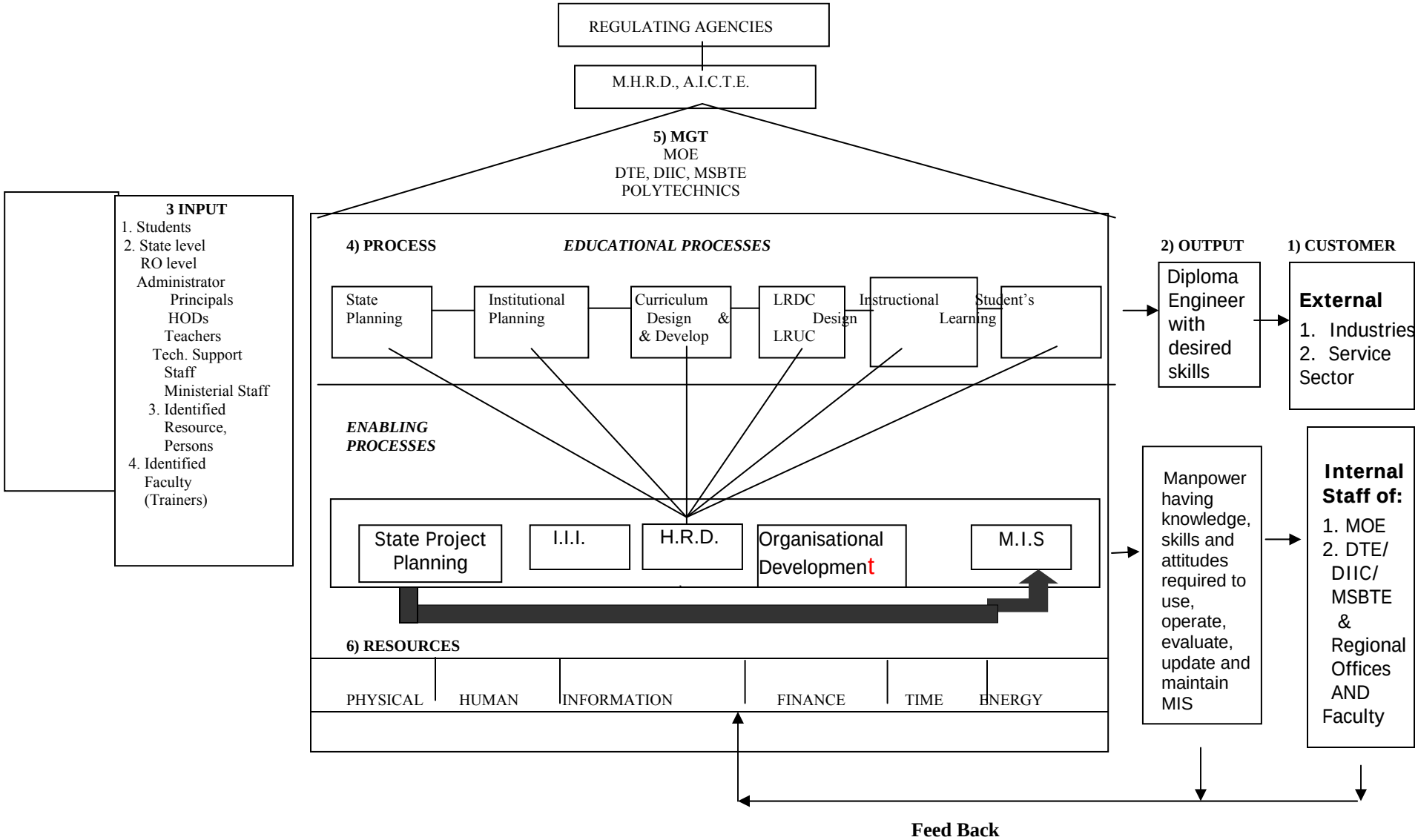



**Fig 1 Systems Approach**

## 1.4 Curriculum goals

1. To develop 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.

## 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 logical thinking ability
- Develop programing skill
- Develop interfacing skill
- 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 Electronics Engineering drawings.
2) Read and interpret Architecture of microcontroller/microprocessor.
3) Carryout programing of particular task.
4) Design simple control model using microcontroller.
5) Prepare database.
6) Prepare algorithm.
7) Perform Flowchart.
8) Use keil software.
9) Follow various standards and codes.
10) Maintain records in various formats.
11) Carry out Hardware maintenance.
12) Prepare various programs.
13) Supervise hardware maintenance work.
14) Select appropriate microcontroller as per requirement.

**B) Motor Skills.**

1) Prepare manual and Computer generated Architecture/circuit diagram.
2) Use microcontroller board as per requirement.
3) Handle testing of microcontroller board.
4) Handle and execute programs.
5) Interface various peripherals with microcontroller board.

## 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.

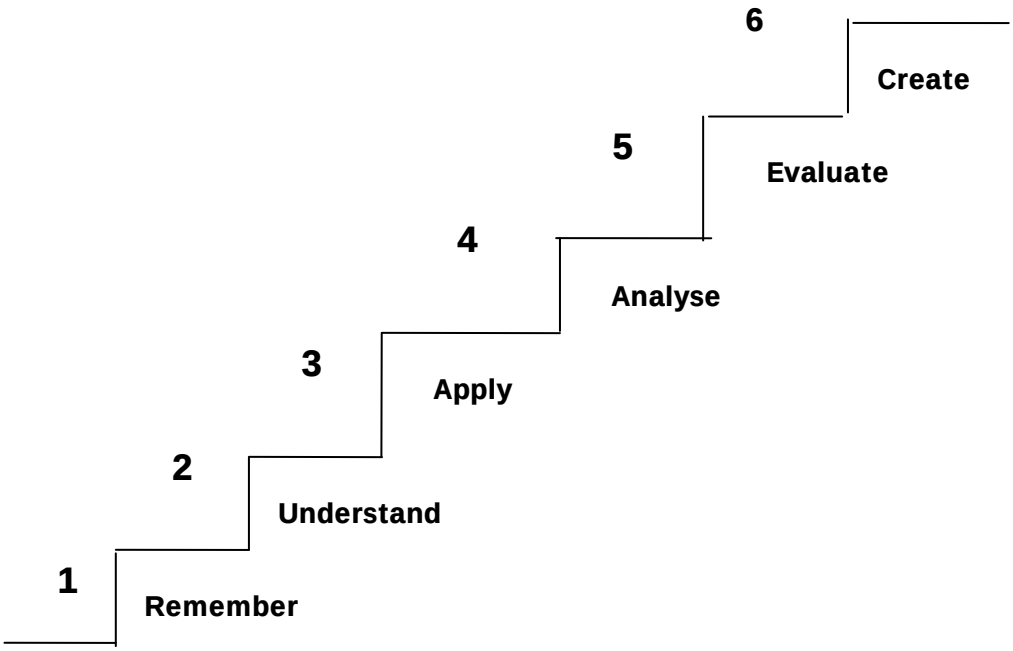
## 2.3 LEVELS OF LEARNING:

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). | Understands fact, principles Interprets verbal material, Interprets charts, tables, graphs. Translates verbal material to | Convert, distinguish estimate, explain, extend, generalize, give examples; infer, paraphrase, predict, rewrite, |

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

### 2.4.2 Categories of Knowledge Dimension

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

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

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

*Procedural Knowledge* (C) is "knowledge of how to do something". It includes knowledge of skills and algorithms, techniques and methods, as well as knowledge of criteria used to determine and/or justify "when to do what" within specific fields and disciplines.

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

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

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

## 2.5 Components of Curriculum:

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

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 LED Interface**

**Attributes:**

1. LED can operate through microcontroller.
2. Interface LED with microcontroller through resistors.
3. Selection of proper resistors.
4. Consider Fan-out of microcontroller.
5. Write proper program for operating LED.

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. Microcontroller is system on chip.
2. Arithmetic calculations using microcontroller is principle, where one digit, two digit, three digit, four digit……etc and Addition, Subtraction, Multiplication, Division, sorting Ascending/Descending orders etc are 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 digits and Addition, Subtraction, Multiplication, Division, sorting Ascending/Descending orders etc by asking questions to the students. Only after that we must tell the relationship among these i.e. Arithmetic Calculations.

### 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.* Arithmetic Calculations can be applied to find out the unknown quantity (Different digit numbers and Addition, Subtraction, Multiplication, Division, sorting Ascending/Descending orders etc).

### 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 microcontroller kit.
2. Procedure to write program on PC in Assembly/C-programing.
3. Procedure to execute program and convert it into machine language as per requirement.

### 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. Selection of microcontroller,
2. Writing a code,
3. Executing code, and
4. Observe the outputs.

Laboratories and workshops of Polytechnics are the locations where these skills are developed among the students under the guidance of expert instructors *of* operators. Writing and executing code 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 : Electronics Engineering Group**

**Course Code : ET/EN/EJ/IE/IS/IC/DE/EV/MU/IU/ED/EI**

**Semester : Fifth for ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU and Sixth for IU/ED/EI**

**Subject Title : Microcontroller**

**Subject Code : 17534**

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| TH | TU | PR | PAPER HRS | TH | PR | OR | TW | TOTAL |
| 03 | -- | 02 | 03 | 100 | 50# | -- | 25@ | 175 |

**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:**

This subject comes under technology area. The subject is an extension of concepts covered in digital technique. 8051 microcontroller architecture, peripheral interfacing to it, assembly language programming is covered in this subject.

Microcontroller is heart of all domestic, industrial, consumer goods and other high end products. Automation in every field of life is being used and microcontroller is inbuilt element of these systems and devices.

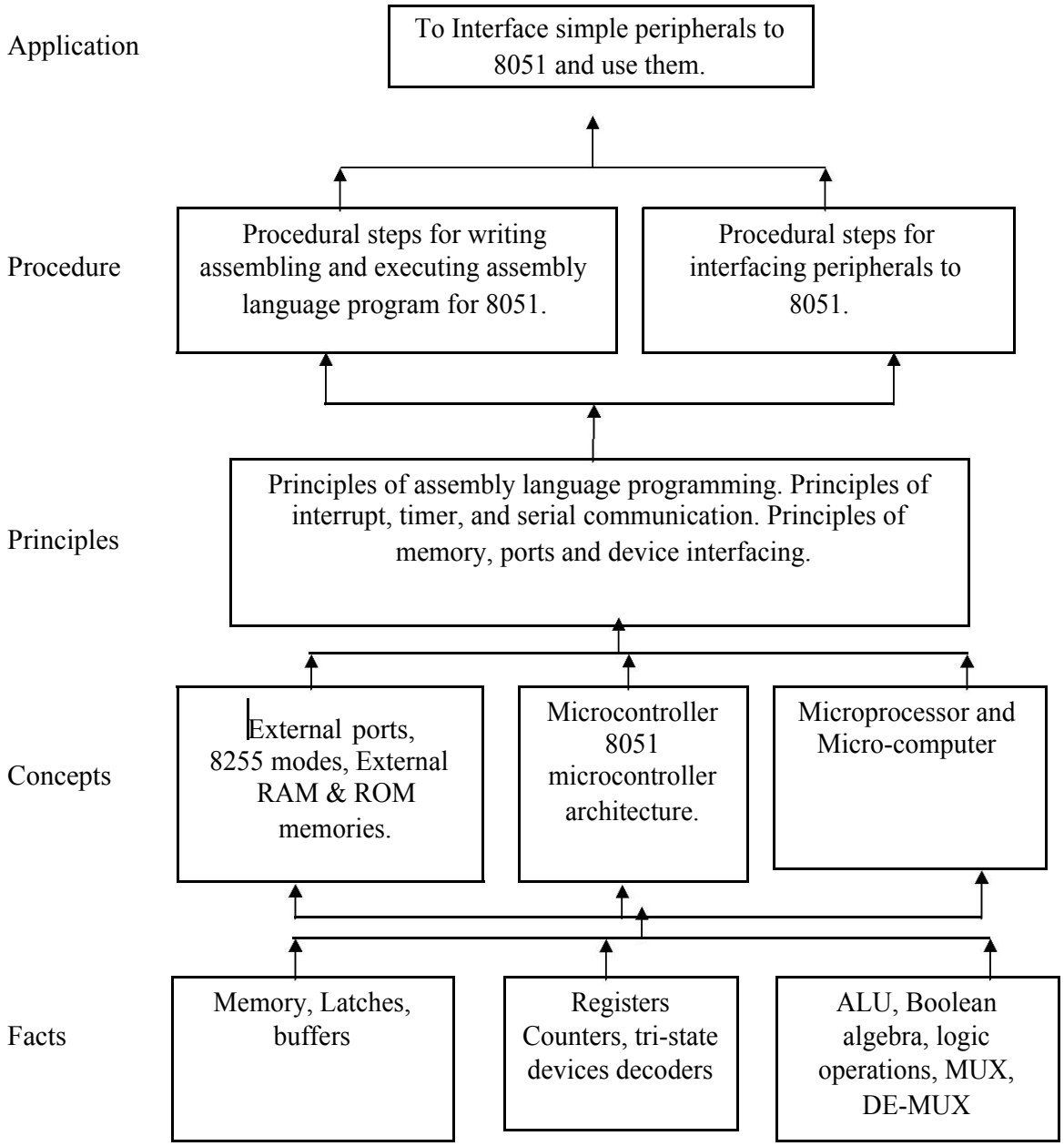
The student will gain the knowledge of peripheral interfacing and programming them. Microcontroller is in built element of embedded system. The subject will help the students to study concepts of embedded system. It will also help to understand design of simple microcontroller systems.

**General Objectives.**

Students will able to:

- Understand concepts of microcomputer, microprocessor and microcontroller.
- Interface peripherals to microcontroller.
- Develop logic for assembly language programming.
- Understand the principles of working of present day microcontroller systems in various fields.

**Learning Structure:**



**Contents: Theory**

| Topic and Contents | Hours | Marks |
|---|---|---|
| **Topic 1: Introduction to Microcomputers and Microcontrollers**<br>**Specific Objectives:**<br>➢ Distinguish microcomputer, microprocessor, and microcontroller<br>**Contents:**<br>1.1 Introduction to single board microcomputer. (Marks 04)<br>Block Diagram of Microcomputer.<br>Elements of Microcomputer. (Buses, Microprocessor, memory, I/O devices).<br>Different types of buses: address, Data, and control bus<br>1.2 Introduction to Microcontroller (Marks 06)<br>General block diagram of microprocessor and microcontroller<br>Comparison of Microprocessors and Microcontrollers.<br>Types of architectures - Harvard and Von-neuman.<br>Selection factors of microcontroller(Architecture type, speed, Word size, instruction set, memory, and I/O capability) | 04 | 10 |
| **Topic 2: 8051 Microcontroller**<br>➢ Identify Hardware features and internal registers with their functions<br>➢ Identify physical difference between external and internal memory and between different ports<br>➢ Compare different members of 8051 family.<br>**Contents :**<br>2.1 8051 Architecture (Marks 10)<br>Features, Architecture, Pin description.<br>Memory Organisation of 8051<br>2.2 Special Features of 8051 (Marks 06)<br>Boolean Processor, Power saving options- idle and power down mode, Derivatives of 8051:- 8031, 8751,8952, 89V51RD2 | 08 | 16 |
| **Topic 3: 8051 Instruction set and programming**<br>➢ Comprehend addressing modes and instruction set.<br>➢ Develop and realize assembly language programs.<br><br>3.1 Addressing modes and instruction set. (Marks 10)<br>Assembler directive- ORG, DB, EQU, END, CODE, DATA<br><br>3.3 Assembly language programming (Marks 10)<br>3.4 Software development cycle- Editor, Assembler, cross compiler, linker, locater, compiler (Marks 04) | 12 | 24 |

| | | |
|---|---|---|
| **Topic 4: Parallel Ports and Serial Communication:**<br>➢ Comprehend Serial and parallel communication<br>**Contents:**<br>4.1 Parallel Port of 8051 (Marks 08)<br>I/O port structure & its Programming.<br>4.2 Serial Port of 8051<br>Serial Communication-SCON, SBUF (Marks 08)<br>Modes of serial communication<br>Simple programs for serial communication. | 08 | 16 |
| **Topic 5: MCS 51 Interrupt and timers**<br>➢ Realize Concept of Interrupts, timer, and related SFRs<br>➢ Use timers and Interrupts through programs<br>➢ Compare interrupts and polling method.<br>**Contents:**<br>5.1 8051 Timer/counter (Marks 08)<br>Timer / Counter logic and modes<br>Simple programs on timer to generate time delay using polling and interrupt method.<br>5.2 8051 Interrupts (Marks 08)<br>Interrupts and polling.<br>SFR - IE, IP<br>Simple programs based on interrupts and polling method | 08 | 16 |
| **Topic 6: Memory and I/O interfacing**<br>➢ Interface I/O devices and memory devices<br>➢ Expand memory and I/O<br>**Contents:**<br>6.1 Memory Interfacing : (Marks 06)<br>Interfacing of External Program and Data Memory<br>Address map table<br>Linear and absolute decoding techniques<br>6.2 I/O Interfacing: (Marks 12)<br>8255-Block diagram, operating modes<br>Port expansion with 8255<br>Interfacing of LED, keys, Relays, Seven segment display, Stepper Motor using 8255. | 08 | 18 |
| **Total** | **48** | **100** |

**Practical:**

Skills to be developed:

**Intellectual skill**

1. Understand hardware and instruction set.
2. Develop assembly programs.

**Motors skills**

1. Handle trainer kits, computer.
2. Interface peripherals.

**List of Practicals:**

1. Understand 8051 development board and tools of keil simulation software.

2. Develop and simulate assembly language program for arithmetic operations as addition, subtraction, multiplication, division.
3. Develop and simulate assembly language program for Block transfer and Block Exchange with external memory.
4. Develop and simulate Assembly Language program for finding smallest/largest numbers and arranging the numbers in ascending/descending order.

**Practice Experiment and Cross word**

5. Develop, simulate and download an assembly language program to generate square and rectangular wave on port pin of 8051 using timer.
6. Develop, simulate and download an assembly language program to ON/OFF LED using a key connected at ports of 8051.
7. Interface seven segment display to 8051 and develop, simulate an assembly language program to design UP/DOWN counter (using Timer Interrupts).
8. Interface stepper motor to 8051 and develop program to rotate motor in clockwise direction.
9. Interface 8 bit DAC and ADC to 8051. Develop and download an assembly language program to generate at least two different waveforms using DAC and convert analog data into digital using ADC.
10. Develop and simulate an assembly language program for Level controller/Traffic controller

**Optional**

11. Develop, simulate and download an assembly language program for serial communication with HyperTerminal of windows operating system.

**Learning resources:**

1. **Books**

| Sr. No. | Title | Author | Publisher |
|---|---|---|---|
| 01 | 8051 Microcontroller architecture programming & application. | K. J. Ayala | EEE/ Prentice Hall of India |
| 02 | The 8051 microcontroller & embedded system. | Mohmad-ali-mazidi, Janice-Gelispe-mazidi , Roline D. Mckinlay | Pearson / Prentice hall |
| 03 | Microcontroller principal & Application | Ajit Pal | Prentice Hall of India |
| 04 | Microcontroller theory & application. | Ajay Deshmukh | Tata McGraw- Hill |
| 05 | Microcontroller Architecture, programming, interfacing, & system design | Rajkamal | Pearson |
| 06 | 8051 Microcontroller Mcs-51 family and its variant. | Satish shaha | Oxford |

2. **C.D's / PPT's** : www.osvn.com
3. **Websites:**
   www.youtubecom
   www.keil.com
   www.faqs.org/microcontroller

## 5. IMPLEMENTATION STRATEGY:

5.1 Planning of Lectures for a Semester with Content Detailing:

Topic I

Name**: Introduction to Microcomputers and Microcontrollers**

**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** | Microprocessor and Microcontrollers | Demonstration of microprocessor and Microcontrollers kits available in laboratory |
| **CONCEPT** | Block diagram of Microprocessor and Microcontrollers | Explanation of general Block diagram of microprocessor and microcontrollers |
| **PRINCIPLE** | Address, data and Control bus | Explain the use of address, data and control bus in Microprocessor and Microcontrollers |
| **PROCEDURE** | Comparison between Microprocessors, Microcontrollers & Microcomputers. | Comparison between Microprocessors and Microcontrollers based on their features and applications. |
| | Types of architectures - Harvard and Von-neuman | Explanation of block diagram of Harvard and Von-neuman architectures |
| | Selection of microcontroller for particular application | Explain the selection of microcontroller based upon architecture type, speed, Word Size, instruction set, memory, and I/O capability |

| | |
|---|---|
| | Learning Resources:<br><br>Books:<br>1. 8051 Microcontroller architecture programming & application….. K. J. Ayala<br>2. 8051 Microcontroller Mcs-51 family and its variant… Satish shaha<br>3. *http://www.8051projects.net/files/public/1259220854_20766_FT0_7426064-the-8051-micro-controller-and-embedded-systems-using-assembly-and-c2nded.pdf*<br>4. *http://cse.iitkgp.ac.in/~soumya/embcs/the-8051-microcontroller-0314772782.pdf*<br><br>Teaching Aids:<br><br>White board and marker pen, black board and chalks<br>PPTs: *staff.fit.ac.cy/com.tk/ACOE343/Lecture2.**ppt***<br><br>Websites-<br>*courses.cs.tamu.edu/cpsc462/walker/Slides/Intro_uC.ppt* |
| Lecture No. | Topic/ Subtopic to be covered |
| 1 | Introduction to single board microcomputer, Block Diagram of Microcomputer. |
| 2 | Elements of Microcomputer. (Buses, Microprocessor, memory, I/O devices). Different types of buses: address, Data, and control bus. |
| 3 | Introduction to Microcontroller: General block diagram of microprocessor and microcontroller, Comparison of Microprocessors and Microcontrollers. |
| 4 | Types of architectures - Harvard and Von-neuman, Selection factors of microcontroller (Architecture type, speed, Word size, instruction set, memory, and I/O capability). |
| Topic 2 | Name**: 8051 Microcontroller**<br>**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.**<br>**e.g.** |

| **Knowledge Category** | **Example/s of category** | **Teaching methodology** |
|---|---|---|
| **FACT** | 8051 Microcontroller | Describe through PPT |
| **CONCEPT** | Features of 8051 | Describe important features of Microcontroller |
| **PROCEDURE** | Architecture,<br><br>Pin description, | Explain function of all registers, SFRS and Ports, Memory, oscillator<br><br>Explain function of all pins |

| | | |
|---|---|---|
| Memory Organization of 8051, | Describe internal RAM organization, Program and data memory map | |
| Special Features of 8051 such as Boolean Processor, | Explain how 8051 can be used as Boolean processor with suitable example | |
| Power saving options- idle and power down mode. | Explain idle and power down mode using block /circuit diagram | |
| Derivatives of 8051:- 8031, 8751,8952, 89V51RD2 | Comparison of Derivatives of 8051:- 8031, 8751,8952, 89V51RD2 based upon their features using black board or ppt | |

Learning Resources::
Books:

1. 8051 Microcontroller architecture programming & application….. K. J. Ayala
2. Microcontroller principal & application… Ajit Pal
3. Microcontroller theory & application…. Ajay Deshmukh
4. *http://www.8051projects.net/files/public/1259220854_20766_FT0_7426064-the-8051-micro-controller-and-embedded-systems-using-assembly-and-c2nded.pdf*
5. .*http://cse.iitkgp.ac.in/~soumya/embcs/the-8051-microcontroller-0314772782.pdf*

Teaching Aids:
White board and marker pen, black board and chalks
PPT with Sample: **.**
*http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/chap2.pdf*
*staff.fit.ac.cy/com.tk/ACOE343/Lecture2.**ppt***

Websites: :
.*http://nptel.ac.in/courses/Webcourse-contents/IIT-ANPUR/microcontrollers/chap2.pdf*

| Lecture No. | Topic/ Subtopic to be covered |
|---|---|
| 1 | 8051 Features, 8051 Architecture: A and B, PC and SP, DPTR |
| 2 | 8051 Architecture: PSW and SFR of timer/counter, serial communication and interrupts |
| 3 | 8051 Architecture: Clock, RAM,EPROM, I/O ports, reset circuits |
| 4 | Pin description and function of each pin. |
| 5 | Memory Organization of 8051: Internal RAM organization, Data and Program memory |
| 6 | Special Features of 8051 :Boolean Processor |
| 7 | Power saving options- idle and power down mode. |
| 8 | Derivatives of 8051:- 8031, 8751, 8952, 89V51RD2 |
| Topic 3 | Name**: : 8051 Instruction set and programming**<br>**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.**<br>**e.g.** |

| **Knowledge Category** | **Example/s of category** | **Teaching methodology** |
|---|---|---|
| **FACT** | Instruction set | Brief introduction of types of instructions set of 8051 |
| **CONCEPT** | Addressing modes of 8051<br><br>Concept of Editor, Assembler, cross compiler, linker, locater, compiler | Explain of immediate, register, direct, indirect, indexed relative and absolute addressing modes with example<br><br>Describe use of Editor, Assembler, cross compiler, linker, locater, compiler. |
| **PROCEDURE** | Describe types of instruction set with examples.<br><br>Describe Assembler directive- ORG, DB, EQU, END, CODE, DATA<br><br>Assembly language programming | Explain instruction's of data transfer, arithmetic, logical, branch control and bit manipulation groups<br><br>Describe use of Assembler directive- ORG, DB, EQU, END, CODE, DATA in 8051 programming<br><br>Develop the assembly language programs on given task |

| | |
|---|---|
| | Learning Resources::<br>Books:<br>1. 8051 Microcontroller architecture programming & application….. K. J. Ayala<br>2. Microcontroller principal & application… Ajit Pal<br>3. Microcontroller theory & application…. Ajay Deshmukh<br>4. .*http://www.8051projects.net/files/public/1259220854_20766_FT0_7426064-the-8051-micro-controller-and-embedded-systems-using-assembly-and-c2nded.pdf*<br>5. .*http://cse.iitkgp.ac.in/~soumya/embcs/the-8051-microcontroller-0314772782.pdf*<br><br>Teaching Aids:<br>White board and marker pen, black board and chalks<br>PPT with Sample: .<br>*http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/chap2.pdf*<br>http://www.win.tue.nl/~aeb/comp/8051/instruction-set.pdf<br><br>Websites:<br>*http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/chap2.pdf* |
| Lecture No. | Topic/ Subtopic to be covered |
| 1 | Addressing modes : Immediate, register, direct , indirect and indexed addressing modes with example and other general examples such as house numbers, library indexing numbers. |
| 2 | Instruction set: Data transfer group along with suitable examples and addressing modes. |
| 3 | Instruction set.: Arithmetic group along with suitable examples and addressing modes. |
| 4 | Instruction set : Logical group along with suitable examples and addressing modes. |
| 5 | Instruction set : Branch control group along with suitable examples and addressing modes. |
| 6 | Instruction set : Bit manipulation group along with suitable examples and addressing modes. |
| 7 | Assembler directive- ORG, DB, EQU, END, CODE, DATA and their use in program. |
| 8 | Assembly language programming: Addition, subtraction, multiplication and division |
| 9 | Assembly language programming : Masking, largest and smallest number |
| 10 | Assembly language programming: Block transfer, Average of numbers , delay generation |
| 11 | Assembly language programming: Ascending and descending |
| 12 | Software development cycle- Editor, Assembler, cross compiler, linker, locater, compiler |
| Topic 4 | Name**: : Parallel Ports and Serial Communication:**<br>**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.**<br>**e.g.** |

| **Knowledge Category** | **Example/s of category** | **Teaching methodology** |
|---|---|---|
| **FACT** | Serial and parallel port | Describe need of Serial and parallel port. |
| **CONCEPT** | Serial and parallel port | Describe Concept of Serial and parallel communication |

| | | | |
|---|---|---|---|
| | **PROCEDURE** | Parallel Port of 8051, I/O port structure& its Programming<br><br>Serial Port of 8051 Serial Communication-SCON, SBUF Modes of serial communication<br><br>Simple programs for serial communication | Describe the function and structure of I/O ports of 8051: P0, P1 , P2 and P3<br><br>Develop the simple programs for data transfer using ports<br><br>Describe the format of SCON and modes of serial communication such as Mode 0, Mode 1, Mode 2 and Mode 3<br><br>Develop the programs to transmit/ to receive data through serial port on black board or ppt and give example of real time applications. |

Learning Resources::
Books:

1. 8051 Microcontroller architecture programming & application….. K. J. Ayala
2. Microcontroller principal & application… Ajit Pal
3. Microcontroller theory & application…. Ajay Deshmukh
4. The 8051 microcontroller & embedded system….. Mohmad-ali-mazidi
5. .*http://www.8051projects.net/files/public/1259220854_20766_FT0_7426064-the-8051-micro-controller-and-embedded-systems-using-assembly-and-c2nded.pdf*
6. .*http://cse.iitkgp.ac.in/~soumya/embcs/the-8051-microcontroller-0314772782.pdf*

Teaching Aids:
White board and marker pen, black board and chalks
PPT with Sample: .
*http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/chap2.pdf*
*http://www.dauniv.ac.in/downloads/EmbsysRevEd_PPTs/Chap_3Lesson01EmsysNew.pdf*
*http://courses.cs.washington.edu/courses/cse477/02sp/ppt/MicrocontrollersIII.pdf*

Websites: :
.*http://nptel.ac.in/courses/Webcourse-contents/IIT-ANPUR/microcontrollers/chap2.pdf*

| Lecture No. | Topic/ Subtopic to be covered |
|---|---|
| 1 | Structure of Parallel Port of 8051 : Port 0 and Port 1 |
| 2 | Structure of Parallel Port of 8051: Port 2 and Port 3 |
| 3 | Simple programs for data transfer using ports: Reading and writing data from/to ports |

| | |
|---|---|
| 4 | simple programs for ports: Square wave generation |
| 5 | Format SCON and function of SBUF |
| 6 | Modes of serial communication: Mode 0, Mode 1, Mode 2 and Mode 3 |
| 7 | Develop the programs to transmit data through serial port |
| 8 | Develop the programs to receive data through serial port. |

Topic 5

Name**: : MCS 51 Interrupt and timers**

**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** | 8051 Timer/counter & Interrupts | Describe need of Timer/counter & Interrupts |
| **PROCEDURE** | Timer / Counter SFR : TCON and TMOD Timers modes | Describe the Format of TCON and TMOD |
| | Programs to generate delay using polling and interrupt method based upon 8051 timer | Develop the programs to generate delay using polling and interrupt method based upon 8051 timer and give examples of real time applications |
| | Interrupts SFR – IE and IP | Describe the Format of IE and IP on black board or ppt |
| | Simple programs based on interrupts and polling method using internal or external interrupts | Develop programs based on interrupts and polling method using internal or external interrupts and give examples of real time applications |

Learning Resources::

Books:

1. 8051 Microcontroller architecture programming & application….. K. J. Ayala
2. Microcontroller principal & application… Ajit Pal
3. Microcontroller theory & application…. Ajay Deshmukh
4. The 8051 microcontroller & embedded system….. Mohmad-ali-mazidi
5. *http://www.8051projects.net/files/public/1259220854_20766_FT0_7426064-the-8051-micro-controller-and-embedded-systems-using-assembly-and-c2nded.pdfhttp://cse.iitkgp.ac.in/~soumya/embcs/the-8051-microcontroller-0314772782.pdf*

| | |
|---|---|
| | Teaching Aids:<br>White board and marker pen, black board and chalks<br>PPT with Sample:<br>**.***www.dsg.cs.tcd.ie/~reillyse/embedded/notes/05.ppt*<br>*https://www.youtube.com/watch?v=0SZPr4iGACg*<br>*http://www.epsem.upc.edu/~jesusv/uc8051_web/Timers_0_1_8051*<br><br>Websites:<br>: **.***http://nptel.ac.in/courses/Webcourse-contents/IIT-NPUR/microcontrollers/chap2.pdf* |
| Lecture No. | Topic/ Subtopic to be covered |
| 1 | 8051 Timer/counter Logic and Modes : Mode 0, Mode 1 , Mode 2 and Mode 3 |
| 2 | 8051 Timer/counter : Format of TMOD |
| 3 | 8051 Timer/counter : Format of TCON |
| 4 | Simple programs on timer to generate time delay using polling method. |
| 5 | Simple programs on timer to generate time delay using interrupt method. |
| 6 | 8051 Interrupts: Format of IE and IP |
| 7 | Develop programs based on interrupts method using internal or external interrupts |
| 8 | Develop programs based on polling method using internal or external interrupts |
| Topic 6 | Name**: : Memory and I/O interfacing**<br>**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** | Program and data memory, LED, keys, Relays, Seven segment display, Stepper motor | Recall the concepts of Program and data memory ,LED, keys, Relays, Seven segment display, Stepper motor |
| **CONCEPT** | Linear and absolute decoding techniques | Explain the concept of Linear and absolute decoding techniques |
| **PROCEDURE** | Memory Interfacing : Interfacing of External Program and Data Memory<br><br>I/O Interfacing8255-Block diagram, operating modes | Describe the procedure of External Program and Data Memory.<br><br>Describe the block diagram of 8255 and its operating modes on black board. |
| **APPLICATION** | Interfacing of LED, keys, Relays, Seven segment display, | Draw the interfacing diagram and write assembly language |

| | | |
|---|---|---|
| | Stepper Motor with 8051 | program to interface LED, keys, Relays, Seven segment display and Stepper Motor on black board. and give examples of real time applications |

Learning Resources::
Books:

1. 8051 Microcontroller architecture programming & application….. K. J. Ayala
2. Microcontroller principal & application… Ajit Pal
3. Microcontroller theory & application…. Ajay Deshmukh
4. The 8051 microcontroller & embedded system….. Mohmad-ali-mazidi
5. 8051 Microcontroller , Hardware, software and applications .. Uday shankar
6. .*http://www.8051projects.net/files/public/1259220854_20766_FT0_7426064-the-8051-micro-controller-and-embedded-systems-using-assembly-and-c2nded.pdf*
7. .*http://cse.iitkgp.ac.in/~soumya/embcs/the-8051-microcontroller-0314772782.pdf*

Teaching Aids:
White board and marker pen, black board and chalks
PPT with Sample: **.**
*http://www.dauniv.ac.in/downloads/EmbsysRevEd_PPTs/Chap_2Lesson02EmsysNew.pdf*
*http://www.newagepublishers.com/samplechapter/002079.pdf*
*http://elearning.vtu.ac.in/10/enotes/06ES42/Unit8-RK.pdf*

Websites: :
**.***http://nptel.ac.in/courses/Webcourse-contents/IIT-ANPUR/microcontrollers/chap2.pdf*

| Lecture No. | Topic/ Subtopic to be covered |
|---|---|
| 1 | Linear and absolute decoding techniques |
| 2 | Memory Interfacing: Interfacing of External Program and Data Memory |
| 3 | 8255-Block diagram and Operating Modes of 8255 |
| 4 | Port expansion using 8255 and its interfacing with 8051. |
| 5 | Interfacing of LEDS and Relay |
| 6 | Interfacing of Keyboard |
| 7 | Interfacing of seven segment display |
| 8 | Interfacing of Stepper motor |
| | |

## 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: assignments are compulsory

- After completion of each chapter, one Assignment (based on all points of concerned chapter, sample question paper, old MSBTE question paper) shall be given to students. It shall be assessed by subject teacher before giving next Assignment.
- Assignment & its Evaluation may be done efficiently in practical.
- OR class test on each chapter may be taken after giving question bank

[At the time of submission of Microcontroller, students should produce this Assignment Note book to Subject Teacher which will contain Six Assignments. Subject Teacher will review for Six Assignments and return it to students for further study of MSBTE Exam.]

## 5.4 Strategies for Conduct of Practical:

### 5.4.1 Approach for design of Manual:

- Basic approach of Lab manual is to develop better understanding of subjects and to develop Intellectual skills and Motor skills as per subject objectives.
- While designing the experiments, various activities should be added in the experiments so that the contents can be related to applications in the industry.

### 5.4.2 Suggestions for effective conduct of practical and assessment:

- Subject Teacher shall prepare Laboratory planning (D2) format in duplicate. One copy of laboratory planning (D2) shall be displayed on Laboratory/Departmental

Notice board for student's information. Subject Teacher shall conduct practical as per planning and assess regularly.

- Display the given data of each experiment in the laboratory.
- Display the charts of all Instruments which are required to the practical of Industrial Electronics and Applications.
- At the beginning of the Semester, Lab Assistant and Subject Teacher should check and ensure that the equipment required to conduct practical are in proper working condition. They should calibrate all necessary equipment to conduct practical using standard calibrated instruments and maintain calibration register and maintenance register.
- Teacher should refer the guidelines given in laboratory manual.
- Teacher should make the students aware of instructions given in the laboratory manual.
- Teacher should motivate the students by taking activities on related contents in theory and practical.
- Teacher should ensure that at least one activity given in the Lab Manual is performed by the student and observations should be tabulated.
- There should be one revision practical after every three regular practical so that students can grasp the content deeply.
- Teacher should make the assessment report of students during the repletion round.
- Teacher should assess the students on the basis of his/her participation in a group and performance in a group during practical as per MSBTE rule.
- Teacher should give Marks out of 10 for each practical.

### 5.4.3 Preparation for conduct of practical

- Experimental set up with sample reading (Expected results) should be prepared by the concerned teacher before the commencement of each experiment.
- Teacher should give the instruction regarding proper handling of Instruments, precautions while performing the experiments.

**5.5 Additional guidelines to conduct course smoothly.**

- Use of ICT based teaching-learning methods, PPT's, internet, CD/DVD's, readymade charts/graphs, video may help students to learn subject easily.
- Prefer use of recommended reference books for teaching / learning purpose.
- Preparation of subject notes will definitely be fruitful for students. However giving Xerox of notes instead of dictating notes will be more beneficial.
- Overview of topics covered in last lecture at start of current lecture is expected.
- Assignments OJ homework based on last lecture or related to next lecture may be helpful for all students.
- Preparation and Circulation of chapter wise question bank based on sample question paper, MSBTE old question papers will definitely give good idea to students about subject.
- Showing of components, portable electronic equipment's, working models, simulations, project boards will definitely give brief idea about subject to understand electronic equipment's to the students.

## 6. Mode of assessment:

### 6.1.1 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:

**G scheme**
**Sample test paper 1**

| Roll No | | | | |
|---|---|---|---|---|

**Subject Code: 17534**

**Institute Name:**
**Course Name: Electronics Engg. Group. Course Code:**
**ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU Semester: Fifth**
**Subject: Microcontroller**
**Marks: 25 Time: 01 Hour**

---

**Instructions:**

1. All questions are compulsory.
2. Illustrate your answer with neat sketches wherever necessary
3. Figure to the right indicates full marks
4. Preferably write the answer in sequential order.
5. Any electronic media not allowed

**Marks**

**Q1) Attempt any three: - 9**

a) Differentiate between Microprocessor and Microcontroller (any three points).
b) Describe the function of address, data and control bus.
c) Draw the block diagram of Harvard and Von Neumann architectures.
d) Draw the format of PSW register of 8051 microcontroller and state the conditions when flags available in PSW are set to 1.
e) Describe the following instructions of 8051 microcontroller.
(i) SWAP A (ii) DIV AB (iii) RLA

**Q2) Attempt any two: 8**

a) List any four important features of 8051 microcontroller.
b) Draw the architecture of 8051 microcontroller.
c) Describe power saving operation of 8051 microcontroller.

**Q3) Attempt any two: 8**

a) List the four addressing modes of 8051 microcontroller with one suitable instruction each.
b) Write an assembly language program for 8051 microcontroller to add two bit numbers stored in internal RAM. Store the result in internal RAM.
c) Describe the function of Editor, Assembler, linker and compiler.

**G scheme**
**Sample test paper 2**

| Roll No | | | | |
|---|---|---|---|---|

**Subject Code: 17534**

**Institute Name:**
**Course Name: Electronics Engg. Group. Course Code:**
**ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU Semester: Fifth**
**Subject: Microcontroller**
**Marks: 25** **Time: 01 Hour**

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**Instructions:**

1) All questions are compulsory.
2) Illustrate your answer with neat sketches wherever necessary
3) Figure to the right indicates full marks
4) Preferably write the answer in sequential order.
5) Any electronic media not allowed

**Marks**

**Q1) Attempt any three: -** **9**

**a)** List the alternative functions of port 3 of 8051 microcontroller
**b)** Draw the format of TCON register and describe the function of each bit.
**c)** List the operating mode of 8255. Describe any one operating mode in detail.
**d)** Describe the different modes of serial communication.
**e)** Draw the interfacing diagram 4x4 keyboard with 8051 microcontroller.

**Q2) Attempt any two:** **8**

**a)** Describe the timer and counter mode of 8051 microcontroller
**b)** Draw the format of IE register and describe the function of each bit.
**c)** Write an assembly language program to generate continuous square wave of 2 KHz on P1.4 using mode 2 of timer 0. The crystal frequency is 11.0592MHz.

**Q3) Attempt any two:** **8**

**a)** Interface 2K byte of EPROM and 2Kbyte of RAM to 8051 microcontroller.

**b)** Draw the interfacing diagram of seven segment display to 8051 microcontroller.

**c)** Write an assembly language program using 8051 microcontroller to rotate stepper motor clockwise continuously.

## 6.2 End of Semester Theory Paper

### 6.2.1 Characteristics of a Good Examination Question Paper

#### 6.2.1.1 Introduction

While a student answers a question, he refers to his Long Term Memory (LTM) and sees if the answer could be readily available from the memorised data. If this is not possible, the student processes information from his LTM and then provides the answer. All these activities are related to processes taking place in the brain. Through question paper, we are trying to measure intellectual activities which may not have precise measurement. The question paper which we use to measure learning of a certain topic is usually called an instrument or a tool. The question paper or the instrument we are designing to measure achievement in a given subject/content should have certain qualities which will ensure a fair degree of confidence on the results of the examination.

Standard of any examination depends upon quality of question paper and therefore efforts must be made to see that question paper is set on scientific principles. A question paper can be called a good quality question paper if it possesses the following essential characteristics.

- Validity
- Reliability
- Objectivity
- Usability

#### 6.2.1.2 Validity

Validity refers to the extent to which it measures what it intents to measure. If we design a test or a question paper to measure what students have learnt in a subject, say "Applied Mechanics", it should measure their achievement in Applied Mechanics only, nothing else; and the scores in this subject are not distorted by irrelevant factors. Basically, the, validity is always concerned with the specific use of the test results and the soundness of our proposed interpretations.

There are different types of validities of a test/question paper. In our examination question paper it is adequate and appropriate to consider only one type of validity i.e. content validity. The content validity is related to the extent to which the question paper conforms to the curriculum content and the pre-determined objectives. This validity is ensured by designing

question paper that matches with the specification table, which contains content matter to be tested and the cognitive levels at which this content is to be tested.

**6.2.1.3 Reliability**

Reliability refers to the consistency of measurement i.e. the consistency with which an examination question paper measures whatever it measures. If a teacher gives today an achievement test in a subject to his students, how similar would have been the student's scores had this test been given yesterday or tomorrow? How would the scores have varied had the teacher selected a different sample of equivalent questions? If it were a question paper containing essay type question, how would the scores have differed had a different teacher scored / evaluated it? These are the types of questions with which reliability is concerned. Unless the measurement can be shown to be reasonably consistent over different occasions or over different samples of the same performance domain, we can have little confidence in the results.

While measuring length, can any one get consistent results while using a tape made of elastic material? Depending upon how much the tape is stretched; different lengths would be obtained on each occasion. Reliability estimates of a question paper refer to the results of measurement. A reliable (consistent) measure is not necessarily valid. Reliability is strictly a statistical concept.

Reliability or the amount of faith which can be placed on the scores/marks of a question paper depends upon a number of factors. Some of these factors are –

i) **Clarity, Definiteness and Objectivity of the question paper**

Question paper which permits students to make widely divergent interpretations of what is expected of them (in their answer) is not likely to yield highly reliable results. For example, teacher assessing the answer books may have different expectations from students, if the questions are not specific, and are worded vaguely.

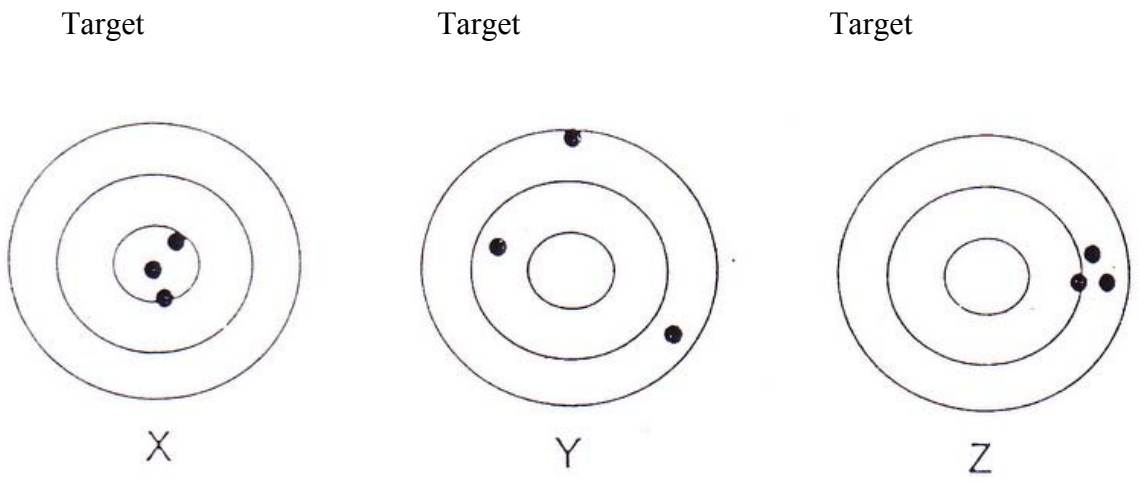
ii) **Examiners Objectivity**

This relates to consistency with which examiners examine and mark the answer scripts/books. If marks assigned to answers are greatly influenced by the examiner's state of mind at that moment, no one will keep faith in the assigned marks, and reliability of marking is adversely affected.

iii) **Number of Questions**

Researchers have shown that more number of questions in a question paper lead to more reliability. Reliability also depends upon the spread of scores, difficulty level of the question paper and objectivity of scoring.

The relation between validity and reliability is sometimes confusing to persons who come across these terms for the first time. Reliability (consistency) of measurement is needed to obtain valid results but we can have reliability without validity. The target shooting illustration, in the figure below, shows the concept that "reliability is a necessary but not a sufficient condition for validity"




| Reliable & Valid Shooting | Unreliable & Invalid Shooting | Reliable but invalid Shooting |
|---|---|---|

Three shooters X, Y, Z shoot at the target, each getting three shots. Shooter Y Shoots at different places far away from the bull's eye. Z consistently shoots at the border spot. X consistently shoots close to the bull's eye.

**6.2.1.4 Objectivity**

This concept is related to marking of answer scripts. When answer scripts are assessed and marked in such a way that the total score obtained by students to not change appreciably, we say that the marking is objective. As against this, if extraneous personal biases and preferences of examiners influence marking of answer scripts, the assessment is subjective in nature. Thus objectivity implies assessment free from all extraneous factors and is opposite to subjectivity.

The element of subjectivity can be substantially reduced and objectivity improved, if the following steps are taken.

1. Designing an assessment scheme for a course.
2. Developing specification table for question paper indicating distribution of marks for different topics and levels.
3. Preparing a format of question paper showing distribution of topics in different questions, and indicating types of questions for abilities to be tested.
4. Designing question paper as per specification table.
5. Editing the question paper so that it meets all the criteria and conform to the specification table.
6. Developing scheme of marking for the answers to supply type questions (i.e. questions which make students to provide answers in sentence/figural/graphical form). This is the most necessary requirement for reducing subjectivity.

**6.2.1.5 Usability or Practicability**

An examination system should be so designed that it is possible to implement it without much problems or difficulties. The system should not be something that looks good or ideal on paper but can't be implemented. In addition to providing examination results that possess a satisfactory degree of reliability and validity, an examination system should also satisfy certain other practical requirements, given below.

i) The system is economical from the point of view of both money and time.

ii) It should be easy for administration and marking.

iii) The system should be simple enough to be properly understood by all the concerned persons.

**6.2.1.6 How to Ensure Reasonable Validity?**

In order to have a valid test or an evaluation procedure, we must ensure that it is relevant to the purpose for which it is to be used; it means that there should be a close relationship between validity of a question paper and objectives of the test. In simpler words, by test validity we mean the *accuracy, conformity and effectiveness* with which the test measures *what it intends to measure* (Objectives).

The following steps can help to ensure reasonable degree of validity:

a) Specify the purpose of assessment.

b) Clearly define the objectives.
c) Divide the course content into convenient chapters.
d) Provide proportional weightage to each chapter.
e) Provide proportional weightage to different objectives and their levels.
f) Develop question on each of the sampled cognitive process dimension in each unit in accordance with the weightage assigned.
g) Avoid providing free option like 'attempt any 6 out of 9'. However, internal option of "either", "or" type can be given with proper care of content and objectives.

It can be noticed that the only assurance we have that a test is a *valid* measure of the intended learning outcomes, is to use a systematic procedure for obtaining a representative sample of the curriculum in the question paper. The table of specifications is a device which provides the procedure for obtaining a representative sample of curriculum in the question paper and thus ensures content validity.

### 6.2.2. Approach for Designing Good Question Paper

#### 6.2.2.1 Concept of Specification Table

A table of specification is a blue print for test or question paper design. Just as an engineer prepares a blue print before constructing a structure, a specification table is prepared in advance of the examination, so that a valid test could be designed.

In fact, a Table of Specifications is a sampling plan of the objectives to be tested in the test. This ensures following things:

- All important topics of the subject matter are adequately represented.
- There is no undue weightage given to any particular topic/topics.
- No content area worthwhile for testing is omitted from the test.
- The test samples adequate proportion of abilities at different taxonomy levels, in each part.

#### 6.2.2.2 Guidelines for Preparing Specification Table

1. Study the two dimensional table of objectives
2. Use the weightages of marks (out of 80) for each chapter/topic in the subject
3. In assigning relative weightages to each topic and level of learning outcomes, a number of factors have been considered. These factors are:
   - How important is each topic in relation with total learning experience?

- How much time is expected to be devoted to each topic during instructions?
- What relative importance does curriculum assign to each topic?
- At what levels is the topic taught?
- What amount of emphasis is given for each topic at what levels?

Specification table should consider the following:

- Content to be observed
- Objectives to be achieved
- Levels of objectives
- Total time and marks for the paper

1. The specification table consists of chapters/topics and levels of cognitive process dimension like R, U, A.

   These cognitive process dimensions are –

   R = Remember

   U = Understand

   A = Analyse / Apply

5. Review the chapter/topic and think about probable distribution of marks at the three levels (R, U, A,) for assessment. Normally distribution be done in multiples of two marks. Enter marks for each topic under the levels R, U, A.
6. Make total of vertical columns R, U, A. Suggested distribution is R=10% to 30%, U=40% to 55% and A=30% to 45% depending upon the level of the students.

   A Sample Classification Table is given below with arbitrary marks.

**G scheme**

**Sample Question Paper**

| Exam seat no. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|

**Maharashtra State Board of Technical Education**

Institute Name: Subject Code: 17534
Course Name: Electronics Engineering Group.
Course Code: ET/EN/EX/EJ/IE/IS/IC/DE/EV/MU
Semester: Fifth
Subject: Microcontroller
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. Preferably, write the answers in sequential order.

**Marks**

**Q1.A) Attempt any Three.** **12**

i) Distinguish between Microprocessor and Microcontroller (any four).

ii) Draw the block diagram of Harvard and Von-Neumann architectures.

iii) List any four important features of 8051 microcontroller

iv) Describe any four addressing modes of 8051 microcontroller with one example each.

**Q1. B) Attempt any One.** **06**

i) Write an assembly language program for 8051 microcontroller to transfer ten bytes of data from source to destination in internal RAM (Assume suitable memory addresses)

ii) Draw interfacing diagram of 2Kbyte EPROM and 2K byte RAM to 8051 microcontroller. Draw the memory map.

**Q2. Attempt any Four.** **16**

a) Draw the internal architecture of 8051 microcontroller.

b) Draw the format of PSW register of 8051 microcontroller and state the function of each flag.

c) Describe the function of following pins of 8051 microcontroller

(i) $\overline{PSEN}$ (ii) ALE (iii) $\overline{EA}$ (iv) RST

d) Draw the internal RAM memory organization of 8051 microcontroller

e) Describe the power saving operation of 8051 microcontroller.

f) Describe the function of address, data and control bus.

**Q3. Attempt any Four. 16**

a) Describe the function of following instructions of 8051 microcontroller

(i) SWAP A (ii) DIV AB (iii) MUL AB (iv) RLA

b) Describe the following directives with one example.

(i) ORG (ii) DB (iii) EQU (iv) END

c) State the function of editor, assembler, linker and compiler.

d) Write an assembly language program for 8051 microcontroller to add two 8 bit numbers 55H and 67H . Store the result at 20H.

e) List all the alternate functions of port 3 of 8051 microcontroller.

**Q4. A) Attempt any Three. 12**

i) Describe following 8051 microcontroller instructions

(i) SET B C (ii) ADD A, @R0

(iii) MOV A, #20H (iv) XCH A, R0

ii) Draw the format of SCON register and describe the function of each bit.

iii) Draw the circuit diagram of port 2 and describe its functions.

iv) With crystal frequency = 11.0592 MHz, what value should be loaded into TH1 to have 9600 baud rate? Give the answer in both decimal and hex.

**B) Attempt any One. 06**

i) Write an assembly language program for 8051 microcontroller to multiply two 8 bit numbers stored at 10H and 11H in internal RAM. Store result at 12H and 13H.

ii) Draw the interfacing diagram of stepper motor with 8051 microcontroller and write an assembly language program to rotate stepper motor continuously in clock wise direction.

**Q.5 Attempt any Four. 16**

a) Draw the format of TCON register and state the function of each bit.

b) Describe the timer modes of 8051 microcontroller.

c) List the various interrupts in 8051 microcontroller along with their priorities and vector locations.

d) Write an assembly language program for 8051 microcontroller to generate square wave on P1.0 using delay subroutine.

e) Draw the interfacing diagram of seven segment display to 8051 microcontroller.

f) Draw the format of PCON register and write the function of each bit.

**Q6. Attempt any Four. 16**

a) Write an assembly language program to generate continuous square of 2 KHz frequency on P1.4 using timer 0. Assume crystal frequency of 8051 microcontroller is 11.0592 MHz.

b) Draw and describe IE register of 8051 microcontroller.

c) Draw the control word register format of 8255 and describe the function of each bit.

d) Draw the interfacing diagram of relay with 8051 microcontroller and write an assembly language program to turn ON and OFF relay.

**e)** Draw and describe IP register format of 8051 microcontroller.