CURRICULUM REVISION PROJECT

2013

TEACHER'S GUIDE FOR

Data Structures using 'C'

Subject Code 17330

THIRD SEMESTER

(CO/CM/IF/CD/CW)

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.

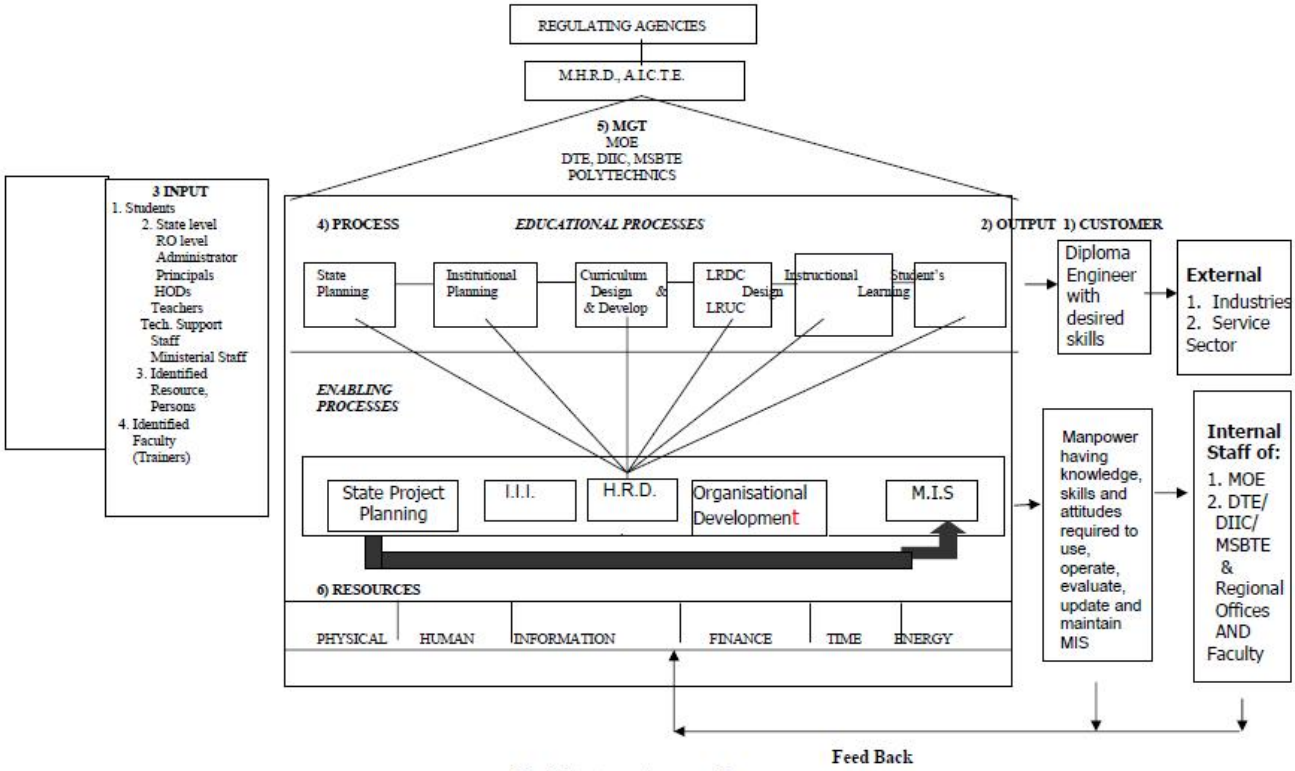


Fig 1 Systems Approach

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.

1.5 DESIRED SKILLS

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

Life Skills:

Search information from various sources

Develop Communication ability

Develop presentation skills

Work as a member of a team/group and as leader

Collect field data

Develop learning to learn

Write repot 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 and 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 and 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 V^{th} 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 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 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 Basic Model of Learning

The basic model of learning is as shown below:

GENERIC DIAG. – Stimulus and Response

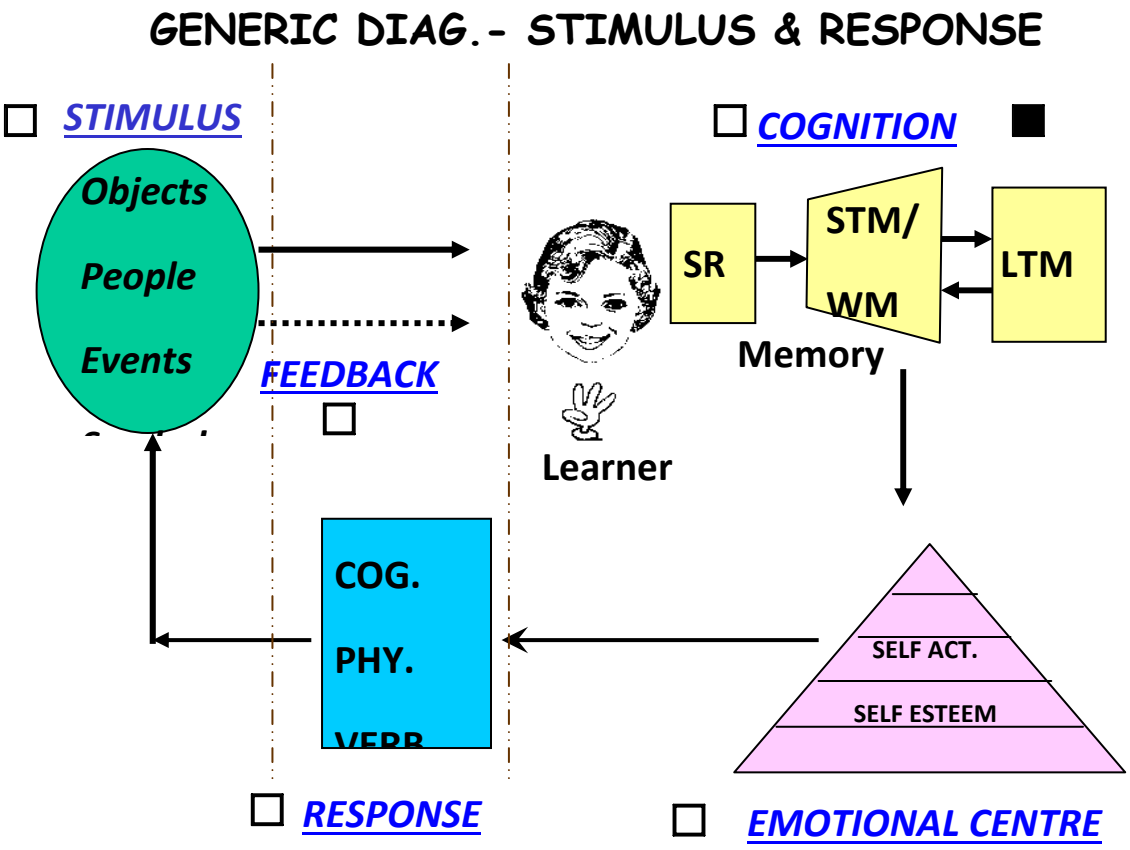


Fig. 2: Generic Diagram of Learners.

Stimulus: The information is received by senses from many things in surroundings. It activates senses for experience. It is called as stimulus. It. includes people, objects, events, symbols etc. For example: teachers, friends, instruments, drawings, text etc are stimulus for students.

Cognition: Cognition is the act of knowing. It deals with mental activities of the learner. It is triggered due to stimulus. It involves memory, its components structure of knowledge in memory and various processes in memory. The study of the same is done to know how learning takes place.

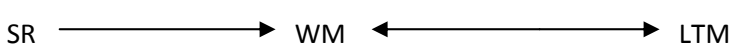
Emotional Centre: Stimulus may be pleasant or unpleasant feelings. It decides whether learner will approach to stimulus situation or avoid it. This is the effect of emotions of learners in emotion centre.

Response: When stimulus stimulate the learner reacts. This response may be mental response like reflection of face (cognition), physical movement (motor skills) or verbal response like communication. The response always aims at changing the stimulus situation.

Feedback: When teacher asks the question, you answer it. Then based on the content of the answer, teacher says whether it is 'correct' or 'wrong'. This is feedback. Thus it may be the information about the changed stimulus situation provided after response by the learner. Feedback helps learner to compare changed stimulus to expected change in stimulus.

Basic Concepts: Different forms used in the study of memory and its working are as below:

- **Memory:** It is the ability to recall the information, which has been previously learnt through experience. In context of memory structure, it is the location learned information is stored.
- **Storage:** It is process of putting information in the memory.
- **Encoding:** In memory, the information is not stored in original form but in numerical form, verbal form, visual images etc. Encoding is the process of modifying information from one form to another form. It helps to store information easily. It also stores new information to existing knowledge.
- **Retrieval:** It is the process to find the information that is previously stored in the memory so that it can be put to use.
- **Components of Memory:** The most prevalent view of human memory states that memory has three distinct components viz.
  - **Sensory Register (SR)**
  - **Working Memory (WM) or Short Term Memory (STM)**
  - **Long Term Memory (LTM)**
- **Control Process:** This is the process of movement of information from one memory component to another memory component.



- **Perception:** It is the final image formed in WM after processing the information from SR and LTM. The final image consists of visual image supported by elaboration and emotional content.

2.3 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.

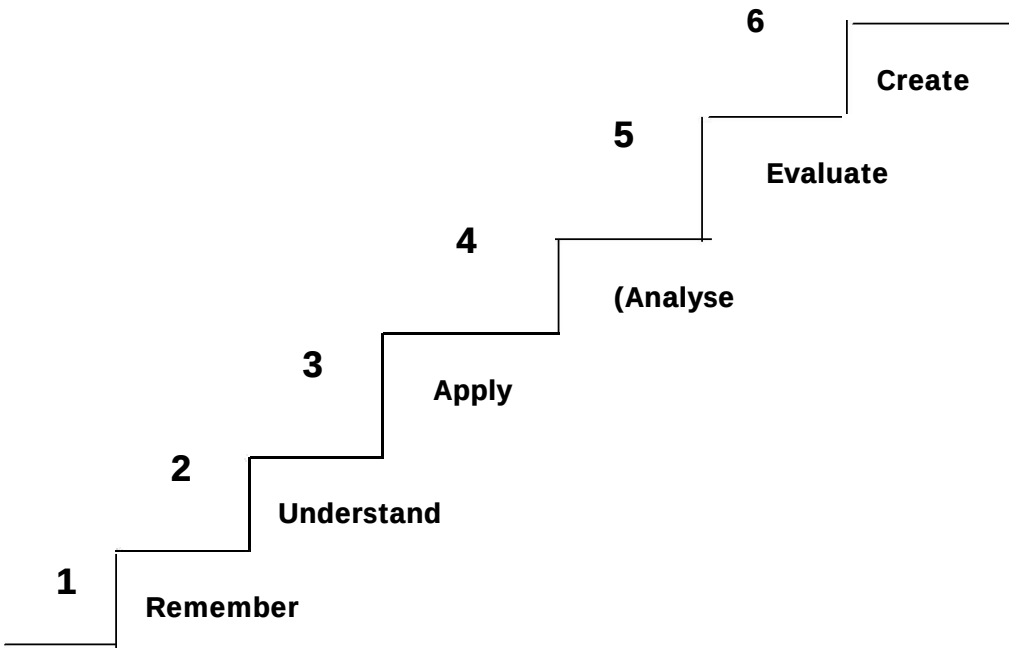
2.4 LEVELS OF LEARNING:

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 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	Understands fact, principles Interprets	Convert, distinguish estimate, explain, extend,

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

2.4.2 Categories of Knowledge Dimension

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

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

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

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

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

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

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

2.5 Components of Curriculum:

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

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

The other indicates how the knowledge gained can be used in the world of work to perform given tasks. Rationale tells the students the connection of subjects related to study of higher level subjects and also the us in their job/profession.

2.5.2 Objectives: Objectives indicate what the student will be to do/perform after he completes the study of the subject. It also in other words indicate the scope of the subject. Objectives indicate what is achievable and hence gives direction 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 in Cognitive Domain knowledge is divided in four components Factual, Conceptual, Procedural and Metacognitive. Of this Factual, Conceptual and Procedural knowledge components are identified in the curriculum of the subject along with the applications. Learning structure gives broad idea of these components for a subject. It indicates the scope of the subject. Normally we first decide what we want to achieve by studying the subject, which forms the application component. Based on this we decide what procedures are required for these applications.

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

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

One has to be careful in allotting the hours required to teach the topics looking at the importance of the topic for development of the subject. Therefore 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

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 organized 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 analyzed here at a micro level.

Before we begin actual leaching of any topic (lesson), we must carefully and critically analyze 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 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 emphasized 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.

3. **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 analyzing 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 (socializing, 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 : Computer Engineering Group

Course Code : CO/CM/IF/CD/CW

Semester : Third

Subject Title : Data Structures Using 'C'

Subject Code : 17330

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	04	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:

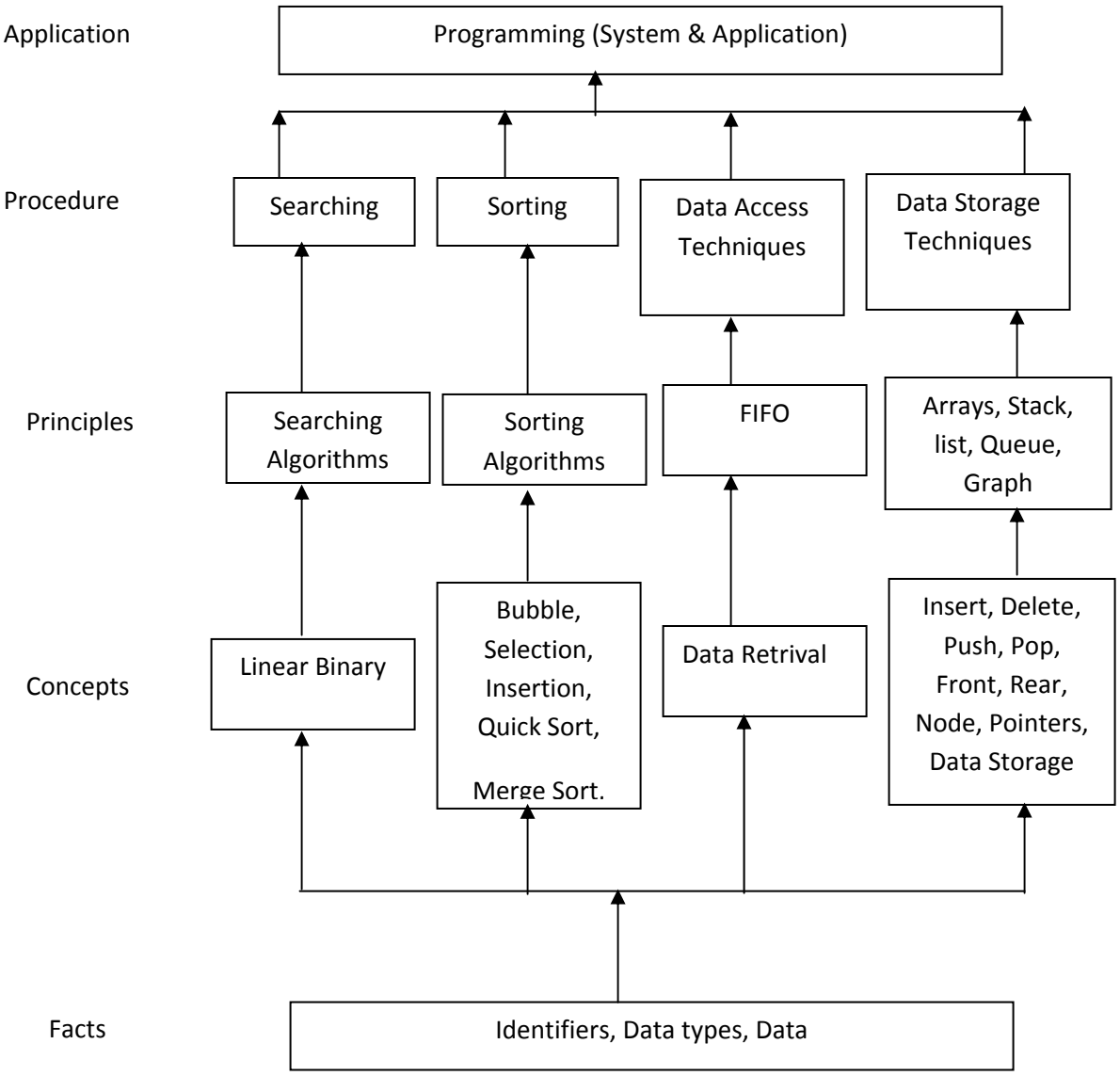
Data structure is a subject of primary importance to the discipline of Computer Science & Engineering. Data structure is a logical & mathematical model of storing & organizing data in a particular way in a computer. After learning this subject student will be able to identify the problem, analyze different algorithms to solve the problem & choose most appropriate data structure to represent the data.

General Objectives:

The student will be able to:

- Know the fundamentals of data structure
- Classify data structures.
- Select the appropriate data structure.
- Apply the different searching and sorting techniques.
- Apply different algorithms to solve the real world problem.

Learning Structure:



Contents: Theory

Topic	Content	Hours	Marks
1	**Introduction to Data Structure** Specific Objective: ➢ To understand data structure organization & classification ➢ To understand operations on data structure. ➢ To understand approaches to design an algorithm. ➢ Knowing the complexity of an algorithm 1.1 Basic Terminology • Elementary data structure organization • Classification of data structure 1.2 Operations on data structures • Traversing, Inserting, deleting • Searching, sorting, merging 1.3 Different Approaches to designing an algorithm • Top-Down approach • Bottom-up approach 1.4 Complexity • Time complexity • Space complexity 1.5 Big 'O' Notation	06	08
2	**Sorting and Searching** Specific Objective: ➢ To understand and apply sorting algorithms on data. ➢ To understand and apply searching algorithms on data. 2.1 Sorting Techniques • Introduction • Selection sort • Insertion sort • Bubble sort • Merge sort • Radix sort (Only algorithm) • Shell sort (Only algorithm) • Quick sort (Only algorithm) 2.2 Searching • Linear search • Binary search	10	16
3	**Stacks** Specific Objective: ➢ To understand and apply the knowledge of the data structure –	12	18

	'stack' in the application programs. 3.1 Introduction to stack • Stack as an abstract data type • Representation of stack through arrays 3.2 Applications of Stack • Reversing a list • Polish notations • Conversion of infix to postfix expression • Evaluation of postfix expression • Converting an infix into prefix expression • Evaluation of prefix expression • Recursion		
4	**Queues** Specific Objective: ➢ To understand and apply the knowledge of the data structure – 'Queue' in the application programs. 4.1 Introduction • Queues as an abstract data type • Representation of a Queue as an array 4.2 Types of Queue • Circular Queue • Double Ended Queue • Priority Queue • Dequeues 4.3 Applications of Queue	08	12
5	**Linked List** Specific Objective: ➢ To understand and apply the knowledge of the data structure – 'Linked List' in the application programs. 5.1 Introduction • Terminologies: node, Address, Pointer, Information, Next, Null Pointer, Empty list etc. 5.2 Type of lists • Linear list • Circular list • Doubly list 5.3 Operations on a singly linked list (only algorithm) • Traversing a singly linked list • Searching a linked list • Inserting a new node in a linked list • Deleting a node from a linked list	08	12

6	**Trees** Specific Objective: ➢ To understand and apply the knowledge of the data structure – 'Trees' on data. 6.1 Introduction ---------- **06 Marks** • Terminologies: tree ,degree of a node, degree of a tree, level of a node, leaf node, Depth / Height of a tree, In-degree & out-Degree, Directed edge, Path, Ancestor & descendant nodes.	04	18
	6.2 Tree Types and Traversal Methods ---------- **12 Marks** ➢ Type of Trees • General tree • Binary tree • Binary search tree (BST). ➢ Binary tree traversal (only algorithm) • In order traversal • Preorder traversal • Post order traversal ➢ Expression tree	08	
7	**Graph and Hashing** Specific Objective: ➢ To understand and apply the knowledge of 'graph' and 'hashing' function on data. 7.1 Introduction • Terminologies: graph, node (Vertices), arcs (edge), directed graph, in-degree, out-degree, adjacent, successor, predecessor, relation, weight, path, length. 7.2 Representations of a graph • Array Representation • Linked list Representation 7.3 Traversal of graphs • Depth-first search (DFS). • Breadth-first search (BFS). 7.4 Applications of Graph 7.5 Hashing • Hash function • Collision resolution techniques	08	16
	Total	**64**	**100**

Practicals:

Skills to be developed:

Intellectual Skills:

1. Classify data structures.
2. Select the appropriate data structure.
3. Apply the different searching and sorting techniques.
4. Use of various algorithms to solve the real world problems.

Motor Skills:

1. Operate the computer system.
2. Knowledge of Family Tree using relationships.
3. Observation of the models used in real world[Airline/Train/Bus reservations]
4. Use of Browsers for understanding of link structures.

List of Practicals:

1. Perform insertion and deletion operation on one dimensional array.
2. Implement the searching of the given number in one dimensional array using linear search and binary search methods.
3. Write a program to sort the given list represented using array in ascending order by sorting techniques like bubble sort, insertion sort and selection sort.
4. Understand the concept of stack and implement PUSH and POP operations on stack using array.
5. Understand the concept of Queue and implement insertion and deletion operation on Queue using array.
6. Understand the concept of Link list and implement operations on Singly Link list.
7. Understand how to create a Binary Tree.
8. Understand and create a graph of n vertices using an adjacency list.
9. Understand the concept of Hashing and write a program to search an element using Hashing techniques
10. Seminar on mini study project.

Learning Resources:

1 Books:

Sr. No.	Author	Title	Publisher
1	ISRD Group New Delhi	Data structure Using C	Tata McGraw Hill
2	Reema Thareja	Data Structure Using C	OXFORD University Press
3	Ashok Kamthane	Introduction to data structures in C	Pearson
4	Prof. P.S. Deshpande, Prof D.G. kakde	C and Data structures	Dreamtech press
5	Amitava Nag & Jyoti Prakash Singh	Data structures & Algorithms Using C	Vikas
6	Yashwant Kanetkar	Data Structures Using C	

2 Websites:

http://www.oupinheonline.com/book/thareja-data-structures-using-c/9780198065449

www.vikaspublishing.com/teachersmannual.aspx

www.pearsoned.co.in/prc

www.phindia.com/learningresources.aspx

3. Mini Project:

Use any resources for mini projects in Data Structures.

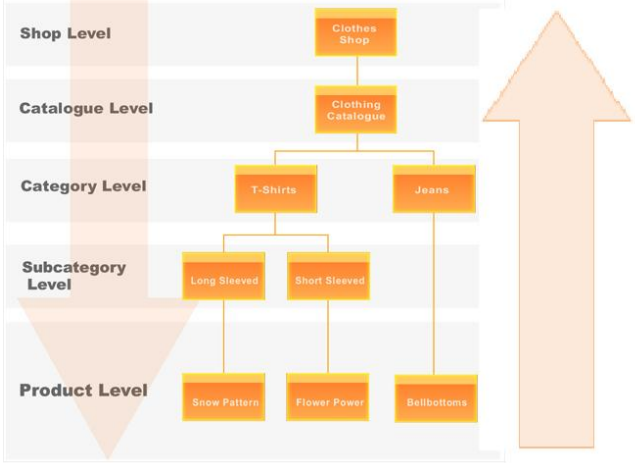
5. IMPLEMENTATION STRATEGY

Common guidelines for effective teaching:

- Describe the learning structure of the subject to the students at the start of the semester in brief.
- Prepare own subject notes.
- Refer the concept structure of every topic.
- Encourage students to write the C program commands and programs given in lab manual / lab notebook.
- Ensure that syntaxes are properly practiced.
- Do not dictate programs/commands
- Give the relevance of each topic with real life applications such as Bus Reservation system, Library Management, University Management, College Management.

5.1 Planning of Lectures for a Semester with Content Detailing:

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

Topic I	**Introduction To Data Structures**
	Facts: ➢ Data, data types, identifiers ➢ Data declarations **Concepts:** ➢ Traversing, inserting, deleting data ➢ Sorting, searching and merging of data. **Principles:** ➢ Time Complexity ➢ Space complexity **Procedure** ➢ Top down approach and Bottom up approach [Procedure with own similar illustration] 

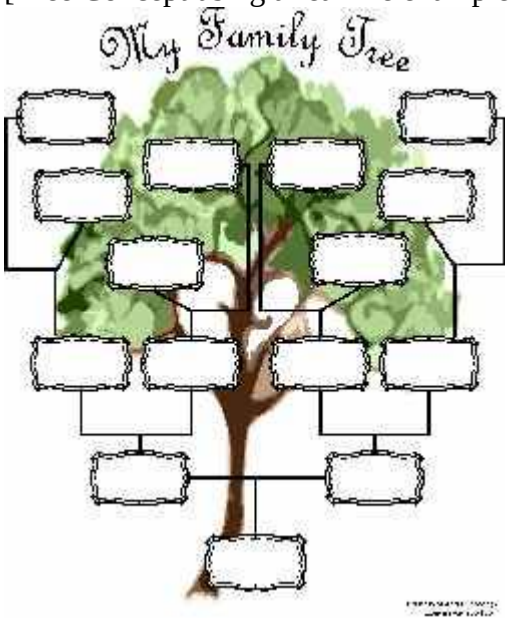
	Reference Material: Books: - Titles 1) Data structure Using C by ISRD group 2) Data Structures in C by Yashwant Kanetkar + Training CD 3) Introduction to Data Structures in C by Ashok Kamthane, Pearson group. 4) Data Structures Using C by Reema Thareja, Oxford press **Teaching Aids:** Black board, Chalk, Transparencies, Power point presentation slides(PPTs), Reference books, notes, LCD projector/OHP Projector **PPTs: -** **Web sites :**1**)** www.youtube.com/user/nptelhrd/cse-IIT Delhi 2) http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-:%20Guwahati/data_str_algo/frameset.htm 3)www.programming.im.ncnu.edu.tw 4)http://pinterest.com/dhruvbird/algorithms-data-structures-in-pictures-or-anyone-c/
Lecture No.	**Topic/ Subtopic to be covered**
1	Concept of Data Structures and its importance in Computer Engineering
2	**P**rogramming languages used to implement Data Structures • C programming language and it's data types
3	**E**lementary Data Structure Organization Classification of Data Structures
4	Operations on Data Structures • Traversing ,Inserting and Deleting
5	• Searching ,sorting and merging
6	• Different approaches to design an algorithm i.e. Top down and Bottom up approach.
7	• Time Complexity. • Space complexity
8	• 'Big O' Notation calculation

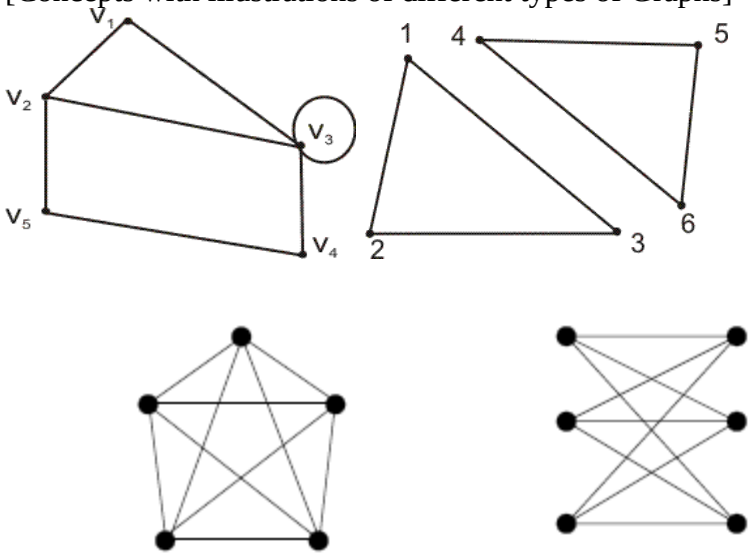
Topic 2	**Sorting and Searching**
	Facts: ➢ Data, data types, identifiers **Concepts:** ➢ Array ,Stack and Queue ➢ [To be taught with real life examples]  ➢ Sorting Techniques **Principles:** ➢ Selection sort, Insertion Sort, Bubble Sort, Merge Sort, Shell Sort and Radix Sort **Reference Material:** Books: Titles- 1) Data structure Using C by ISRD group 2) Data Structures in C by Yashwant Kanetkar + Training CD 3) Introduction to Data Structures in C by Ashok Kamthane, Pearson group. 4) Data Structures Using C by Reema Thareja, Oxford press **Teaching Aids:** Black board, Chalk, Transparencies, Power point presentation slides(PPTs), Reference books, notes, LCD projector/OHP Projector **PPT with Sample: -** **Websites:** 1**)** www.youtube.com/user/**npte**lhrd/cse-IIT Delhi 2)http://**nptel**.iitm.ac.in/courses/Webcourse-contents/IIT-:%20Guwahati/data_str_algo/frameset.htm 3)www.programming.im.ncnu.edu.tw
Lecture No	Topics /subtopics to cover.
1	**Sorting Techniques** • Bubble sort
2,3	• Selection sort
4	• Insertion sort
5	• Merge Sort
6	• Radix sort algorithm
7	• Merge Sort algorithm
8	• Quick sort algorithm
9,10	• Linear search and Binary Search

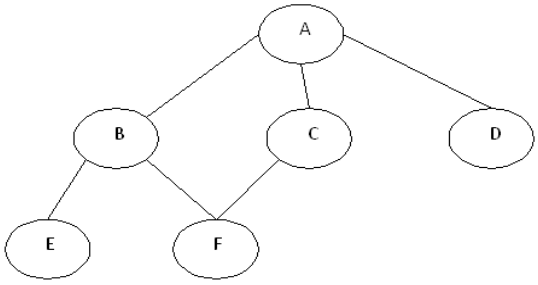
Topic 3	**Stacks**
	Concepts: ➢ Stack ➢ Abstract Data Types **Recursion** **Principles:** ➢ LIFO Procedure ➢ Evaluation of Expression such as Prefix, Postfix and Infix ➢ Application :- Polish Notation, Converting of Infix to Postfix and Postfix to Infix ➢ Reversing list **Reference Material:** Books: - Titles- 1) Data structure Using C by ISRD group 2) Data Structures in C by Yashwant Kanetkar + Training CD 3) Introduction to Data Structures in C by Ashok Kamthane, Pearson group. 4) Data Structures Using C by Reema Thareja, Oxford press **Teaching Aids:** Black board, Chalk, Transparencies, Power point presentation slides(PPTs), Reference books, notes, LCD projector/OHP Projector **PPT with Sample: -** **Websites:** 1)www.youtube.com/user/nptelhrd/cse-IIT Delhi 2):http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-:%20Guwahati/data_str_algo/frameset.htm 3):www.programming.im.ncnu.edu.tw
Lecture No.	**Topic/ Subtopic to be covered**
1-6	• Introduction to Stack • Stack as an abstract data type • Representaion of stack through an array and [linked list to be taught after completion of ch. 5]
7-8	• Applications of Stack • Reversing the list
9	• Evaluation of Postfix expression
10	• Evaluation of Prefix expression
11-12	• Recursion

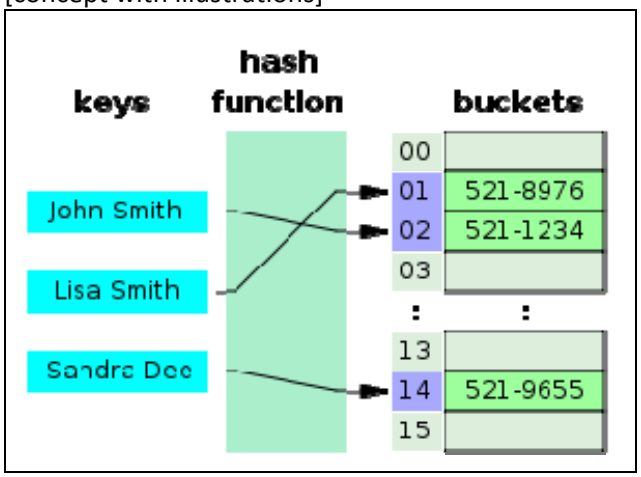
Topic 4	**Queues**
	Concept: ➢ Abstract data type, Queue, Circular Queue, Double Ended Queue, Priority Queue, Dequeues. **Principle** ➢ Queue as an array **Procedure** ➢ Algorithm for implementing the above mentioned Queue using arrays. **Applications** ➢ Application of Queues for process scheduling in Operating System ➢ Spooling on printer for printing job. **Reference Material:** **Text Books** 1) Data structure Using C by ISRD group 2) Data Structures in C by Yashwant Kanetkar + Training CD 3) Introduction to Data Structures in C by Ashok Kamthane, Pearson group. 4) Data Structures Using C by Reema Thareja, Oxford press **Teaching Aids:** Black board, Chalk, Transparencies, Power point presentation slides(PPTs), Reference books, notes, LCD projector/OHP Projector **Websites:** 1)www.youtube.com/user/nptelhrd/cse-IIT Delhi 2)http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-:%20Guwahati/data_str_algo/frameset.htm 3)www.programming.im.ncnu.edu.tw
Lecture No.	**Topic/ Subtopic to be covered**
1-2	• Significance of Queues in Data Structure • Queue as an abstract Data Type
3	• Types of Queues
4	• Circular Queue
5	• Double ended Queue
6	• Priority Queue
7	• Dequeue
8	• Applications of Queue
Topic 5	**Linked List**
	Concepts: ➢ Node, Address pointer ➢ Null pointer, Empty list, Linear list, Circular and Doubly lis**t**

	Principles ➢ Linked list as a Data Structure. **Procedure** ➢ Traversing a singly linked list ➢ Searching an element in a list ➢ Inserting a new node and deleting node form list **Applications** ➢ Applications of singly linked list such as Patient information in Hospital ➢ Employee information in an organization **Reference Material:** Books: - Titles- 1) Data structure Using C by ISRD group 2) Data Structures in C by Yashwant Kanetkar + Training CD 3) Introduction to Data Structures in C by Ashok Kamthane, Pearson group. 4) Data Structures Using C by Reema Thareja, Oxford press **Teaching Aids:** Black board, Chalk, Transparencies, Power point presentation slides(PPTs), Reference books, notes, LCD projector/OHPProjector **PPT with Sample: -** **Websites:** 1)www.youtube.com/user/nptelhrd/cse-IIT Delhi 2)http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-:%20Guwahati/data_str_algo/frameset.htm 3)www.programming.im.ncnu.edu.tw
Lecture	**Linked List**
1	Introduction To Linked List
2	Node, Address, Pointer, Information, Next, Null Pointer, Empty list etc.
3	Type of lists • Linear list
4	• Circular list • Doubly list
5	Operations on a singly linked list (only algorithm) • Traversing a singly linked list
6	• Searching a linked list
7	• Inserting a new node in a linked list
8	• Deleting a node from a linked list

Topic6	Tree
	Concepts: ➢ Tree, Degree of Node, Degree of Tree, Level of Node, Depth, Height of Tree ➢ Indegree, Outdegree, Directed edge, Path, Ancestor, Descentds, Expression Tree. **Principles** ➢ Tree as nonlinear type of Data Structure **Procedure** ➢ Inorder Traversal ➢ Preorder traversal ➢ Post order traversal **Application** ➢ Operating System file Structure, NFS, NTFS **Reference Material:** Books: - Titles-1) Data structure Using C by ISRD group 2) Data Structures in C by Yashwant Kanetkar + Training CD 3) Introduction to Data Structures in C by Ashok Kamthane, Pearson group. 4) Data Structures Using C by Reema Thareja, Oxford press **Teaching Aids:** Black board, Chalk, Transparencies, Power point presentation slides(PPTs), Reference books, notes, LCD projector/OHP Projector, **Websites:** 1)www.youtube.com/user/nptelhrd/cse-IIT Delhi 2)http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-:%20Guwahati/data_str_algo/frameset.htm 3)www.programming.im.ncnu.edu.tw
Lecture	Topics to be covered
1	Introduction to Tree as a Data Structure [Tree Concept using a real life example] 

2	Terminologies: tree ,degree of a node, degree of a tree
3	level of a node, leaf node, Depth / Height of a tree, In-degree and out-Degree
4	Directed edge, Path, Ancestor & descendant nodes.
5	Tree Types and Traversal Methods
7	• Binary tree
8	• Binary search tree (BST).
9	Binary tree traversal (only algorithm) • In order traversal
10	• Preorder traversal • Post order traversal
11	Expression tree
12	Revision
Topic 7	**Graph and Hashing**
	Facts ➢ Vertices and edges **Concepts:** ➢ Graph ,node, arcs, directed graph, Indegree, outdegree, adjescent, successor predescessor, relation,weight, path, length, DFS ,BFS [Concepts with illustrations of different types of Graphs] 

	Principles ➢ Representaion of graph ,array representation ,linked list representation ,hashing **Procedure** ➢ Depth first search.breadth first search Application ➢ Application of singly linked list such as Patient information in Hospital, ➢ Employee information in an organization **Reference Material:** Books: - Titles-1) Data structure Using C by ISRD group 2) Data Structures in C by Yashwant Kanetkar + Training CD 3) Introduction to Data Structures in C by Ashok Kamthane, Pearson group. 4) Data Structures Using C by Reema Thareja, Oxford press **Teaching Aids:** Black board, Chalk, Transparencies, Power point presentation slides(PPTs), Reference books, notes, LCD projector/OHP Projector. **Websites:** 1)www.youtube.com/user/nptelhrd/cse-IIT Delhi 2)http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-:%20Guwahati/data_str_algo/frameset.htm 3)www.programming.im.ncnu.edu.tw
Lecture	**Topics to be covered**
1	Introduction Terminologies: graph, node (Vertices), arcs (edge), directed graph
2	• In-degree, out-degree, adjacent, successor, predecessor, relation, weight, path, length.
3	Representations of a graph • Array Representation
4	Representations of a graph • Linked list Representation
5	Traversal of graphs • Depth-first search (DFS). 

6	Traversal of graphs Breadth-first search (DFS).
7	Hashing [concept with illustrations] 
8	Hashing • Hash function • Collision resolution techniques

5.2 Planning and conduct of Test:

- There will be two tests each of 25 marks each.
- The tests 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 mandatorily displayed on the notice board prior to the internal exams.
- Teacher shall give the feedback to the students about their performance.

5.3 Details about conduct of Assignments:-

Left to the discretion of Professor

5.4 Strategies for Conduct of Practicals:-

5.4.1 Approach for Design of Manual

N/A

5.4.2 Suggestions for effective conduct of practical and assessment

1. The Lab Assistant prior to practicals should ensure that the labs are well equipped with working Systems and the desired softwares.
2. The faculty may devide the students into groups as felt necessary.
3. The faculty should make the students aware of the problem statement of the day and applications.
4. The faculty should refresh the concepts for the relevant topic/practical and carry out discussions.
5. The faculty should then help the students to design/implement the stated problem Statement.
6. The students shall enter the code and observe the outputs.
7. The teacher shall help students debug errors if any.
8. **The students should then complete the Manual for the above and they will be grades as per the MSBTE continous assessment norms for attendance-2, written work -4, effective execution of code-2 and orals-2.**

6.1 Class Test: -It is proposed that there will be two tests each of 25 marks. The tests will be conducted as per MSBTE schedule

6.1.1 Guidelines for setting class test question paper:

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

1. The question paper should be set according to the given **Sample Test Paper format**.
2. Question paper for class tests first & 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.

Class Test-I

Syllabus for class test I:
Topic I, Topic II and Topic III up to 3.2

Class Test-II

A) Syllabus for class test II:
Topics 3.3 to topic 7.

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.

Class Test I

Course Name Computer Engineering Group **Course Code : CO/CM/IF/CD/CW**

Semester : Third

Title of the subject: Data Structure using 'C' **Subject Code 17330**

Q 1:- Attempt any Three 3*3=9 Marks

a. Give a brief description of
   i) Searching
   ii) Sorting
   iii) Traversing

b. State the use of 'Big O' Notation, in the analysis of an algorithm.
c. Differentiate between the Bubble Sort and Selection Sort methods.
d. How can a Stack be used as an Abstract Data type?

Q 2:- Attempt any Two. 4*2=8 Marks

a. Describe Algorithm analysis in terms of Time Complexity and Space Complexity.
b. Write an algorithm for the implementation of Quick Sort.
c. State the different approaches to design an algorithm and describe any one in brief.

Q 3: Attempt any Two. 4*2=8Marks

a. Write a c program to implement Non recursive implementation of Binary search.
b. Write in brief about the POLISH Notation.
c. Write the Push & POP functions in C simulating Push and Pop operations of STACK implemented using an array of integers.

Class Test II

Course Name Computer Engineering Group **Course Code : CO/CM/IF/CD/CW**

Semester : Third

Title of the subject: Data Structure using 'C' **Subject Code 17330**

Q1) Attempt any Three. 3*3=9 Marks

i) State how a Queue can be used as an abstract data type.
ii) Describe linked list.
iii) Describe linked representation of a Binary tree.
iv) State the differences between the Depth First Search (DFS) and the Breadth- First Search (BFS) methods.

Q 2) Attempt any Two 4*2=8 Marks

i) Translate following infix expression into its equivalent Postfix expression:-
(a+b) + (c+d) –e*f

ii) Write in Short about the types of Queues.
iii) Write a 'c' program to delete the first node, which contains the integer item 'item50', in the info field of a singly linked list.

Q 3 Attempt any Two 4*2=8Marks

i) Construct a binary tree to represent following infix expression.
(a+b) + (c+d) –e
ii) Describe the collision resolution techniques.

iii) Elaborate on the linked list representation of a graph.

Question Paper 100 marks

Course Name Computer Engineering Group Course Code : CO/CM/IF/CD/CW

Semester : Third

Title of the subject: Data Structure using 'C' Subject Code 17330

Q1 a) Attempt any Six. (6*2 = 12)

i) State the limitations of the 'Big-O' Notation.
ii) Elaborate on the Space Complexity of an algorithm.
iii) List the various Sorting Techniques.
iv) State the applications of Stack.
v) Define a complete binary Tree.
vi) Define Directed edge of a Tree
vii) Differentiate between the Radix Sort and Shell Sort methods.
viii) Define Connected Graph.

Q1 b) Attempt any two 2*4=8 Marks

i) Describe the different approaches to design an algorithm
ii) Write a program for sorting the array of 10 elements using the Bubble Sort method.
iii) Describe Priority Queue with its advantages.

Q2 Attempt any Four (4*4 =16)

i) Describe linear search with an example.
ii) Find out infix equivalent of the following postfix expression
    a) AB+C*D –
    b) ABC* + D-
iii) Write a program to print the number of non-zero elements in the list.
iv) Describe concept of Binary Tree and it's applications.
v) Write a program to calculate the number of items in a Queue.
vi) Write a program for Linear Search of an array.

Q3 Attempt any Four 4*4=16 marks

i) Write a program to convert an infix expression into a Postfix expression.

ii) Describe concept of circular queue. How it is better than linear Queue.

iii) Describe doubly linked list with an example

iv) Write a function to traverse a node of a Binary Tree.

v) Describe Expression Tree with an example.

vi) Describe the concept of hashing with it's applications.

Q4 Attempt any four 4*4=16 Marks

i) Write a program to sort 10 integers using an array of pointers.

ii) Write a program to print 'Fibonacci series', using recursion.

iii) Describe Queue as an abstract data type.

iv)Write a program to delete the first node from a linked list.

v) Describe Stack using Linked List.

vi)Describe the Pre-Order Binary tree traversal algorithm.

Q5 Attempt any Two 2*8=16 Marks

i) Write a program for Selection Sort with its complexity.

ii) Convert the following infix expression into a post fix expression.
(A-2*(B+C)/D*E)+F

iii) Describe the collision resolution techniques in hashing with an example.

Q6 Attempt any Two 2*8=16 Marks

i) Write a program to read an integer number. Print the reverse of this number using recursion (ex. 345 to 543).

ii) Write a program to count the number of nodes in a Binary search tree.

iii) Describe the Breadth First search traversal of a Graph.