OUTCOME BASED ASSESSMENT NORMS (OBAN) 2021






Government Polytechnic, Sakoli,
District: Bhandara
Maharashtra 441802

OUTCOME BASED ASSESSMENT NORMS 2021

by

GOVERNMENT POLYTECHNIC SAKOLI

Document Developed by

Dr. C.S. Thorat, Principal and Chairman

Prof. S. P. Lambhade, HOD, Computer Tech. and Member

Prof. A.A. Ali, HOD, Electronics & Tele. Comm. and Member

Dr. V. G. Kondekar, HOD, Civil Engg. & Member

Prof. B. S. Vaikunthe, I/C HOD, Mechanical Engg. & Member

Prof. V. V. Wararkar, I/C HOD, Electrical Engg. & Member

&

Dr. U. B. Aher, NBA Coordinator and Member Secretary Government Polytechnic, Sakoli, India

Approved by

Institute Curriculum Implementation Unit (ICIU),

Government Polytechnic, Sakoli

Published by

Prof. S. P.Lambhade

Principal,

Government Polytechnic, Sakoli, India

Vision of Institute

To be an institute of national repute creating technocrats to serve the society.

Mission of Institute

The mission of Government Polytechnic, Sakoli -

1. To set up state of the art infrastructure, laboratories, library and supporting services.
2. To achieve academic excellence in teaching and learning through continuous development using latest technologies and resources.
3. To inculcate technical and entrepreneurial skills, moral and ethical values in students.
4. To build strategic networking with alumni, industries and academic institutions.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES and FORMATS

CHAPTER 1

Government Polytechnic, Sakoli an Introduction

The brief history of Government Polytechnic Sakoli is given in this Chapter.

1.1 History

Government Polytechnic, Sakoli (GPS) is one of the foremost institutions in Vidarbha region in Maharashtra State in India and started in Naxal affected area in 1983 which is run by Government of Maharashtra. At its commencement the intake was 60. At present annual intake of the institute is 300. This institute aims to develop the eminent diploma holders who are skilled and zealous to the highest professional standards in the field of engineering and technology.

During its establishment year, the institute provided course in Civil Engineering. Later in 1990 Mechanical Engineering, in 1995 Electronics & Telecommunication Engineering, in 2007 Electrical Engineering and in 2008 Computer Technology Courses were also established.

1.2 Geographical Location of Sakoli

Sakoli is a small village in Bhandara city in the Indian state of Maharashtra. The latitude of Sakoli, India is 21.0826483, and the longitude is 79.9926926. Sakoli, District Bhandara, is located at India country in the Bhandara Cities place category with the gps coordinates of 21°04'57.5"N and 79°59'33.7"E. Sakoli, India elevation is 265 meters. Sakoli is situated in the Indian state of Maharashtra. Figure 1.1 shows the location.

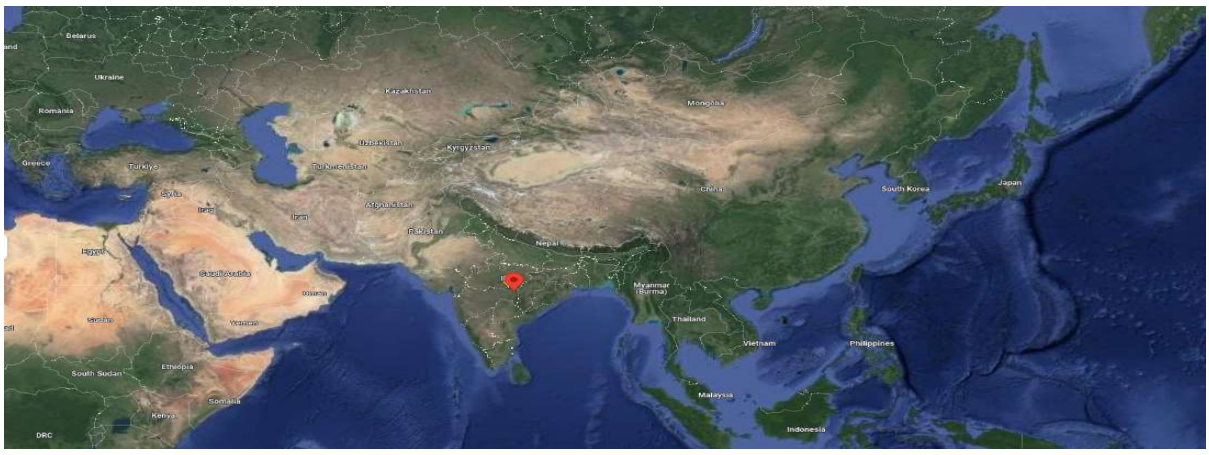


Figure 1.1. Location of Sakoli

1.3 Government Polytechnic, Sakoli (GPS) Campus

Government Polytechnic, Sakoli is situated on National Highway 53 (NH-53 old NH-6),

Sendurwafa, Sakoli, , 1,5 km distance from Sondad railway station (on Nagpur-Raipur rout) and 1.5 km distance from Sakoli bus station. Figure 1.2shows the campus map of Government Polytechnic, SAKOLI.

Figure 1.2. Government Polytechnic, Sakoli Campus

1.4 Bodies Responsible for Technical Education in GPS

The higher education in India is categorised into General Education, Professional Education and Vocational Education. Polytechnic Education System (PES) in India is the undergraduate level category of professional Education.

GPS is one of the polytechnics of PES in India. It is mandatory for GPS to follow the guidelines framed by the various bodies responsible for technical education, which are as follows:

1.4.1 Department of Higher Education, MHRD

The Department of Higher Education, MHRD, is responsible for the overall development of the basic infrastructure of Higher Education sector, both in terms of policy and planning in India. Under a planned development process, the Department looks after expansion of access and qualitative improvement in the Higher Education, through world class Universities, Colleges, and other Institutions.

1.4.2 All India Council for Technical Education (AICTE)

The All India Council for Technical Education (AICTE) has been in existence since November 1945 as a national level Apex Advisory Body. AICTE became a statutory body through an act of Parliament 52, in 1987.

AICTE was established with a view to the proper planning and coordinated development of the technical education system throughout the country, the promotion of qualitative improvement of such education in relation to planned quantitative growth and the regulation and proper maintenance of norms and standards in the technical education system for matters connected therewith. One of the major functions of AICTE is to lay down norms and standards for courses, curricula, physical and instructional facilities, staff pattern, staff qualifications, quality instructions, assessment and examinations.

1.4.3 National Board of Accreditation (NBA)

The National Board of Accreditation (NBA), India was initially established by AICTE (All India Council of Technical Education) under section 10(u) of AICTE act, in the year 1994, for periodic evaluations of technical institutions & programmes basis according to specified norms and standards as recommended by AICTE council. NBA in its present form came into existence as an autonomous body with effect from 7th January 2010, with the objective of Assurance of Quality and Relevance of Education, especially of the programs in professional and technical disciplines, i.e., Engineering and Technology, Management, Architecture, Pharmacy and Hospitality, through the mechanism of accreditation of programs offered by technical institutions.

NBA has introduced a new process, parameters and criteria for accreditation. These are in line with the best international practices and oriented to assess the outcomes of the programme. NBA adopted Outcome Based Education (OBE) model for accreditation of all engineering programs in India from 2013.

1.4.4 Higher and Technical Education, Government of Maharashtra

It is the apex authority responsible for steering and supporting the development and growth of quality Higher and Technical Education that meets educational and social objectives of the state. This department is highly committed towards inclusive education and realizes the importance of quality of education and has undertaken numerous initiatives for achieving highest quality standards in the field of education. Accreditation and Re-accreditation of the Universities

and Institutes of higher learning has been made mandatory to ensure the quality of institutions.

1.4.5 Directorate of Technical Education (DTE), Government of Maharashtra

The role of the Directorate is to maintain, enhance the standard, quality of technical education by laying the policies, establishing developing Govt. Institutions, guiding supervising the aided, private institutions, interacting with industry and national level institutions, coordinating with other departments of State Government, Government of India Statutory Organizations and to contribute to the development of industry society at large.

1.4.1 Maharashtra State Board of Technical Education (MSBTE)

Maharashtra State Board for Technical Education (MSBTE) was established with the enactment of the Maharashtra State Board of Technical Education Act 1997 to regulate the matters pertaining to diploma level technical education in the state of Maharashtra. GPS is affiliated to MSBTE. The MSBTE shall monitor all academic and examination related activities of the Institutions such as curriculum, teaching examination scheme, teaching hours, academic schedule, eligibility of candidate to appear for the examination, etc.

CHAPTER 2

Outcome Based Education Philosophy

Maharashtra State Board of Technical Education (MSBTE), Mumbai adopted the OBE approach for curriculum design because, National Board of Accreditation (NBA) focusing on the adoption of OBE approach for all engineering Programs in India since 2013 for accreditation. Programs to be accredited since 2013 will have to be based on OBE approach. NBA adopted Outcome based Model because, OBE is "Learner Centric" rather than "Teacher Centric". OBE is briefly described in this chapter.

2.1 Outcome Based Education

Outcome Based Education (OBE) is an education approach that focuses on the graduate attributes or outcomes after completing an academic Program. Outcome based approach means knowing what you want to achieve and then taking the steps to do so.

Some Benefits of OBE are-

1. More directed and coherent curriculum.
2. Graduates (students) will be more "relevant" to industry and other stakeholders.

The framework required for implementation of OBE consists of the following as shown in Figure 1.1 and consists of:

- Outcome Based Curriculum (OBC): What students should be able to do?
- Outcome Based Teaching learning (OBTL): Making the students to achieve the outcomes.
- Outcome Based Assessment (OBA): How to measure, what the students has achieved?

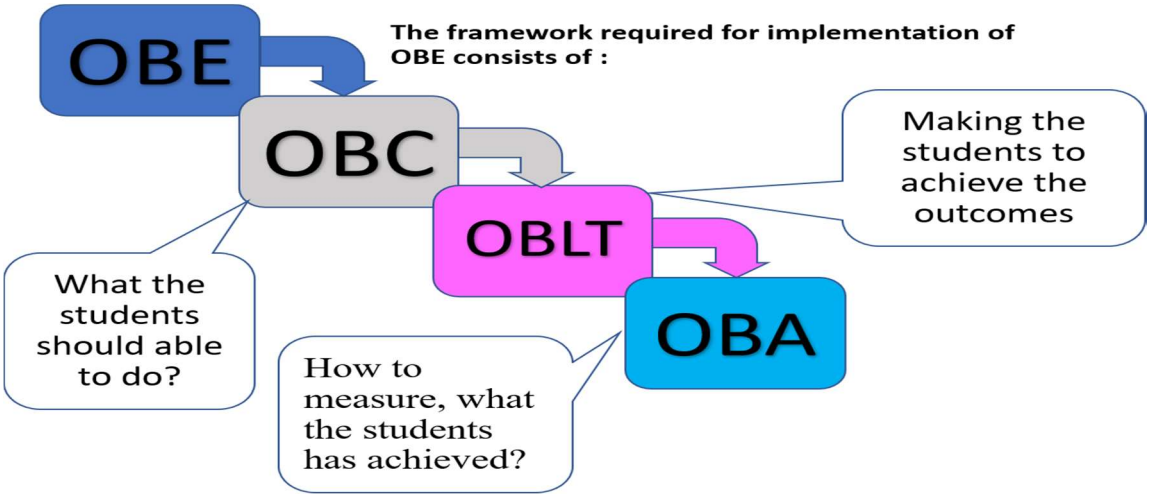


Figure 2.1. Outcome Based Education Framework

2.2 Outcome Based Curriculum (OBC)

An outcomes-based curriculum (OBC) model provides direction and guides students on why learning is important at a particular stage or phase. This enables students to define their learning needs; enables teachers to locate their teaching and assessment in relation to the whole; and offers program designers a basis for continuous quality control of the curriculum through assessment design and curriculum evaluation.

2.3 Outcome Based Learning Teaching (OBLT)

OBTL is a student-centered approach for the delivery of educational programs. The curriculum topics in courses are expressed clearly as the intended outcomes for students to achieve. Teaching is then designed to directly facilitate students to achieve those outcomes. Assessment tasks address what students are supposed to learn and achieve as well. In this approach, teachers act as facilitators, and students should take responsibility and participate actively.

2.4 Outcome Based Assessment (OBA)

Outcome Based Assessment is the process of developing the appropriate assessments for the learning outcomes as well as conducting some necessary activities to make the assessments transparent, valid, and reliable. OBA plays a critical role in OBE since without the presence of transparent, valid, reliable assessments, it would not be possible to tell what and how the students have achieved with respect to the pre- determined learning outcomes.

2.5 KEY constituents of OBE

Figure 2.5.1 shows the key constituent of OBE:

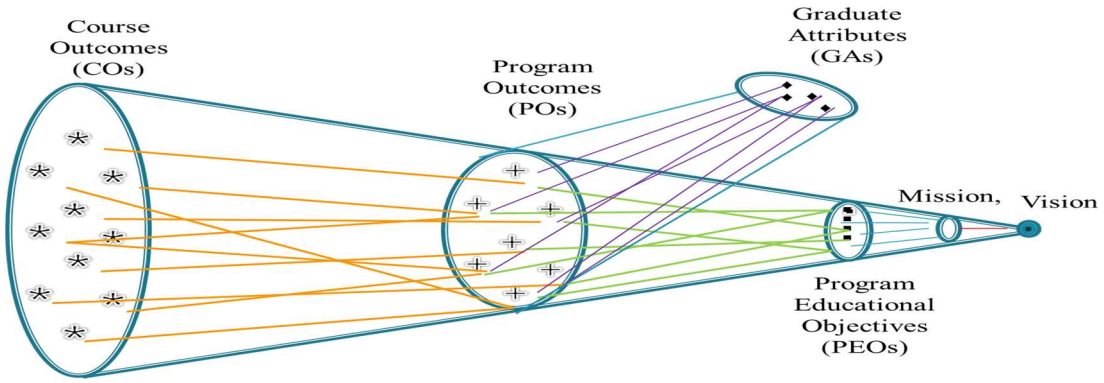


Figure 2.5.1. KEY constituents of OBE

1. **Vision**

   Vision is a picture of the future you seek to create, described in the present tense, as if it is happening now. It shows where we want to go, and what we will be like when we get our goal.

2. Mission

Mission statement defines what an institution is, why the institution exists, and its reason for being. It defines what we are here to do together.

Vision vs Mission

Mission	Vision
A mission statement is what an organization is all about.	A vision statement is what the organization wants to become.
A mission statement explains what the organization does, for whom and the benefit.	A vision statement describes how the future will look if the organization achieves its mission.
A mission statement gives the overall purpose of an organization,	A vision statement describes a picture of the "preferred future".

3. Graduate Attributes (GA's)

Graduate attributes are the **qualities**, **skills** and understandings a university community agrees, its students should develop during their time with the institution. These attributes include but go beyond the disciplinary expertise or technical **knowledge** that has traditionally formed the core of most university courses. WA (Washington Accord) defines 12 GA's for Engineering Graduates.

- **Graduate Attributes (GA's) as per WA (Washington Accord)**

i. **Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and core engineering specialization to the defined and applied engineering procedures, processes, systems or methodologies.

ii. **Problem Analysis:** Identify, formulate, study literature, and analyze *broadly-defined* engineering problems in reaching substantiated conclusions using analytical tools appropriate to respective discipline or area of specialization.

iii. **Design/ development of solutions:** Design solutions for *broadly- defined* engineering/ technology problems and *contribute to* the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

iv. **Investigation:** Conduct investigations of *broadly-defined* problems; locate, search and select relevant data from codes, databases and literature, design and conduct experiments to provide valid conclusions.

v. **Modern Tool Usage:** Select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to *broadly-defined* engineering activities, with an understanding of the limitations.

vi. **The Engineer and Society:** Demonstrate understanding of the societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to engineering technology practice.

vii. **Environment and Sustainability:** Understand the impact of engineering/technology solutions in societal and environmental context, and demonstrate knowledge of, and need for sustainable development.

viii. **Ethics:** Understand and commit to professional ethics and responsibilities and norms of engineering technology practice.

ix. **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse technical teams.

x. **Communication:** Communicate effectively on *broadly-defined* engineering activities with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

xi. **Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and apply the same to one's own work, as a member and leader in a team and to manage projects in multidisciplinary environments.

xii. **Life-long learning:** Recognize the need for, and have the ability to engage in independent and life-long learning in specialized technologies.

4. Program Outcomes (PO's)

Program Outcomes (POs) describe what students should know and be able to do at the end of the program. They are to be in line with the graduate attributes (GAs) of NBA. PO's are to be specific, measurable and achievable. POs transform the PEOs into specific student performance and behaviors that demonstrate student learning and skill development.

Following are POs (Seven) for all diploma programs as per NBA guidelines from January 2019 –

- **POs (for Diploma Program) given by NBA**

PO1: Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the

engineering problems.

PO2: Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods.

PO3: Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

PO4: Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

PO5: Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

PO6: Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

PO7: Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

5. Program Educational Objectives (PEO's)

The Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the programme is preparing graduates to accomplish. PEOs should be measurable, appropriate, realistic, time bound and achievable. As per NBA guidelines program shall have 3 to 5 PEOs.

6. Program Specific Objectives (PSO's)

No definition for PSO's is found in literature. According to Dr. B.L. Gupta, NITTTR, Bhopal, PSO's are the broad statements of Program specific objectives as per the local needs. As per NBA guidelines program shall have 2 to 4 PSOs (if any).

Ex. If more power plants exist nearby the institute, then PSOs based on the needs of power sector industry.

Example	
PSO1	Maintain Electrical Equipment
PSO2	Maintain Electrical Power Systems

7. Course Outcomes (CO's)

Course Outcomes (COs) are clear statements of what a student should be able to demonstrate upon completion of a course. They should be assessable and measurable knowledge, skills, abilities or attitudes that students attain by the end of the course. It is

generally a good idea to identify between four and seven. All courses in a programme would have their own course outcomes. These course outcomes are designed based on the requirement of the programme outcomes (POs). Each course outcomes are mapped to relevant POs and they are mapped to the programme educational objectives (PEOs). The teaching learning process and assessment methods are to be designed in such a way to achieve the COs. It is important to ensure that the student can acquire the knowledge or skill required.

MSBTE "I" Scheme curriculum has six COs and map with educational taxonomy (Bloom's and Other).

- **Course Objectives Vs Course Outcomes**

  Following table clarifies the difference between Course Objectives Vs Course Outcomes

Course Objectives	**Course Outcomes**
Describe what a teacher needs to teach, and what needs to be planned to teach.	Describe what students should demonstrate upon the completion of a course.
Example- At the end of the course, students will understand the types of wiring system.	**Example-** At the end of the course, students will be able to choose a suitable wiring system for particular installation.

- **Characteristics of Course Outcomes:**
  - The course outcomes must state the major knowledge, skills, attitude, or ability that students will acquire.
  - Course outcomes should be expressed in terms of measurable and/or observable behaviors
  - Course Outcomes should be agreed upon by the faculty in a program and should drive program outcomes.
  - Course outcomes should begin with an action verb (e.g., write, install, solve, and apply).
  - It would be better to map the course outcomes to the learning domain in Blooms or other Taxonomy.
  - All courses having Five to Six course outcomes (COs) having action verbs according to Educational Taxonomy in-
    - Cognitive domain: Cognitive domain- defining knowledge classification

- Affective domain: Defining behaviors that correspond to attitude and values.
- Psychomotor domain: Defining physical skills or task classification.

- **Course Outcomes Example of Course: Electrical Machines.**

Course Outcomes (COs)	Domains of Learning
1. **Apply** laws governing the operation of electrical machines.	Cognitive
2. **Evaluate** different machine parameters under different conditions.	Cognitive
3. **Recommend** electrical machines for specific application.	Cognitive
4. **Perform** various electrical machine operations	Affective
5. **Operate** DC motors, DC generators, Induction motors, transformers etc.	Psychomotor
6. **Prepare** panel diagram for AC / DC motors.	Psychomotor

8. Specific Learning Outcomes (SLO's) or Learning Outcomes (LO's)

Learning outcomes (LO's) or Specific Learning Outcomes (SLO's) are "*statements of what is expected that the student will be able to do as a result of learning the activity*". (Jenkins and Unwin, 2001); i.e at the end of each unit or chapter. SLO's should also be assessable and measurable knowledge, skills, abilities or attitudes that students attain by the end of the unit.

MSBTE "I" Scheme curriculum has SLOs which are derived as subset of COs and called **PrOs** for Practical Outcomes, **ADOs** as affective domain Outcomes and **UOs** as Unit outcomes.

- **Example of POs-COs-UOs Relation (Course: Electrical Materials and Wiring Practice)**

Program Outcome (POs)	Course Outcomes (COs)	Unit Outcomes (UOs)	Questions in Cognitive Domain
PO1: Basic and Discipline specific knowledge **PO4:** Engineering Tools, Experimentation and Testing	**Use** various wiring tools for electrical Installation.	**Describe** given types of wiring tools, its construction and working.	1. **Describe** electrician screwdriver with the help of sketch. 2. **Describe** philips screwdriver with the help of sketch. 3. **Describe** combination plier with the help of sketch. 4. **Describe** crimping tool with the help of sketch.

CHAPTER 3

Outcome Based Curriculum Implementation Philosophy

Curriculum Implementation represents one of the important phases of curriculum development. It starts after curriculum design and curriculum development. As it converts a blueprint in the form of a curriculum into reality, hence any institute should handle it seriously. It is said a good design and bad execution leads to a disaster. This chapter covers the detailed philosophy to ensure right kind of curriculum implementation of outcome-based curriculum.

The curriculum Implementation and Assessment Norms (CIAAN) are prepared by MSBTE for ensuring the effective curriculum implementation. These norms are applicable to GPG.

3.1 Approaches for Curriculum Implementation

Refer page 17 of CIAAN 2017.

3.2 Norms and Strategies

Norms for Curriculum Implementation Process

Refer page 19 of CIAAN 2017.

Strategies for Curriculum Implementation

Refer page 19 and 20 of CIAAN 2017.

3.3 Mechanism for Curriculum Implementation

Fig. 3.1 shows the structure of curriculum implementation mechanism. which consists of followings: (Fig. 5 of CIAAN 2017 is reproduced here as Fig. 3.1 for ready reference)

- MSBTE which consists of Board and Academic Committee
- RBTE - Regional Board of Technical Education
- RRC - Regional Review Committee
- EAMC - MSBTE, External Academic Monitoring Committee
- ICIU- Internal Curriculum Implementation Unit at diploma institute level
- IAMC- Internal Academic Monitoring Committee for Program

Roles and responsibilities of RRC, EAMC, ICIU, Principal, academic coordinator and IAMC are described in CIAAN 2017. Refer page 21 to 23 of CIAAN 2017.

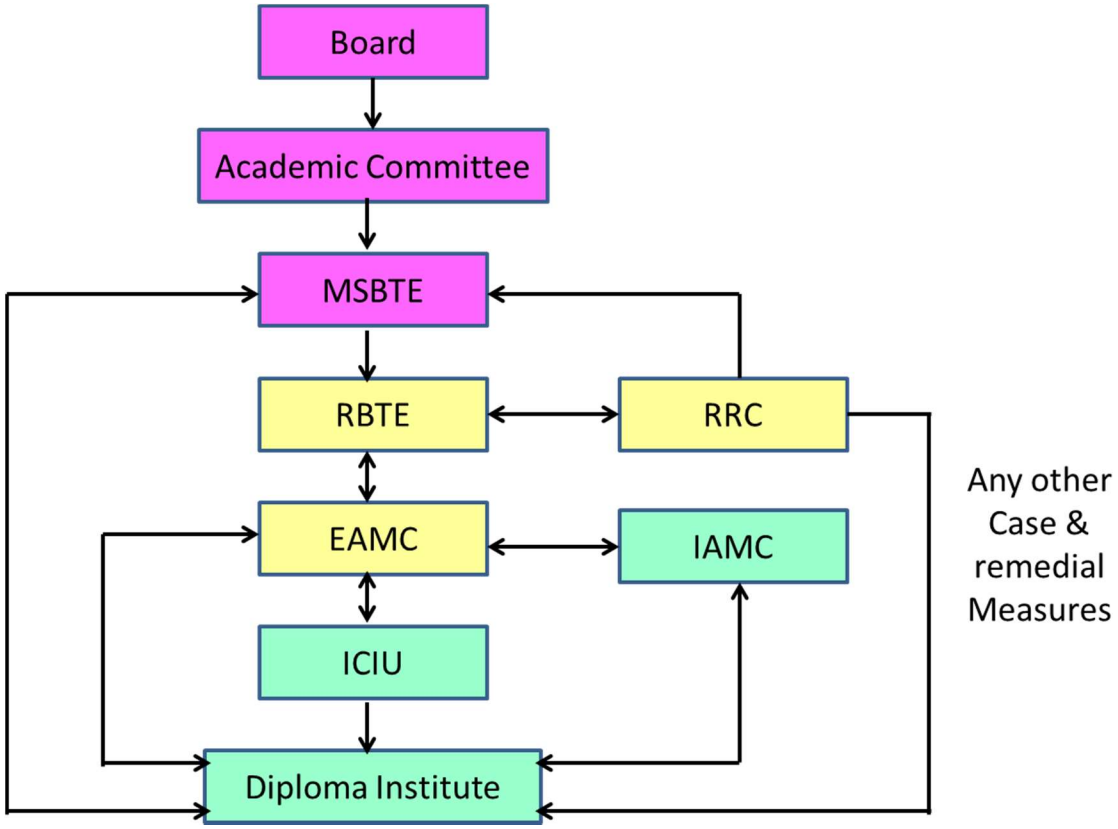


Figure 3.1. Structure of Curriculum Implementation Mechanism

Institute Level Curriculum Implementation Unit (ICIU)

ICIU is responsible for institutional planning, monitoring curriculum implementation and maintain the records. Fig. 3.2 shows the structure of ICIU which consists of followings: (Fig. 6 of CIAAN 2017 is reproduced here as Fig. 3.2 for ready reference)

The structure of ICIU will comprise of the following officials –

1. Principal - Ex-officio Chairman
2. Heads of Department (HODs) - (01 from each program) - Ex-officio member.
3. Academic Coordinator (HOD/Sr. Lecturer) – Ex-officio Member Secretary.
4. Representatives of institute teaching staff -Member– 02 (To be nominated by Principal)
5. Students Representatives - Member – 02 (One female and one male, to be nominated by Principal)
6. Parent representative- Member – 1(To be nominated by Principal).

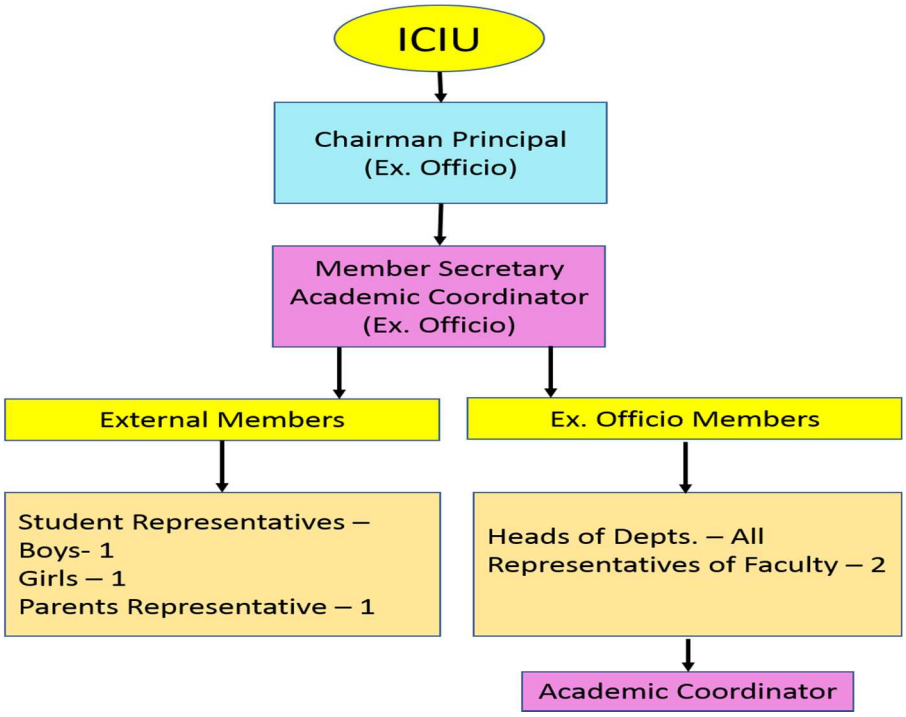


Figure 3.2. Structure of ICIU

3.4 Instructions for peoples involved in curriculum implementation

Following are clear and precise instructions to different class of people involved in curriculum implementation:

3.4.1 Instructions to Program Heads

Being a chief coordinator of a whole Learning Teaching Process (LTP) at a program level in implementing term curricula and the Program curriculum, which comprise of curricula of many courses, Program Heads have especially important role to play. It is to canalize efforts of all course's faculty members not only of the program but also those of other programs/departments. By doing so shall ensure achievement of predetermined PEOs, POs, PSOs and COs. In that case Program Heads are required to establish formal dialogue with all course faculty members and in-charge/Heads of the other departments/programs, whose faculty member's input, is equally important in successful curriculum implementation. Program Heads are expected to do following in order to achieve that: -

- Prepare a program/department plan and submit it to Academic coordinator based on MSBTE academic calendar.
- Identify senior faculty and allocate him/her the portfolio of curriculum implementation and monitoring.
- Organize preterm commencement meeting of all faculty members.
- Guide faculties in preparing an integrated course plan of the course(s) they are going to teach considering five experiences viz. Classroom, laboratory, library, field, and

experts lectures.

- Take term budget of consumables for implementing curricula of various courses.
- Monitor curriculum implementation though internal mechanism.
- Form guidance and counselling mechanism at program level to address academically weak students; prepare and implement strategic plan for the same.
- Collect feedback from student (*Format D*14), Exit Survey (*Format GA* 6) Parent (*Format GA* 7), Faculty (*Format GA* 8), Alumni (*Format GA* 9), and Management (*Format GA* 11) ones in a year.
- Analyse the PEOs, POs, and PSOs of the program and take corrective measures/actions.
- Ensure that faculties follow outcome-based learning teaching process and CIAAN 2017.

3.4.2 Instructions to Department Heads

Department (Non program) Heads have a challenging role to play to participate in implementation of curricula of various Programs of the institute. They are required to remain as a link between HODs of the Program/departments and faculty members of their department. Hence, they are expected to ensure following: -

- Prepare a department plan and submit it to Academic coordinator based on MSBTE academic calendar.
- Establish liaison with all Program Heads to which the department offers services.
- Seeks information about the other courses being offered in the ensuing term by various program/departments.
- Guide faculty members of the department in order to ensure that the course is getting linked with the other courses in a semester.
- Form guidance and counselling mechanism at department level to address academically weak students; prepare and implement strategic plan for the same.
- Ensure that faculties follow outcome-based learning teaching process and CIAAN 2017.

3.4.3 Instructions to Course Faculty

Course faculty have an especially important role of converting curriculum into predetermined outcomes. Course faculty is an important person behind achieving PEOs, POs, PSOs and COs. For that course faculties are required to do following things: -

- Read & comprehend Vision, Mission, Program Educational Objectives (PEOs), Program

Outcomes (POs) and Program Specific Outcomes (PSOs) of the program.

- Read & comprehend Course Outcomes (COs) of the course(s).
- Provide the authentic copy of curriculum to the students (Stamped by MSBTE) and discus the curriculum with the students in first period.
- Prepare course file separate for each course in advance before the start of academic session to implement the course curriculum effectively. Course file comprises of the following documents with necessary data.
  - Academic Calendar
  - Institute Academic Calendar
  - Curriculum of Course allotted
  - Timetable
  - Teaching Plan (TP) - *Format D1*
  - Laboratory Planning (LP) - *Format D2*
  - Progressive Assessment of Practical - *Format D3*
  - Progressive Assessment of Theory - *Format D5*
  - Industrial Visit Plan- *Format D7*
  - Expert Lectures Plan- *Format D8*
  - Consumables and Misc. Items Requirement
  - Attendance Sheet(s)/Record/Register
  - List of Students having less Attendance.
  - Progressive Test Question Paper(s)– *(Example Appendix: B)*
  - Rubrics - *(Example Appendix: D)*
  - Progressive Test(s) Result Analysis.
  - Course Outcome Attainment Gap Analysis - *Format GA 2*
  - Course Outcomes (COs) Attainment (After result for current term) *Format GA 3*
  - POs and PSOs Attainment of the course (After result for current term) - *Format GA 4*
  - End of Course Survey forms – *Format GA 5*
  - Course Material –handouts, notes, DVDs, PPTs, Model Question paper, previous terms Question Papers, Progressive Test Papers etc.

- Follow CIAAN 2017 and outcome-based assessment norms (OBAN) 2019.
- Submit the course file to Head of the department for record after declaration of result.

CHAPTER 4

Outcome Based Learning Teaching Process

Outcome-based education is an educational model in which curriculum and pedagogy and assessment are all focused on student learning. Learning Teaching process is equally or more important to accomplish learning outcomes. Domains of learning, learning teaching process are described in this chapter.

4.1 Learning

Learning is a relatively permanent change in behavior potentiality that results from reinforced practice or experience. Benjamin Bloom (1948) developed classifications of intellectual behavior and learning in order to identify and measure progressively sophisticated learning. Bloom's taxonomy is especially important in higher education where outcomes need to address the student ability to use information, not just recall and regurgitate concepts. Lower levels of learning are easier to assess but do not adequately display what the student can do with the knowledge. However, learning is not a purely cognitive function; learning occurs differently when it entails performing a skill or re-evaluating behavior. This approach is based on biological structure of human being as shown in figure 3.1.

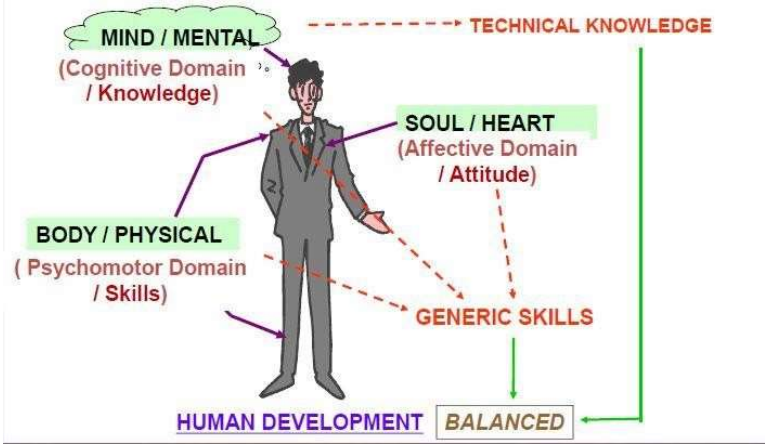


Figure 4.1. Human Being and Domains of Learning

Important elements of this approach which form basics of learning are explained below.

4.2 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. However,

learning is not a purely cognitive function; learning occurs differently when it entails performing a skill or re-evaluating 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, whereas 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 based on suitable examinations. When classroom and laboratory teaching is viewed in this light, evaluation becomes an integral part of teaching – learning process.

4.2.1 Cognitive Domain

Dr. Benjamin Bloom (1956) analyzed 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 shown in figure 4.2.

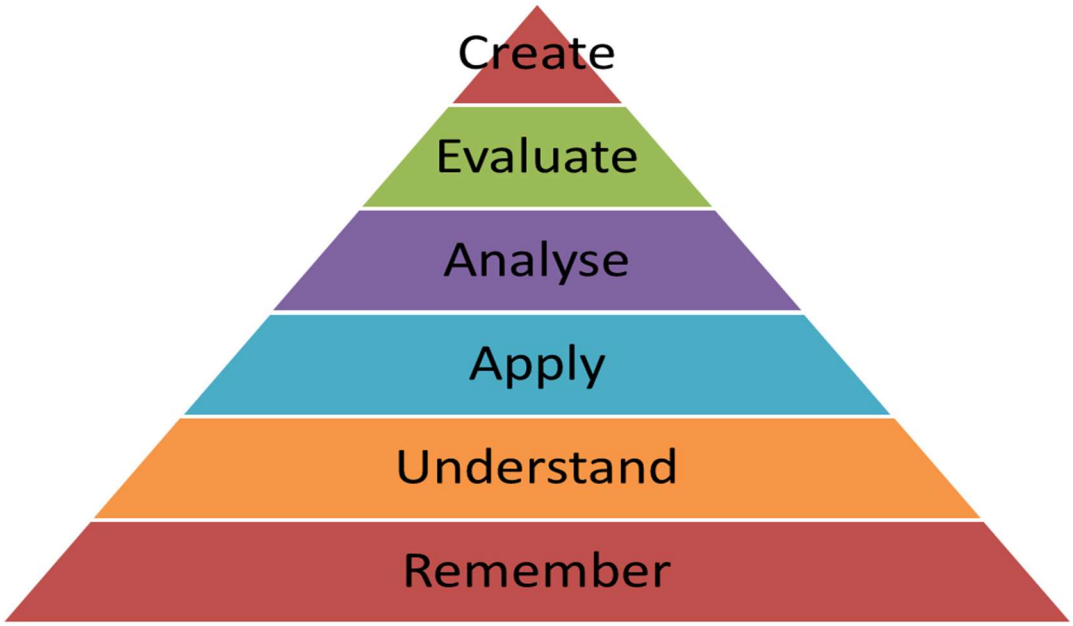


Figure 4.2. Revised cognitive hierarchy Levels Table

4.1. Cognitive Domain Levels Action Verbs

Cognitive Domain Levels	Behavior descriptions	Action Verbs
Remember	Recall or recognize information	Define, Duplicate, List, Name, Identify, Recall, Reproduce, Recognize, Retrieve
Understand	Understand meaning, re-state data in one's own words, interpret, extrapolate, translate	Calculate, Categorize, Clarify, Classify, Compare, Conclude, Contrast, Describe, Exemplify, Expand, Illustrate, Infer, Interpret, Locate, Paraphrase, Predict, Report, Restate, Summarize, Translate
Apply	Use or apply knowledge, put theory into practice, use knowledge in response to real circumstances	Carry out, Classify, Demonstrate, Execute, Illustrate, Implement, Practice, Solve, Use, Utilize
Analyse	Interpret elements, organizational principles, structure, construction, internal relationships; quality, reliability of individual components	Appraise, Attribute, Compare, Contrast, Deconstruct, Detect, Differentiate, Discriminate, Distinguish, Examine, Formulate, Infer, Integrate, Organize, Parse, Relate, Select, Sequence, Structure, Test
Evaluate	Assess effectiveness of whole concepts, in relation to values, outputs, efficacy, viability; critical thinking, strategic comparison	Appraise, Check, Coordinate, Critique, Defend, Detect, Dispute, Judge, Monitor, Prioritize, Rate, Reconstruct, Select, Support, Verify

	and review; judgment relating to external criteria	
Create	Develop new unique structures, systems, models, approaches, ideas; creative thinking, operations	Change, Combine, Compile, Compose, Construct, Create, Design, Formulate, Generate, Hypothesize, Improve, Invent, Plan, Predict, Produce

4.2.2 Psychomotor Domain

The Psychomotor Domain (RH Dave's version, 1970) was established to address skills development relating to the physical dimensions of accomplishing a task. Because, 'motor' skills extend beyond the originally traditionally imagined manual and physical skills, always consider using this domain, even if you think your environment is covered adequately by the Cognitive and Affective Domains. Whatever the situation, it is likely that the Psychomotor Domain is significant.

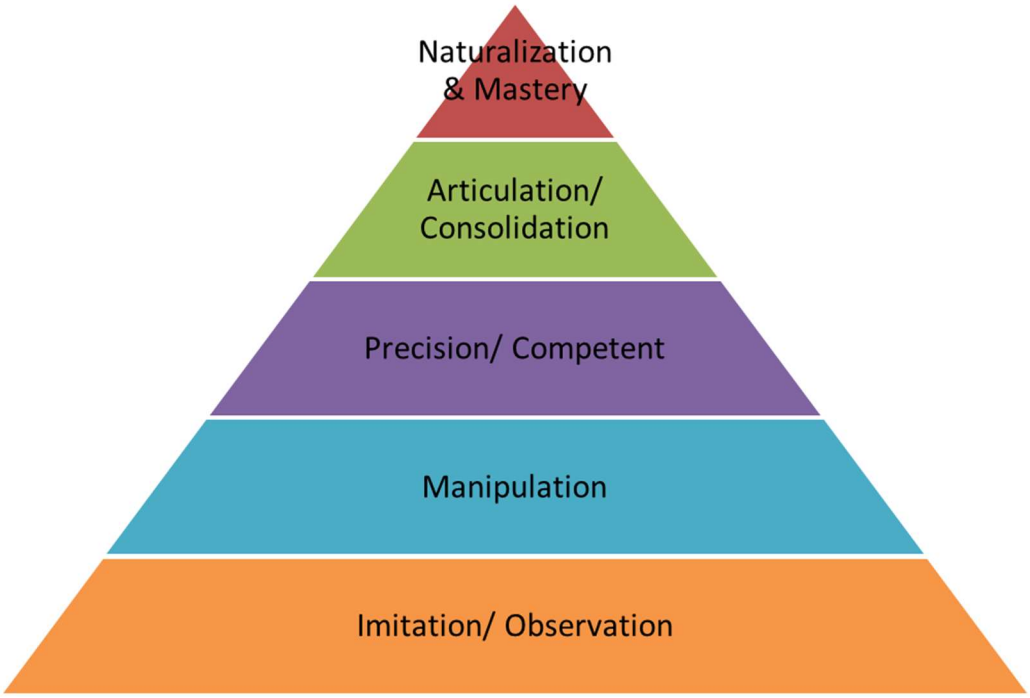


Figure 4.3. Psychomotor hierarchy Levels Table

4.2. Cognitive Psychomotor Domain Levels Action Verbs

Psychomotor Domain Levels	Behavior descriptions	Action Verbs
Imitation/ observation	Copy action of another; observe and replicate	Copy, follow, replicate, repeat, adhere, attempt, reproduce, organize, sketch, duplicate

Manipulation	Reproduce activity from instruction or memory	Re-create, build, perform, execute, implement, acquire, conduct, operate
Precision/ competent	Execute skill reliably, independent of help, activity is quick, smooth, and accurate	Demonstrate, complete, show, perfect, calibrate, control, achieve, accomplish, master, refine
Articulation/ consolidation	Adapt and integrate expertise to satisfy a new context or task	Solve, adapt, combine, coordinate, revise, integrate, adapt, develop, formulate, modify, master
Naturalization & Mastery	Instinctive, effortless, unconscious mastery of activity and related skills at strategic level	Construct, compose, create, design, specify, manage, invent, project-manage, originate

4.2.3 Affective Domain

Affective Domain, was detailed by Bloom, Krathwhol and Masia (1964, *Taxonomy of Educational Objectives: Vol. II*, *The Affective Domain*.) Bloom's theory advocates this structure and sequence for developing attitude - also now commonly expressed in the modern field of personal development as 'beliefs'. As with the other domains, the Affective Domain detail provides a framework for teaching, training, assessing and evaluating the effectiveness of training and lesson design and delivery, and also the retention by and affect upon the learner or trainee.

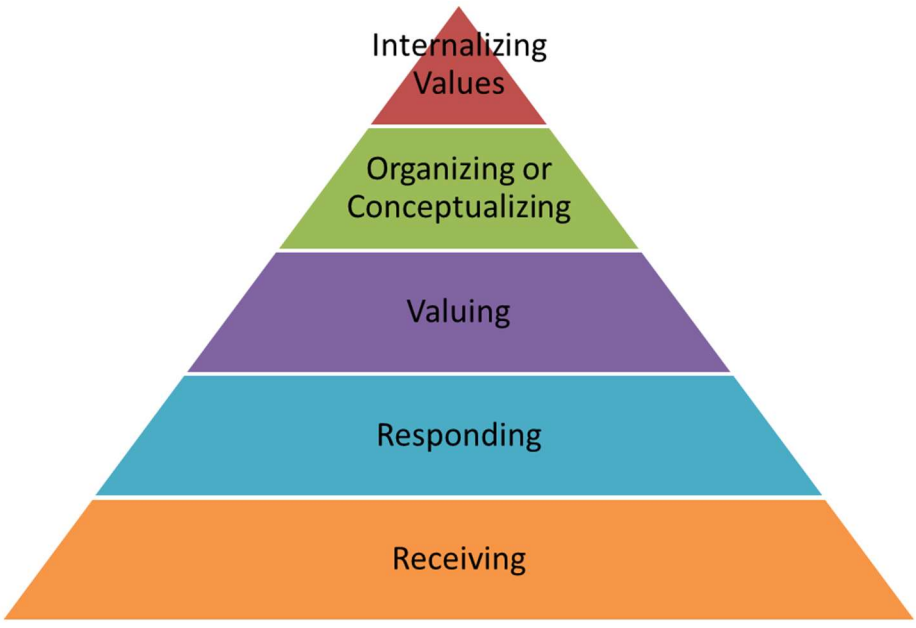


Figure 4.4. Affective Domain hierarchy Levels Table

4.3. Affective Domain Levels Action Verbs

Affective Domain Levels	Behavior descriptions	Action Verbs
Receiving	Open to experience, willing to hear	Ask, listen, focus, attend, take part, acknowledge, hear, be open to, retain, follow, concentrate, read, do, feel
Responding	React and participate actively	React, respond, interpret, clarify, contribute, question, present, cite, write, perform
Valuing	Attach values and express personal opinions	Argue, challenge, debate, refute, confront, justify, persuade, criticize,
Organizing or Conceptualizing	Reconcile internal conflicts; develop value system	Build, develop, formulate, defend, modify, relate, prioritize, reconcile, contrast, arrange, compare
Internalizing Values	Adopt belief system and philosophy	Act, display, influence, solve, practice,

Program Outcomes (POs) framed by NBA for diploma students are the specific characteristics required by the stake holders in the students. There is definite relation between these outcomes with the three different domains of learning, In some cases, POs may have relation with two or three domains of learning.

4.3 Learning – Teaching Process

OBE is focused on student centric learning, so teacher has less direct control over what and how students learn. The prerequisite knowledge skills must be assessed before storing L-T process. The course outcomes must be explained to them so that they will come to know what they have to achieve. Students are encouraged to think more for learning on their own. Teacher has important role of facilitator of learning process by engaging them with content in curriculum. Student should be helped to work their learning contents to other subjects a periodical progress of learning can be assessed by teacher to know mastery of outcomes. Teacher has plan teaching and learning methods for the program and course by different methods. Faculty should focus on learning rather than teaching.

The traditional methods of teaching-learning are lecture, lecture with discussion and use

of multimedia. In OBE learning based innovative method are to be adopted such as:

1. Problem based learning.
2. Cooperative learning.
3. Project based learning.
4. Small group teaching other than traditional methods, Tutorials, seminar, workshop and lab classes.
    a. Focused discussion
    b. Problem based learning.
    c. Student led seminar.
    d. Role Play.
5. Inquiry based learning.
6. Discovery learning.
7. Authentic learning.

Faculties should adopt the best suited learning process for attainment of their course outcomes and program outcomes.

CHAPTER 5

Outcome Based Assessment (OBA)

Assessment and evaluation are not to prove but to improve. Assessment and evaluation of students should be in tune with program outcomes (POs) and course outcomes (COs) of program and every individual course. Any program consists of different learning experiences spread over different sites viz. classroom, laboratory, library, field, and other relevant sites. The achievements of students' learning outcomes are measured through well-defined assessment whose purpose is to assess and provide feedback on student learning so that the student can improve his performance. The continuous feedback will be useful to the learner and to the faculty so that faculty can change the methodology to ensure learning of students.

The Evaluation schemes are mentioned in the individual course curriculum. In this section norms for conduct of evaluation and assessment of various heads are given.

5.1 Assessment Pattern

- Assessment Pattern for all Instruments is based on the Educational Taxonomy levels.
- Taxonomy levels of cognitive domains considered are remember (R), understand (U) and apply/analyze (A). Percentages levels of cognitive domains are indicated in individual course curriculum document.
- Taxonomy levels of psychomotor domain and affective domains are defined by the action verbs in individual curriculum.

5.2 Methods of Assessment

Assessment methods are used to provide adequate feedback to the program to identify strengths and weaknesses. There are basically two types of assessment methods to gather evidence of student learning. The assessment should be done through direct and indirect method as given below.

1. Direct assessment

A direct assessment method is based on a sample of actual student work. Direct assessment consisting of following heads.

a. Theory

   i. End Semester Examination (ESE)

   ii. Progressive Assessment (PA) consist of Progressive Assessment Tests

and Micro project

b. Practical

- End Semester Examination (ESE)
- Progressive Assessment (PA): Experiment/Assignment/Sheet/ Job/ Project etc.

2. Indirect assessment

An indirect assessment is based upon a report of perceived student learning. Following feedbacks are used for indirect assessment.

a. End of Course survey: *Format GA 5*

b. Exit survey: *Format GA 6*

c. Parent survey: *Format GA 7*

d. Faculty survey: *Format GA 8*

e. Alumni survey: *Format GA 9*

f. Employer survey: *Format GA 10*

g. Management survey: *Format GA 11*

5.3 Program Outcomes and Direct Assessment tools

PO1: Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

Direct Assessment tools:

- Test questions in exams on application/analyze level.
- Micro projects that involve problem analysis.
- Rubrics for specific engineering problems.
- Project and design projects in various courses. Examples:
- Obtain the Transfer Function of the First Order Active LPF realized using the Operational Amplifier.
- Obtain the of Fourier Transform of the signal given below:

  $x(t) = e\text{-}4tu(t)$
- Obtain the of Transfer Function of the circuit given below:
- Derive EMF equation of single-phase transformer.

PO2: Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods.

Direct Assessment tools:

- Test questions in exams on application/analyze level.

- Micro projects that involve problem analysis.
- Rubrics for specific engineering problems.
- Project and design projects in various courses.

PO3: Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

Direct Assessment tools:

- Test questions in exams on application/analyse level.
- Design major/ micro projects in which this attribute is integrated.
- Rubrics for specific engineering problems.
- Project and design projects in various courses.

PO4: Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

Direct Assessment tools:

- Lab reports in engineering courses using rubrics.
- Lab and field tools assessed by faculty and industry experts.
- Assignments on specific analysis problems.
- Assignments that include analysis software, CAD programs, etc.
- Project and design projects in various courses.
- Projects that assess student ability to appropriately apply tools.

PO5: Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

Direct Assessment tools:

- Assignments that examine student understanding of this attribute.
- Design projects in which this attribute is integrated.
- Complementary studies courses.
- Through Seminar/Quiz
- Exam questions in ethics related courses.
- Rubric to score essays from courses that discuss ethics.
- Reports and testing based on case studies.

PO6: Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

Direct Assessment tools:

- Lab reports and design projects that involve group work.
- Observations of faculty members and industry experts.
- Team member's assessment of other team members.
- Project that involves group work.
- Conducting Quiz
- Quiz after listening the video.
- Writing abstract of reports/papers/IS codes.
- Assignments in any course that require written work and presentations.
- Rubric for student seminar and project.

PO7: Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

Direct Assessment tools:

- Can be introduced in all courses.
- Engage in independent/ self-study.
- Assignments that assess student ability to search Internet and library.
- Rubric for project.
- Exam questions in the law and ethics course.
- Work of students in various competitions.

5.4 Rubrics for Assessment

Use of rubrics is an essential component in OBE. The example of rubrics is shown in appendix D.

A rubric is defined as scoring guide, consisting of specific pre-established performance criteria, used in evaluating student work on performance assessments. Rubric is typically the specific form of scoring instrument used when evaluating student performances or products resulting from a performance task.

5.4.1 Necessity of Rubrics

- Rubrics help to measure higher-order skills or evaluate complex tasks.
- Rubrics help to clarify vague, fuzzy goals.
- Rubrics help students to understand teachers' expectations.
- Rubrics help students to self-improve.

- Rubrics can inspire better student performance.
- Rubrics improve feedback to students.
- Rubrics make scoring easier and faster.
- Rubrics make scoring more accurate, unbiased, and consistent.
- Rubrics reduce arguments with students.
- Rubrics improve feedback to faculty and staff.

5.4.2 Use of Rubrics

Rubrics are used to assess followings.

- Essays/Papers
- Projects /reports
- Laboratory work
- Presentations /seminars
- Assignments
- Exam questions
- Capstone projects
- Exhibits
- Performances
- Portfolios of student work
- Artwork
- Internships

5.4.3 Types of Rubrics

1. **Holistic Rubric**

   In holistic rubric all criteria are assessed as a single score. Holistic rubrics are good for evaluating overall performance on a task. Because only one score is given, holistic rubrics tend to be easier to score. However, holistic rubrics do not provide detailed information on student performance for each criterion; the levels of performance are treated.

2. **Analytical Rubric**

   In analytical rubric each criterion is assessed separately, using different descriptive ratings. Each criterion receives a separate score. Analytical rubrics take more time to score but provide more detailed feedback.

5.4.4 Elements of a Rubric

Criteria, levels of performance, scores and descriptors are the four basic elements of rubrics, which are described below.

1. **Criteria**

   Criteria identify the trait, feature or dimension which is to be measured and include a definition and example to clarify the meaning of each trait being assessed. Each assignment or performance will determine the number of criteria to be scored. Criteria are derived from assignments, checklists, grading sheets or colleagues.

   Criteria examples:

   a. Introduction
   b. Thesis
   c. Arguments/analysis
   d. Grammar and punctuation
   e. Spelling
   f. Internal citations
   g. Conclusion
   h. References

2. **Levels of performance**

   Levels of performance are often labelled as adjectives which describe the performance levels. Levels of performance determine the degree of performance which has been met and will provide for consistent and objective assessment and better feedback to students. These levels tell students what they are expected to do. Levels of performance can be used without descriptors, but descriptors help in achieving objectivity. Words used for levels of performance could influence a student's interpretation of performance level (such as superior, moderate, poor or above or below average).

   Levels of performance example:

   - Excellent, Good, Fair, Poor
   - Master, Apprentice, Beginner
   - Exemplary, Accomplished, Developing, Beginning, Undeveloped
   - Complete, Incomplete
   - Yes, No

3. **Scores**

Scores make up the system of numbers or values used to rate each criterion and often are combined with levels of performance. Begin by asking how many points are needed to adequately describe the range of performance you expect to see in students' work. Consider the range of possible performance level.

Score example: 1, 2, 3, 4, 5 or 2, 4, 6, 8 etc.

4. **Descriptors**

Descriptors are explicit descriptions of the performance and show how the score is derived and what is expected of the students. Descriptors spell out each level (gradation) of performance for each criterion and describe what performance at a particular level looks like. Descriptors describe how well students' work is distinguished from the work of their peers and will help you to distinguish between each student's work.

5.5 Norms for Assessment

The assessment consisting of various heads End Semester Examination (ESE) theory, Progressive Assessment (PA) theory (which consist of Progressive Assessment Tests and Micro project), End Semester Examination (ESE) practical and Progressive Assessment (PA) practical. (This consists of Experiment/Assignment/Sheet/ Job/ Project etc.)

Faculty should follow the norms mentioned in CIAAN 2017 para 5.1.

5.6 Curriculum Mapping and Course Mapping

Before calculating attainment, it is necessary to perform curriculum mapping and course mapping. Attainment of POs and PSOS are based on COs-POs/PSOs mapping matrix, which described later in this chapter. Curriculum and Course mapping description is given below:

5.6.1 Curriculum Mapping

Curriculum mapping focuses on teaching and aligns instruction with program outcomes. It is used to explore what is taught and how. The course curriculum is first mapped with POs and PSOs. Minimum one PO should be mapped with the course curriculum content.

5.6.2 Course Mapping

Course mapping (Outcome mapping) facilitates the alignment of course

outcomes (COs) with program outcomes (POs). It allows faculty to create a visual map of a course. It is also used to explore how students are meeting program-level outcomes at the course level. Course mapping focuses on student learning.

Course mapping has following benefits:

- Identifies how required courses contribute to achievement of program outcomes.
- Increases student achievement in meeting program outcomes.
- Encourages reflection (can reveal gaps in the curriculum or prompt re-examination of outcomes)
- Makes Outcomes Assessment less cumbersome: explicit linkages reduce the amount of formal outcomes assessment required (focus can shift to program-level assessment projects)

5.7 CO, PO, PEO Attainment Process

The process of CO, PO and PEO is described in Figure 5.1, which is self-explanatory.

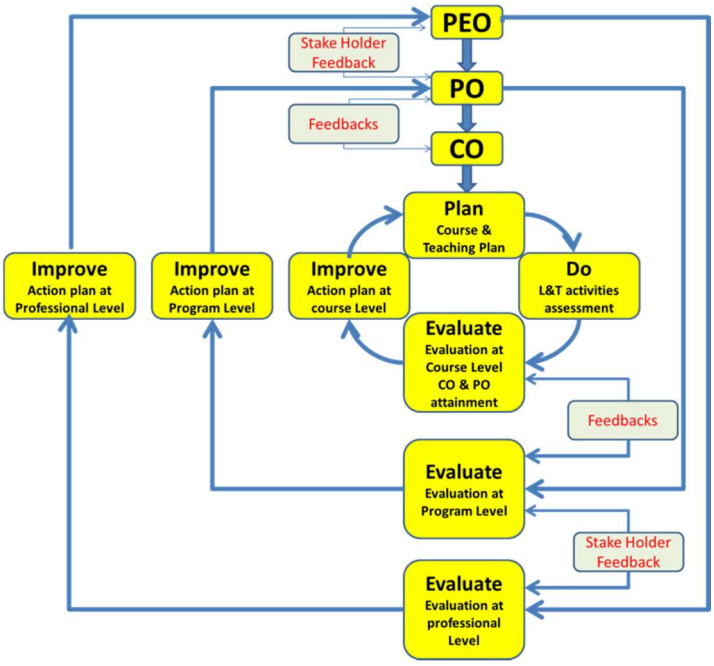


Figure 5.1. CO, PO, PEO Attainment Process

5.8 Attainment of Course Outcomes (COs)

- Attainment of COs can be measured directly and indirectly.
- Direct attainment of COs can be determined from the performances of students

in all the relevant assessment instruments Progressive assessment of theory: Progressive test and Micro Project, End Semester Examination of Theory, Progressive assessment of practical and End Semester Examination of Practical

- Indirect attainment of COs can be determined from the course exit surveys.
- Percentage weightage for computation of direct attainment of COs should be 80% which consist of:
  - Progressive assessment of theory: Progressive test and Micro Project
  - End Semester Examination of Theory
  - Progressive assessment of practical
  - End Semester Examination of Practical
- Percentage weightage for computation of indirect attainment of COs should be 20

  % which consist of:
  - End of Course survey

5.8.1 Method of Direct CO attainment

- The Program/Department will have access progressive assessment of Theory (Progressive test and micro project) and continuous assessment of practical. End semester Theory and Practical examination is conducted and evaluated by MSBTE.
- Average percentage of each COs should be calculated for progressive assessment of Theory (Progressive test and micro project) and progressive assessment of practical.
- Faculty should use MS Excel Program (*CO_Attainment_Calculator*) prepared for calculation of CO attainment.

5.8.2 Setting targets for Course Outcomes and identification of attainment gap

- Targets are set for each COs of a course separately.
- Setting target has the advantage of finding out the difficulty of specific COs.
- Attainment gap is identified by comparing CO attainment and setting target.
- Suitable action is initiated to fill the gap at the course faculty level and the same is documented.
- If the target achieved, higher target is set.

5.8.3 Calculation of Direct CO attainment

- CO attainment can be measured by following formula:

$$\%\ CO_i\ attainment = \sum_{e=1}^{n} \frac{\sum_{q=1}^{k}(Average\ Marks)_i}{\sum_{q=1}^{k}(Total\ Marks)_i}\ x\ 100$$

Where, i = Number of Course Outcomes (COs)

e to n = Number of examinations conducted

q to k = Number of questions related to CO_i

5.9 Attainment of Program Outcomes (POs) and Program Specific Outcomes (PSO)

- POs and PSOs are attained through program specific Core Courses.
- Each Course addresses a sub-set of POs and PSOs to varying levels (strengths) (1, 2 or 3).
- COs are mentioned in course curriculum to meet the identified POs/PSOs.

5.9.1 Strength of CO-PO/PSO Mapping

- Attainment of a PO/PSO depends both on the attainment levels of associated COs and the strength to which it is mapped.
- To determine the level (mapping strength) a particular PO/PSO is addressed by the course.
- Strength of mapping is defined at three levels: Low (1), Medium (2) and Strong (3)

5.9.2 Method to relate level of PO/PSO

- A following method is to relate the level of PO/PSO with the number of hours devoted to the COs which address the given PO/PSO.
- If >70% of classroom sessions addressing a particular PO/PSO, it is considered that PO/PSO is addressed at Level 3
- If 40 to 70% of classroom sessions addressing a particular PO/PSO, it is considered that PO/PSO is addressed at Level 2
- If 5 to 39% of classroom sessions addressing a particular PO/PSO, it is considered that PO/PSO is addressed at Level 1
- If < 5% of classroom sessions addressing a particular PO/PSO, it is considered that PO/PSO is considered not-addressed (Means 0 or "-")
- COs-POs and PSOs mapping is done by course teacher in consultation with HOD.
- The example of COs-POs and PSOs mapping is shown in *Appendix E.*

5.9.3 POs/PSOs Attainment Method

- PO/PSO attainment are calculated using following formula-
  PO/PSO attainment= Mapping strength of PO/PSO x Average of CO attainment addressing the particular PO/PSO
- These computations are approximate but indicative PO/PSO attainment
- Evaluations of attainment of POs and PSOs based on Direct and Indirect Methods are combined to arrive at the Final Evaluation.
- Combined Evaluation= (Weightage of direct attainment x Attainment value) + (Weightage of indirect attainment x Attainment value)
- Typical values of weight age of direct and indirect attainment are 0.8 and 0.2 respectively.
- Values of indirect attainment are calculated from feedback system as follows:
  - Student Exist Survey: 10%
  - Faculty Survey: 5%
  - Parent Survey: 2.5% and
  - Management Survey: 2.5%
- Use MS Excel Program (*CO_Attainment_Calculator*) for finding PO/PSO attainment.

5.9.4 Setting of POs/PSOs Attainment Target Level

- POs/PSOs target should be set depends upon previous attainment level before start of academic term with the consent of faculties in departmental meeting. The levels are as follows:
  - Level 1- Attainment between 0 to 0.5
  - Level 2- Attainment between 0.51 to 1.0
  - Level 3- Attainment between 1.01 to 1.5
  - Level 4- Attainment between 1.51 to 2.0
  - Level 5- Attainment between 2.01 to 2.5
  - Level 6- Attainment between 2.51 to 3.0
- If target achieved, higher target shall be set for next academic year.
- If target is not achieved, proper actions should be taken and recorded for its improvement.

5.10 Attainment of Program Educational Objectives (PEOs)

- POs –PEOs mapping of each program is to be done by individual program.
- Attainment of PEOs based on attainment of POs and Indirect Methods.
- Combined Evaluation= (Weight age of direct attainment x Attainment value of POs) + (Weight age of indirect attainment x Attainment value from feedback)
- Typical values of weight age of direct and indirect attainment are 0.8 and 0.2 respectively.
- Values of indirect attainment are calculated from feedback system as follows:
  - Industry Survey: 10%
  - Alumni Survey: 10% and
- Use MS Excel Program (*CO_Attainment_Calculator*) for finding PO/PSO attainment.

REFERENCES

[1.] Dr. V.V.Rao, *"Outcome Based Education and Accreditation"* VRV Consultants, 2015.

[2.] Government Polytechnic, Nagpur, *"Outcome Based Learning Teaching and Assessment Norms 2016"*

[3.] Government Polytechnic, Gondia, *"Outcome Based Learning Teaching and Assessment Norms 2020"*

[4.] http://www.nbaind.org/files/workshops/Three%20days%20workshop%20-%20Outcome%20based%20education.pdf , assessed on 23rd August, 2016

[5.] http://www.nbaind.org/files/workshops/Training%20Text%20Material.pdf , assessed on 23rd August, 2016

[6.] http://dte.kar.nic.in/Circulars/LRDC/Preparation%20for%20NBA%20ACCREDITATION.pdf

[7.] http://msbte.org.in/file/CIAAN%20Norms%202017.pdf

[8.] Maharashtra State Board of Technical Education, Mumbai, Curriculum Revision Project, 2012 Teacher Guide of different subjects, June 2013

[9.] Government Polytechnic, Nagpur, Workshop on Question Bank Development (Under TEQIP) , 8th & 9th February, 2007

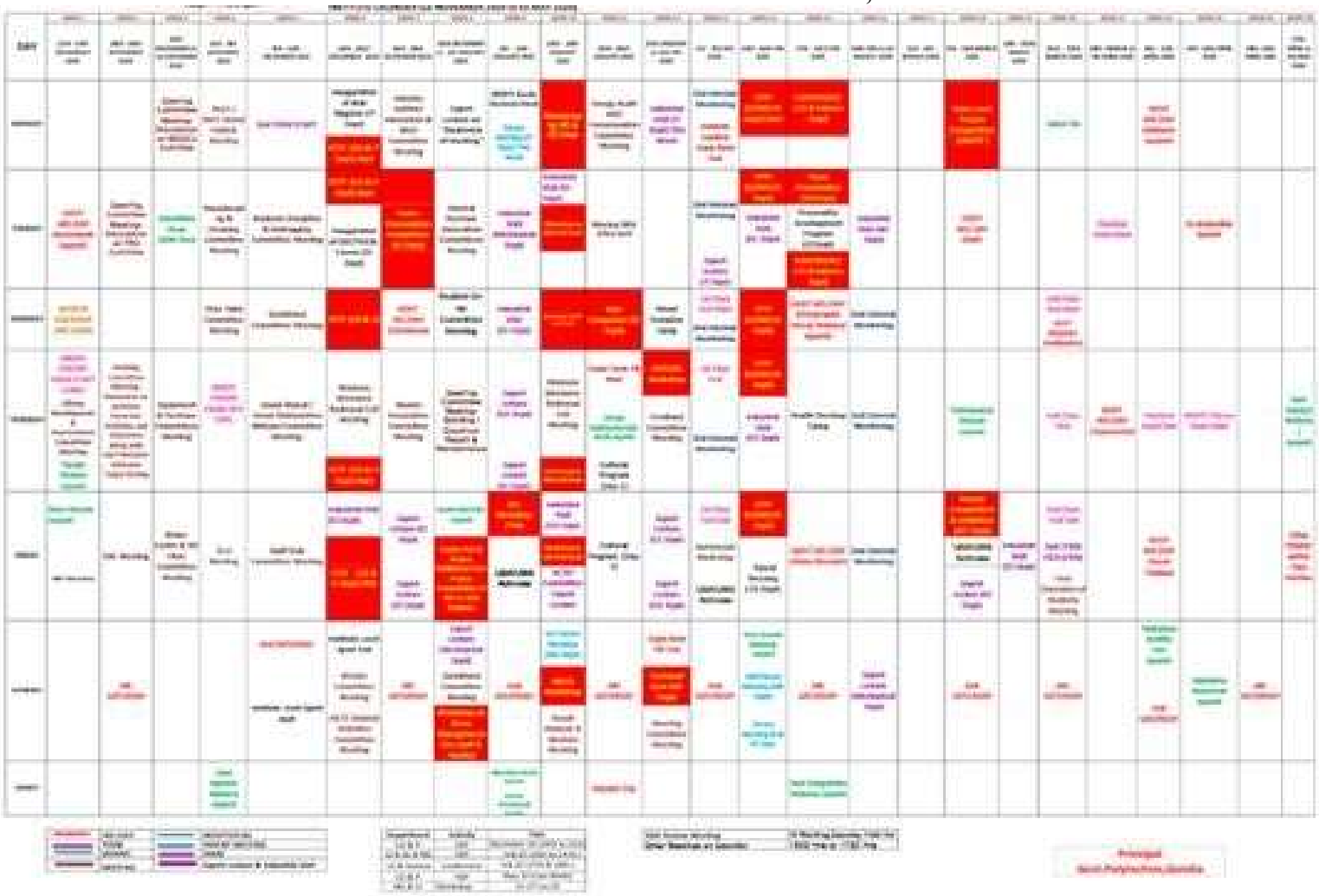
[10.] Government Polytechnic, Nagpur Workshop on Question Paper Setting and Model Answer 30th August, 2016

[11.] Ms. Varsha T. Lokare et. al., *"Course Outcomes Attainment for Data Structure Course Using Direct And Indirect Methods"*, Journal of Engineering Education Transformations, Special Issue, eISSN 2394-1707.

APPENDIX A: Formats

Format GA.1. Institute Plan

GOVERNMENT POLYTECHNIC, SAKOLI



Format GA.2. Course Outcomes Attainment Gap Analysis

GOVERNMENT POLYTECHNIC, SAKOLI.
Course Outcomes Attainment Gap Analysis
(TERM :_____ODD/EVEN)

Name of Program/ Dept: …… Diploma in ……..
Course Code : …… **Course Name : ……**
Name of Faculty: …….

Course Outcomes (COs)	COs Target in %	COs Attainment in %	COs Attainment Gap in %	Action Proposed to bridge the Gap	Modification
CO1					
CO2					
CO3					
CO4					
CO5					
CO6					
CO7					
CO8					

Name & Sign of Course Faculty

Format GA.3. Course Outcomes Attainment

GOVERNMENT POLYTECHNIC, SAKOLI.
Course Outcomes Attainment
(TERM :_____ODD/EVEN)

Name of Program/ Dept: …… **Diploma in ……..**
Course Code : …… **Course Name : ……**
Name of Faculty: …….

Assessment Tool	Course Outcomes (COs) Attainment in %							
	CO1	CO2	CO3	CO4	CO5	CO6	CO7	CO8
Progressive Test1								
Progressive Test2								
Assignment								
Continuous Assessment Practical								
Theory Score Index								
Practical Score Index								
Direct CO attainment (Average of Above)								
Indirect CO attainment from feedback								
CO attainment (80% of Direct+20% of Indirect)								

Name & Sign of Course Faculty

Format GA.4. POs/PSOs Attainment

GOVERNMENT POLYTECHNIC, SAKOLI.
POs/PSOs Attainment
(TERM :_____ODD/EVEN)

Name of Program/ Dept: …… **Diploma in ……..**
Course Code : …… **Course Name : ……**
Name of Faculty: …….

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
Required POs/PSOs attainment										
Direct POs/PSOs attainment										
Indirect POs/PSOs attainment										
Overall POs/PSOs attainment 80% of direct + 20% of Indirect										

Name & Sign of Course Faculty

Format GA.5. End of Course Survey

GOVERNMENT POLYTECHNIC, SAKOLI.
End of Course Survey

Course Code: | | | | | | | **Name of Course:** ……

Dear Student,
The purpose of this survey is to obtain input from the students, for assessment the Course Outcomes (COs). As a student of Computer Technology program at Government Polytechnic, Sakoli, we seek your help in completing this survey. Your response is a key part of our continuous improvement process and is critical to our NBA accreditation endeavor. Your participation is greatly appreciated.

Please insert ✓ in the appropriate box to indicate the degree of your satisfaction level.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	**Course Outcomes (COs)**	**1**	**2**	**3**	**4**
To what level you are able to:					
1					
2					
3					
4					
5					
6					
7					
8					

Any other suggestions: How to improve? / Any other comments.

……

Signature of Student:……

Format GA.6. Exit Survey

GOVERNMENT POLYTECHNIC, SAKOLI.

Exit Survey

Dear Student,

The purpose of this survey is to obtain input from the diploma students, on the quality of education they have received and level of preparation they have had in Computer Technology program at Government Polytechnic, Sakoli. The survey is meant to assess the Program Outcomes (POs) and Program Specific Outcomes (PSOs). As a recent diploma in engineering pass out of Computer Technology program at Government Polytechnic, SAKOLI, we seek your help in completing this survey. Your response is a key part of our continuous improvement process and is critical to our NBA accreditation endeavor. Your participation is greatly appreciated.

Name of Student: ……**Enrolment No**……...

Name of Organization:……...

Position: ……..

Email ID……**Mobile**……...

Please insert □ in the appropriate box to indicate the degree of your satisfaction level.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	Program Outcomes (POs)	1	2	3	4
To what level you are able to:					
1	**Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.				
2	**Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.				
3	**Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.				
4	**Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.				
5	**Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.				
6	**Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.				
7	**Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.				
S.N.	**Program Specific Outcomes (PSOs)**	**1**	**2**	**3**	**4**
To what level you are able to:					
1					
2					
3					

Any other suggestions: How to improve? / Any other comments.

……

Signature of student:……

Format GA.7. Parent Survey

GOVERNMENT POLYTECHNIC, SAKOLI.

Parent Survey

Dear Sir,

The purpose of this survey is to obtain input from parents, on the quality of education their wards (students) received and level of preparation they have had in..... (Name of program) program at Government Polytechnic, Sakoli. The survey is meant to assess the Program Outcomes (POs) and Program Specific Outcomes (PSOs). As the part of Parents involvement and contribution in the development and the continuous improvement of **…….** (Name of program) program at Government Polytechnic, Sakoli, we seek your help in completing this survey. Your response is a key part of our continuous improvement process and is critical to our NBA accreditation endeavor. Your participation is greatly appreciated.

Name of Parent: ……..…….....

Name of your ward: ……**Enrolment No**…….....

Name of your ward Program:…….....

Email ID……...**Mobile**…….....

Please insert ✓ in the appropriate box to indicate the degree of your ward has achieved.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	**Program Outcomes (POs)**	**1**	**2**	**3**	**4**
To what level your ward is able to:					
1	**Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.				
2	**Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.				
3	**Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.				
4	**Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.				
5	**Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.				
6	**Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.				
7	**Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.				
S.N.	**Program Specific Outcomes (PSOs)**	**1**	**2**	**3**	**4**
To what level your ward is able to:					
1					
2					
3					

Any other suggestions: How to improve? / Any other comments.

……..

Strengths of program:……

Deficiencies of program:……

Signature of Parent:……

Format GA.8. Faculty Survey

GOVERNMENT POLYTECHNIC, SAKOLI.

Faculty Survey

Dear Sir,

The purpose of this survey is to obtain input from faculty, on the quality of education the students have received and level of preparation they had in **……** (Name of program) program at Government Polytechnic, Sakoli. The survey is meant to assess the Program Outcomes (POs) and Program Specific Outcomes (PSOs). As the part of faculty contribution in the development and the continuous improvement of POs and PSOs of ..... (Name of program) program at Government Polytechnic, Sakoli, we seek your help in completing this survey. Your response is a key part of our continuous improvement process and is critical to our NBA accreditation endeavor. Your participation is greatly appreciated.

Name of Faculty: ……..…….....

Designation: …….....

Department / program: …….....

Email ID……...**Mobile**…….....

Please insert ✓ in the appropriate box to indicate the degree of your satisfaction.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	**Program Outcomes (POs)**	**1**	**2**	**3**	**4**
To what level students are able to:					
1	**Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.				
2	**Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.				
3	**Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.				
4	**Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.				
5	**Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.				
6	**Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.				
7	**Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.				
S.N.	**Program Specific Outcomes (PSOs)**	**1**	**2**	**3**	**4**
To what level students are able to:					
1					
2					
3					

Any other suggestions: How to improve? / Any other comments.

……..…….

Signature:……

Format GA.9. Alumni Survey

GOVERNMENT POLYTECHNIC, SAKOLI.
Alumni Survey

Dear Alumni,

The National Board of Accreditation (NBA) is the professional accrediting organization in India that accredits Engineering and Technology programs. The NBA requires each accredited program to demonstrate that certain criteria are met through a specific process.

The purpose of this survey is to obtain input from the alumni, on the quality of ……. (Name of program) engineering programs at Government Polytechnic, Sakoli and to assess the Program Outcomes (POs) and Program Specific Outcomes (PSOs) and Program Educational Objectives (PEOs). We seek your help in completing this survey. Your response is a key part of our continuous improvement process and is critical to our NBA accreditation endeavor. Your participation is greatly appreciated.

Name: ……**Program**…….....

Name of Organization:……...

Position: ……**Year of Diploma**…….

Email ID……...**Mobile**…….....

Please insert ✓ in the appropriate box to indicate the degree of your satisfaction level.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	Program Outcomes (POs)	1	2	3	4
To what level you are able to:					
1	**Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.				
2	**Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.				
3	**Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.				
4	**Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.				
5	**Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.				
6	**Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.				
7	**Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.				
S.N.	**Program Specific Outcomes (PSOs)**	**1**	**2**	**3**	**4**
To what level you are able to:					
1					
2					
3					

Program Educational objectives are at highest level, which are the broad statements that describe the career and professional accomplishments that the program are preparing diploma holders to achieve, 3-5 years after passing diploma.

Please insert ✓ in the appropriate box to indicate the degree of your satisfaction level.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	Program Educational Objectives (PEOs)	1	2	3	4
To what level you are able to:					
1					
2					
3					
4					
5					

Any other suggestions: How to improve? / Any other comments.

……

Signature of Alumni:……

Dear Sir,

GOVERNMENT POLYTECHNIC, SAKOLI.
Employer / Industry Survey

The National Board of Accreditation (NBA) is the professional accrediting organization in India that accredits Engineering and Technology programs. The NBA requires each accredited program to demonstrate that certain criteria are met through a specific process.

The purpose of this survey is to obtain input from employers, on the quality of ……. (Name of program) engineering programs at Government Polytechnic, Sakoli and to assess the Program Outcomes (POs), Program Specific Outcomes (PSOs), and Program Educational Objectives (PEOs). We seek your help in completing this survey. Your response is a key part of our continuous improvement process and is critical to our NBA accreditation endeavor. Your participation is greatly appreciated.

Name of Organization: …….....

Employer Name: ……**Position**…….....

Type of Business: ……**Organization size (No. of Employees)**……

Email ID……..**Mobile**…….....

Please insert ✓ in the appropriate box to indicate the degree of your satisfaction level.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	Program Outcomes (POs)	1	2	3	4
To what level our students are able to:					
1	**Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.				
2	**Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.				
3	**Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.				
4	**Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.				
5	**Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.				
6	**Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.				
7	**Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.				
S.N.	**Program Specific Outcomes (PSOs)**	**1**	**2**	**3**	**4**
To what level our students are able to:					
1					
2					
3					

Program Educational objectives are at highest level, which are the broad statements that describe the career and professional accomplishments that the program are preparing diploma holders to achieve, 3-5 years after passing diploma.

Please insert ✓ in the appropriate box to indicate the degree of your satisfaction level.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	Program Educational Objectives (PEOs)	1	2	3	4
To what level our students are able to:					
1					
2					
3					
4					
5					

Any other suggestions: How to improve? / Any other comments.

……

Signature:……

Format GA.11. Management Survey

GOVERNMENT POLYTECHNIC, SAKOLI.

Management Survey

Respected Sir,

The purpose of this survey is to obtain input from management, on the quality of education the students received and level of preparation they have had in.....(Name of program) program at Government Polytechnic, Sakoli. The survey is meant to assess the Program Outcomes (POs) and Program Specific Outcomes (PSOs). As the part of Management involvement and contribution in the development and the continuous improvement of ..... (Name of program) program at Government Polytechnic, Sakoli, we seek your help in completing this survey. Your response is a keypart of our continuous improvement process and is critical to our NBA accreditation endeavor. Your participation is greatly appreciated.

Name of Member: ……..…….....

Designation: …….....

Organization:…….....

Email ID……...**Mobile**…….....

Position in GB/BOS/PBOS…….

Please insert ✓ in the appropriate box to indicate the degree of your satisfaction.

1: Poor, 2: Fair, 3: Good, 4: Excellent

S.N.	Program Outcomes (POs)	1	2	3	4
To what level our students are able to:					
1	**Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.				
2	**Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.				
3	**Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.				
4	**Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.				
5	**Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.				
6	**Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.				
7	**Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.				
S.N.	**Program Specific Outcomes (PSOs)**	**1**	**2**	**3**	**4**
To what level our students are able to:					
1					
2					
3					

Any other suggestions: How to improve? / Any other comments.

……..

Signature:……

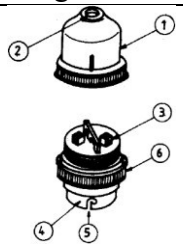
Appendix B: Model Progressive Test Paper

GOVERNMENT POLYTECHNIC, SAKOLI.
First Sessional Examination ODD2019

Program : **Diploma in Electrical Engineering** **Semester** : **Third**
Course : **Electrical Materials and Wiring Practice** **Course Code : 22328**
Time : **1 Hour** **Max. Marks : 20**

Instructions:

1. All questions are compulsory
2. Illustrate your answers with neat sketches wherever necessary
3. Figures to the right indicate full marks
4. Use of non-programmable calculator is permissible
5. Assume suitable data if necessary
6. Preferably, write the answers in sequential order.

Level	Q1	Attempt any Four (2x4)		(08)	COs
1R2	a)	Name any four electrical safety accessories.			CO1
2R2	b)	State any two properties of Aluminium.			CO2
2R2	c)	State the meaning of following terms. i. Hysteresis loop ii. Hysteresis			CO2
3R2	d)	Define following term Resistivity. State its unit.			CO3
1U2	e)	Identify the given tool and State its use.			CO1
2U2	f)	Compare the properties of copper and aluminum on the basis of resistivity and Melting point (^{0}c).			CO2
	Q2	**Attempt any Three (4x3)**		**(08)**	
3U4	a)	Classify the following insulating material as gaseous, liquid and solid insulators Hydrogen, Mica, Nylon, PVC, Mineral oil, SF6, Bakelite, Steatite.			CO3
1A4	b)	Study the figure 1 and answer the following questions.			CO1
		 Figure 1	i. Identify the accessory shown in figure 1. ii. State the material of part 3. iii. State, why part 5 is provided? iv. State the specification of this accessory.		

2A4	c)	Answer the following questions related to conducting materials i. Suggest best conducting materials for coil of incandescent lamp. Justify your answer. ii. State, why aluminium is not used as a terminal material?		CO2
3A4	d)	Suggest proper insulating materials for the following application. Justify your answer. i. Body of single pole switch ii. Insulation over heating coil of electric iron.		CO3

Course Outcomes:

CO1	Follow Safe Practices when undertaking electrical works.
CO2	Select relevant conductors and electromagnetic/magnetic materials.
CO3	Select relevant insulating materials.

Appendix D: Model Rubrics

Rubrics

Course Code: 22033 Course Title: Electrical Drawing & CAD

Name of Faculty: …….

Criteria	Unsatisfactory	Fair	Good	Excellent
Sketch	Sketch is completed with 5-6 errors. (0-2)	Sketch is completed with 3-4 errors. (3-4)	Sketch is completed with 1-2 errors. (5-6)	Sketch is 100% accurate. (7-10)
Drawing work / skill	Drawing is recreated with 5-6 errors Drawing is completed with major blemishes and cannot be interpret. (0-4)	Drawing is recreated with 3-4 errors Drawing is completed with major blemishes and is difficult to interpret. (5-8)	Drawing is recreated with 1-2 errors Drawing is completed with minor blemishes and still can be interpret. (9-12)	Drawing is recreated with 100% accuracy. Drawing is neatly completed and easily interprets. (13-20)
Printout layout aesthetic	Drawing is not completed within specified time and printout not taken. (0-2)	Drawing is completed within specified time and aesthetic of drawing is fair. (3-4)	Drawing is completed before specified time and aesthetic of drawing is good. (5-6)	Drawing is completed before specified time and aesthetic of drawing is excellent. (7-10)
Viva Voce	No Questions from external/internal are answered Correctly. (0-2)	25% Questions from external/internal are answered Correctly. (3-4)	50% Questions from external/internal are answered Correctly. (5-6)	All Questions from external/internal are answered Correctly. (7-10)

Name and Sign. Of Faculty

Appendix E: CO_PO/PSO Mapping

I Scheme Course Mapping Program: Diploma in Electrical Engineering
Course Code & Name:22212 Fundamentals of Electrical Engineering

No.	Course Outcomes	No. of Hours devoted in Curriculum
1	Determine Various parameters use in electric circuit.	11
2	Use basic laws of electrical engineering.	13
3	Make use of capacitors in different conditions.	11
4	Use principles of magnatism.	13
5	Use principles of electromagnatism.	16
6		0
	Total Hours	64

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
	Basic Knowledge & Discipline	Problem analysis	Design/ development of solutions	Engineering Tools, Experimentation and	Engineering practices for society,	Project Management	Life-Long Learning				Maintain Electrical Equipments	Maintain Electrical Power System
Course Mapping	X			X	-	-	X				X	X
CO1	3	-	-	3	-	-	3	-	-	-	2	2
CO2	3	-	-	3	-	-	3	-	-	-	2	2
CO3	3	-	-	3	-	-	3	-	-	-	-	-
CO4	3	-	-	3	-	-	3	-	-	-	-	-
CO5	3	-	-	3	-	-	3	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-
Total Hr. Devoted	64	0	0	64	0	0	64	0	0	0	24	24
Total Hr. of Curriculum	64	64	64	64	64	64	64	64	64	64	64	64
Percentage	100			100			100				37.5	37.5
Mapping Strenght of PO	3	-	-	3	-	-	3	-	-	-	2	2