Engineering Diploma Curriculum NITTTR-MSBTE Model 2016

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***Abstract*—Currently, the engineering education system is India is undergoing a massive overhaul due to the adaptation of outcome-based education across the country by the National Board of Accreditation (NBA) which is responsible for improving the quality of technical education. Maharashtra State Board of Technical Education (MSBTE), an autonomous government organisation in the highly industrialised state of Maharashtra in the Western region of India is responsible for ensuring the quality of technology education in the 550 technical colleges (called polytechnics in India) producing technologists. The currently offered technology curriculum called "G" scheme launched in 2012 includes the curricula of over 18 engineering diploma programmes of various occupations, comprising of about 450 courses. Due to the anomalies and lacunae of these curricula vis-a-vis outcome-based education MSBTE needed to re-design these curricula. To effectively plan, design and implement outcome-based curricula for different occupations in large number of institutes is always a daunting challenge for any organisation. Since NITTTR Bhopal has been undertaking curriculum development for the past several decades for various technology programmes, MSBTE entrusted NITTTR Bhopal to undertake this task. Therefore, the authors evolved the innovative outcome-based "Engineering Diploma Curriculum NITTTR-MSBTE Model 2016" for these 18 technology programmes, the salient features of which are presented in this "work in progress (WIP)" paper.**

Keywords—Curriculum; OBE; OBC, competency; course map; programme structure; MSBTE, NITTTR Bhopal.

I. INTRODUCTION

Till the early nineteen eighties, most of the technical colleges (called polytechnics in India) producing technologists did not have permanently constituted expert curriculum development committees. They followed the "*temporary committee collective wisdom"* approach, whenever a need arose for curriculum revision. However, during the last decade, the rapidly changing technologies changed the nature of work, not only in the Indian industry scenario [7], but across the world, where the products of these technical colleges also have to get employed. This scenario created a demand for new skill sets [9] of knowledge and competencies [4,5] in graduates for different categories of occupations to work effectively and efficiently in the industry. In this context, it is worth noting that the term "industry" is defined as "any enterprise, either wage employed or self-employed, which helps to earn one's livelihood [5]." Therefore, the "G" scheme [1] technology curricula offered by Maharashtra State Board of Technical Education (MSBTE) since 2012 necessitated a re-look. MSBTE is an autonomous state government organisation responsible for ensuring quality in technology education of the 550 polytechnics of Maharashtra (spread over 307,710 square kilometres) which is a highly industrialised province in the Western region of India.

To effectively plan, design and implement common outcome-based curricula for different occupations in large number of institutes is always a daunting challenge for any organisation. Since the National Institute of Technical Teachers and Research (NITTTR) Bhopal has been undertaking curriculum development projects for the past several decades for various technology programmes, MSBTE entrusted NITTTR Bhopal to re-design the currently offered 18 technology curricula to outcome-based curricula (OBC) in order to address the industry need. Hence, the authors evolved the "Engineering Diploma Curriculum NITTTR-MSBTE Model 2016" (figure 1), christened as "I- scheme" by MSBTE. As known, the curriculum development process comprises of four major components: curriculum planning, curriculum design, curriculum implementation and curriculum evaluation. This innovative curriculum model is currently in the curriculum design stage and the salient features of this model. is presented in this paper.

II. PURPOSE

The National Board of Accreditation (NBA) established by the government of India [2] to improve the quality of technical education systems is a votary of "Outcome-Based Education (OBE)". It is now rendering OBE almost mandatory for engineering education institutions all across India through various policies and incentives. To fall in line with NBA philosophy, Gujarat Technological University [3] was the first state level government university in India to launch the "Outcome-Based Engineering Diploma Curriculum - 2012 Gujarat Model" [6] for the 24 engineering diploma programmes in all the 100 polytechnics across the whole of Gujarat state, the core designers of which were the authors of this paper.

As the saying goes "success breeds success" the success of the outcome-based Gujarat curriculum model is helping many institutions to think of OBC as a panacea for getting accredited at the earliest. MSBTE also embarked for a relevant

OBC model for state of Maharashtra with NITTTR Bhopal as academic consultants. Therefore, to match the OBE philosophy, the authors evolved the innovative "Engineering Diploma Curriculum NITTTR-MSBTE Model 2016" (figure 1) based on "competency approach" which is a variation of "Backward Design" [13], to fulfil the need of the Maharashtra state polytechnic system.

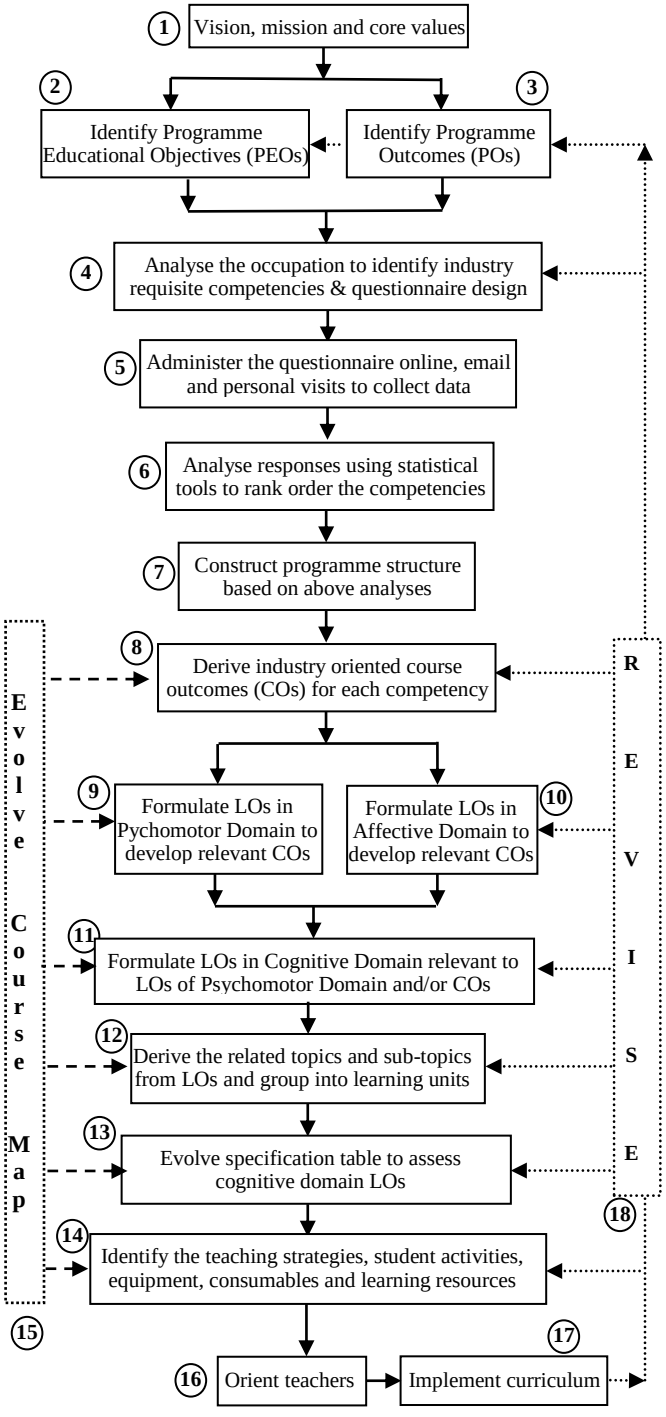

Figure 1 "Engineering Diploma Curriculum NITTTR-MSBTE Model 2016"

There could be different approaches for OBE i.e. "Design-Based Research", "Backward Design" and others. Design-Based Research approach "heralds a practical research methodology to effectively bridge the chasm between research and practice in formal education"[12]. In the Backward Design approach, "One starts with the end - the desired results (goals or standards) - and then derives the curriculum from the evidence of learning (performances) called for by the standard and the teaching needed to equip students to perform" [13]. "Performance Support Systems in higher education are characterized by a focus on active learning, competency development, technology to address instructional issues [4]." Although NBA does not emphasise the term "competency", the authors adapted this term, as it is a better understood industry jargon, the authors adapted the "competency approach" in this innovative curriculum model rendering it more student and industry friendly.

The argument of the authors is that from assessment point of view, the "Program Outcomes (POs)" mentioned in NBA criteria [2] are too broad and complex for either the students or the industry to understand of how they can be attained and assessed. Moreover, since the POs encompass more than one course, even teachers are at a loss of how to develop, assess and certify the POs. Another reason for adapting this "competency approach" is that, primarily every competency is generally single 'course specific' and hence more understandable for the student and the teacher to develop and assess. In this backdrop, it bears much significance to follow this approach as the focus of every course is competency development (figure 2) and bridges the large gap between the course outcomes and programme outcomes.

III. CONTRIBUTION

The primary aim of the technology programme is to prepare the student for the stated occupation i.e. the "world of work", so that s/he can earn his/her livelihood. To achieve this aim, the major contribution of the authors is the evolvement of this innovative OBC model (figure 1). As stated earlier, NBA [2] is a votary of OBE which requires that the students are made equally aware about the "vision", "mission", "Programme Educational Objectives (PEOs)" and "Programme Outcomes (POs)" of the technology programmes that they will be undertaking and hence these have been included in the model as seen in box 1, 2 and 3 of figure 1.

Every occupation consists of several jobs for which competencies are required that are clearly stated end points [13]. One of the cardinal features of this model is that even before s/he joins the technology programme, the student who is one of the primary stakeholders of the curriculum is informed in advance about the competencies (end point outcomes) stated by the industry in observable and measurable terms (box 4, figure 1), which s/he has to attain to become employable in the industry [5]. The "specification table" (box 14 of figure 1) is another unique feature of this model to be used for assessment of various outcomes of every course.

Another interesting feature of this model is that, it informs the student even of the "intermediate outcomes", at various stages during the journey through the curriculum (figure 2 in

appendix) thereby highlighting the model's holistic nature. It is worth noting that Figure 2 is an offshoot from within the evolved model in figure 1. It is a typical course map of a sample course depicting the linkages of the competency, course outcomes (COs), sample learning outcomes (LOs) in the cognitive, psychomotor and affective domains of learning with the associated topics related to the outcomes. Therefore, this design provides several cues to the student and teacher, to foster self-learning (a key element of NBA criteria) utilising various modes of learning rather than only depending on classroom and institutional teaching.

IV. CURRICULUM MODEL DESCRIPTION

A major curriculum development activity for the authors is orienting and training the curriculum development team of MSBTE in analysing each of the occupations to zero down on the entry level jobs stated as threshold competencies (end points) in observable and measurable terms to be undertaken by the technologists in the concerned industry (box 4, figure 1). This serves as the foundation for the OBC.

Based on the occupation analyses, two questionnaires for each of the 18 technology programmes containing the competency statements — one for the employers and the other for the employees — were designed by each respective curriculum development teams under the guidance and supervision of the authors (design of the questionnaire is not within WIP scope, but can be discussed during conference). If this activity goes faulty, the whole curriculum development exercise gets affected. These designed questionnaires were then administered online, email and through personal visits (box 5, figure 1) for a period of one month. The responses were then statistically analysed using the weighted mean scores to arrive at the competency rankings (box 6, figure 1).

Based on the rank ordered competencies, the relevant courses to be included in the programmes were identified / formulated. The relevant credits were then allotted for lecture, tutorial and practical work for each course. It is to be noted that a "credit" is defined here as "one contact hour/week for 16 weeks in a semester", other than the hours used in assessment and examination. These identified courses served as the building blocks to build up the 3-year technology "programme structures" (box 7, figure 1) of the 18 technology programmes. The relevant teaching hours and marks were also allotted for the "progressive assessments" and "end-semester-examinations" similar to the pattern adapted in Gujarat Technological University [3]. As the programme structure is the foundation for any programme, sequencing of the core courses and the placement of the pre-requisite courses in the programme structure is also crucial when building it, as the effectiveness of the entire curriculum depends on it and the authors role has been pivotal in this activity too.

The next step after building the programme structure is how each course could be implemented, so that the industry identified competencies and course outcomes are developed through each course. This lead to the development of the "course map" (figure 2) related to each course. In fact, figure 2 in the appendix is an offshoot of figure 1 which shows the various implementation stages of a course with the sample competency, "Test the performance of transformers and rotating AC machines", (box 8 through box 15 in figure 1). Figure 2 depicts the various intermediate outcomes, thereby providing relevant cues for teaching—learning processes of the competency which integrates these cluster of smaller outcomes in involving the "head" i.e. learning outcomes (LOs) in the cognitive domain, "hand" i.e. LOs in the psychomotor domain and "heart" i.e. LOs in the affective domain to perform a job independently at the work place at the threshold proficiency level [5]. Competency-based education requires that students be given enough time and work-based learning opportunities to hone all the three domain specific outcomes and to integrate them at the right time at the right place s competencies required for various jobs [5,6,7].

Boxes 16 and 17 of figure 1 are concerned with implementation of the curriculum model and will be considered after the entire curriculum is developed. Box 18 is about the formative evaluation when the curriculum is being implemented so that mid-course corrections can be incorporated wherever required.

On scrutinising figure 1 and figure 2, it is evident that in this "competency approach" curriculum model, the "competency" has been skilfully incorporated and weaved into the design which can be developed and assessed and certified through various means. This model also, renders it easier for the industry to identify the right person with the right talents required for the performance of various jobs for the concerned occupation. This is because, at the time of recruitment, the certified course specific competencies and outcomes for every programme will be explicitly available to the industry.

V. CONCLUSION

This "curriculum planning" stage of this innovative "Engineering Diploma Curriculum NITTTR-MSBTE Model 2016" is complete. The "curriculum design" stage is currently on (box 8 through 15 of figure 1) for various courses with authors orienting and training the different curriculum development teams. The strategy of this model is to involve the teachers in the development of the curricula of all the 18 technology programmes, so that simultaneously on-the-job training of the concerned teachers happens during the curriculum design. These teachers will later become the resource persons to train a large number of their fellow teachers in different parts of the state of Maharashtra to effectively implement this curriculum from July 2017. Sometime later, the authors hope to present a full paper and share further experiences of this innovative curriculum development model.

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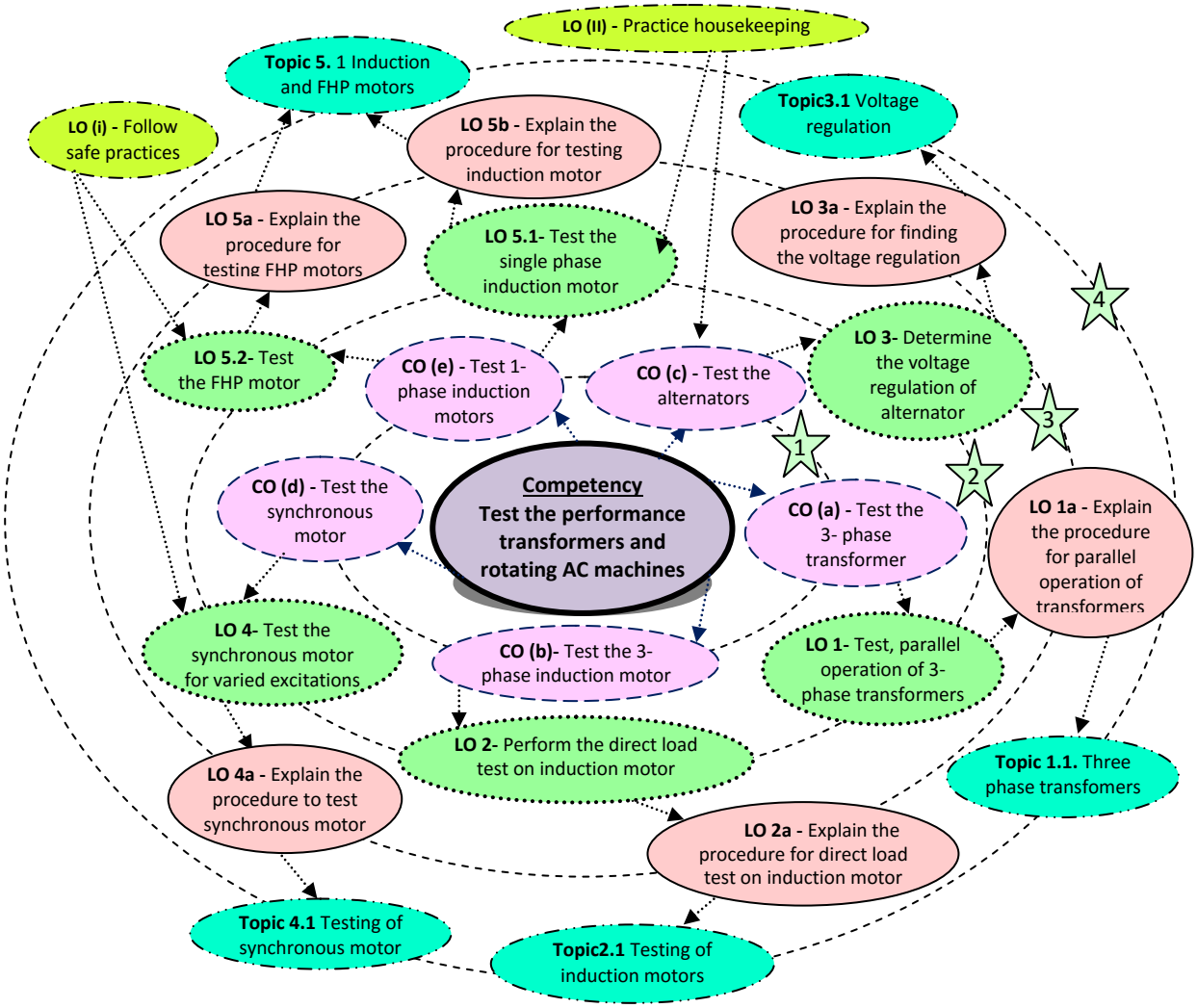

Figure 2 - Course Map

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