

Some Innovative Practices on Quantity and Quality of Engineering Education and Research

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Abstract: -- Engineering education and research becomes an international service, which concerns both quantity and quality assurance mechanisms [6]. That is quantity in terms of access to engineering education and quality in terms of relevance and degree of academic excellence. There is a great challenge indeed for internationalization of engineering education and research by the institutions with relevant to the current and projected needs of our society and industries. Their academic potential, credibility and excellence have to grow with respect to time. The ideas and ideals of the institutions should evolve and change with respect to trends worldwide, international and national requirement. Our current engineering education must adopt open, transparent and efficient system so as to produce value added knowledgeable trained human power. Both quantity and quality shall depend up on curriculum aspects, teaching-learning process, performance evaluation, productivity of faculty, staff and students, research and development, consultancy and extension, students' support and progression, educational innovations, enhancement strategies, plans for institutional growth, feedback from stake holders, innovations in the organization, management and communication[4].

Key-Words: - academic, education, extension, excellence, innovative, norms, quality, quantity, research, standards, teacher-educator

1 Introduction

Consequent upon the privatization and commercialization policies of our engineering education, there is a great concern about both the quantity and quality assurance mechanisms in

schools, teacher education and higher educational institutions [1]. There is a premium on both quantity and quality of education, quantity in terms of access to education and quality in terms of relevance and excellence of academic programmes offered [6]. There is a great challenge indeed by the teacher and higher educational institutions, which offers teacher and higher education relevant to the current and projected needs of the society and industry. Their academic potential and excellence have to grow with respect to time. The ideas and ideals of these institutions will evolve and change with respect to trends worldwide, global needs and national requirements. Therefore, our teacher education and higher education should adopt open, transparent and efficient system to produce value added knowledgeable trained human power [2]. This demands quality and credibility in functioning of educational institutions. The quantity and quality depend on curriculum aspects, teaching learning and evaluation, research, consultancy and extension, student support and progression, organization, management and healthy practices. There should be a specific focus and emphasize given on the educational innovations, mission and goals, quality enhancement strategies, master plans for institutional growth, feedback from stake holders and innovations in management and communication.

2 Problem Formulation

In the last fifteen years, there is an explosive growth of engineering colleges and polytechnics in the world. As per the survey conducted, out of the total faculty working in the engineering colleges and polytechnics, as Professors, and lecturers, about 85% possess only bachelor's

degree. More than 80% of them do not have sufficient experience in teaching and research [1]-[4]. To develop these faculty, various innovative methods such as quality improvements programmes, flexible programmes, in-house programmes, distance-cum-contact courses, sequential summer and winter schools, and part-time programmes must be required. The quality of engineering education depends on the curriculum and instructional methods. A part from engineering education, teacher and higher education both have become an international service, consequent to the general trend of globalization of economic activities. The author has gained sufficient experience during his long service in several schools, colleges, universities, teacher educator and research institutions. Innovative scientific, efficient methods including educational innovations are provided to improve the productivity of a teacher and quality of lectures in teacher-educator and higher educational institutions[4]. The institutions, which have adopted these innovative methods, have turned out with improvements in their systems with special reference to productivity and quality. The quantity and quality assurance mechanisms may be practiced in schools, teacher education and higher educational institutions. Innovative methods are discussed in this paper. These methods will be more useful for the purpose of internal academic audits [2]. This research paper also highlights the concepts of Academic Information System (ACADIS), Teaching Slots Concept (TSC) and Faculty Credit Log Concept (FCLC) for managing all the academic courses conducted for the various classes of teacher educational institutions / higher levels during the semesters/ trimesters/

2.1 Objectives

- i) Faculty competency profile and performance assessment and evaluation
- ii) To prepare workload norms for teacher educational institutions,
- iii) To assess the past initiatives for teacher development, both pre-service and in-service.
- iv) To propose a competency profile for the technical teachers.
- v) To synthesize the existing programmes for in-service teacher training and development.
- vi) To formulate various innovative in-service and pre-service teacher development programmes that

yearly patterns. These concepts viz. ACADIS, TSC and FCLC are computer based educational innovations developed by the author to manage the entire academic courses. The information contained here will be useful to all Principals, Teacher-Educators & teachers, for improving the productivity in their institutions and quality and quantity of education[5].

In this research work, both the quantity and quality assurance mechanisms have been considered and innovative and efficient methods are presented to improve the productivity of a teacher and quality of lectures in teacher educational institutions [1]-[2]. These methods are given below :-

1. Specifying workload norms for teacher-educators/ workload distribution per week/ filling up of 6 X 8 matrix form weekly.
2. Preparation of lecture plans (yearly/semester wise, weekly & daily), lesson action plans for theory, tutorials, and practicals
3. Reporting self-assessment by the teacher-educator for each day's progress (work diary) Table. Reporting weekly summary report by the teacher given in Table
4. Structure of the classroom lecture. Methods for preparation of the lecture notes and methods for preparation of lecture notes supplement.
5. Computer oriented e.based education .
6. Setting up of performance appraisal system for the teachers .
7. Training and development for teacher –educators,
8. ACADIS (Academic Information System), teaching slots & teacher-educator credit log systems

The information contained in this research paper shall be useful to all the Principals, professors, faculty, Teacher-Educators and teachers for improving the productivity in their institutions and quality and quantity of engineering education and research.

- could be conducted.
- vii) To evaluate efficient methods to improve the productivity of a teacher and quality of lectures in teacher educational Institutions,
 - viii) To promote experimentation among teachers and teacher-educators.

3 Problem Solution

Teachers should be provided with opportunity to improve upon their qualifications through the quality improvement programs. The opportunities have to be provided for pedagogy and professional training. Under the quality improvement programmes a variety of short term courses need to be provided to meet the training needs for all levels of faculty[4].

The higher educational systems should need three tiered mechanics 1. Internal quality measured mechanism, 2. Evaluation by peers, 3. Accreditation by the independent component organization, 4. Universities to develop the basic values and ideals which are to change the conditions from time to time of the ideals like search for truth and pursuit of knowledge are intrinsic qualities of the institutions of higher education. The universities to impact the basic orientation towards knowledge irrespective of the geographical location and social economic environment [1]-[2].

There should be specific focus and emphasize to be given on the educational innovations, mission and goals, quality enhancement strategies, master plans for institutional growth, feedback from stake holders, innovations in management and communication[5].

There is a need to supply value added, trained human power at all levels. There is a survey result show that the job opportunity pattern is undergoing a sea change. The jobs in Government and Government supported Organizations are under decline. In industry , the job profile is changing. All over the world the manufacturing industry is undergoing a sea change; there is down-sizing, there is outsourcing and there is a new approach in management of industries. This means the work force in core and allied support industries is under decline. This does not mean such industries would be closed but they would be operating under decentralized and diversified umbrella structure, which is spread over the world [1]-[6]. They require human work force that can think of innovative ways of product design, product manufacturing, product marketing and organizing the entire gamut of industry that is running in different styles. There is no more going to

be localization of industry in any particular country but it is going to be a world enterprise spread in different nations. The management of the work force is going to be a different challenge because people with different culture and identify will be working in different countries. The question then arises how this is affecting Indian industries. Indeed our industry is also facing challenge They no more have protected market but have to face a global competition. Not only that, they also have to enter the world market and with quality product enhance the export. They will have to innovate. Hence their job requirements are changing. Whether it is Indian industry or any industry outside India, both need skilled human power. What the employers are looking for are trained persons in all basic fields with sound knowledge base in their core discipline and with abilities to adapt for new demands. Another sector, which would be on the rise, is the service sector. This is happening for India and for other nations [6].

It is projected that during the future twenty years at global level almost sixty to seventy per cent of jobs would be in service sector. The world is looking for not only persons who are experts and/or innovators at high end but also for highly skilled persons who can work at second or third level[5]. Globally the demands are increasing in pure science and technology sectors, in social and humanity areas, in economics and commerce domain as well as in utility sectors. It is in these areas there are a shortage of human power and the gap between demand and supply is going to expand. Economical and financial impacts are seen in recent move by US, Canada, UK, Germany and many nations in Europe to enhance the work permit quota and initiatives taken by countries like Japan, Korea, Malaysia and Australia to drop their visa barriers while accelerating the outflow of skilled human power from India. Therefore there is need for the production and supply of trained human power at various levels to fulfill our internal and external demand [2].

3.1 Faculty Competency Profile

Considering the role to be played by the faculty members in high education and research , a competency profile consisting of ten areas have been developed. By self-evaluation, one can rate the present level of competency. Then one can plan for

acquiring additional competencies through various development programmes [2].

The following are the major areas of competency profile of faculty member in an engineering college, which can be rated on a ten-point scale for self-evaluation:

I. Curriculum Development

- (i) Identifying potential areas for new diploma, degree, post-graduate diploma and post-graduate degree programmes in engineering / technology / selected field of specialization by conducting needs assessment.
- (ii) Forming development group from all stakeholders (Alumni, employers, students, parents, specialists, teachers, educational administrators and scientists).
- (iii) Conducting needs analysis, generating programme goals, course objectives, instructional objectives, and identification of contents.
- (iv) Conduct of formative evaluation, monitoring the quality, developing logical framework for planning staff / faculty development programmes, organizing faculty development in-house programmes, and evaluation of the implementation.
- (v) Evaluation of curriculum, rationale, observing the implementation, comparing the standards, drawing inference and pronouncing judgments.
- (vi) Assessing the impact of various educational programmes on the industry within the country.
- (vii) Develop world class programmes.
- (viii) Develop short-term need based subject updating courses (working Professionals)
 - Acceptable minimum score for Lecturers
 - Acceptable minimum score for Assistant Professors
 - Acceptable minimum score for Professors
 - Acceptable minimum score for Deans

II Teaching at Graduate and Post Graduate Level:

- (i) Interpret the curriculum document and generate learning objectives.
- (ii) Analyze the learners and identify their learning needs in the appropriate branch of specialization.
- (iii) Develop appropriate course plan and lesson plan, and prepare appropriate instructional materials and media
- (iv) Implement the instructional delivery systems to achieve the specified objectives.
- (v) Evaluate the progress of the learners and conduct remedial classes wherever necessary.
 - Acceptable minimum score for Lecturers
 - Acceptable minimum score for Assistant Professors
 - Acceptable minimum score for Professors and above,

III Evaluation:

- (i) Evaluate the achievement of the students using scientific method through appropriate test instruments.
- (ii) Evaluate the professional preparedness of the learners through viva-voce project evaluation.
- (iii) Evaluate the growth potential of the students and guide them to select suitable elective courses.
- (iv) Evaluate the impact of the programmes.
 - Acceptable minimum score for Lecturers.
 - Acceptable minimum score for Assistant Professors
 - Acceptable minimum score for Professors and above

IV Instructional Materials Development:

- (i) Development appropriate instructional materials for the students incorporating the stated objectives, learner participation, case studies and sample transfer exercises. (Text Books, Lab. Manuals, Drawing Manuals, Workshop Manuals, Case Studies, Data Manuals etc.)
 - Acceptable minimum score for Lecturers.
 - Acceptable minimum score for Assistant Professors

- Acceptable minimum score for Professors and above
- V Instructional Media Development:
- (i) Development appropriate teacher made instructional aids slides, power points, field specimens, models, video and multimedia programmes.
Acceptable minimum score for Lecturers.
Acceptable minimum score for Assistant Professors
Acceptable minimum score for Professors and above
- VI Research and Development
- (i) Evaluate various processes, methods, and policies in the development of people and resources in the selected branch of specialization.
 - (ii) Develop research projects based on State/National needs.
 - (iii) Undertake sponsored research projects from the government, industry and society.
 - (iv) Generate new knowledge, research products, patents and new processes for application in the community in the selected branch of specialization.
 - (v) Network with National Laboratories, State Laboratories and other higher education institutions and develop interdisciplinary programmes and projects in the selected branch of specialization.
Acceptable minimum score for Lecturers.
Acceptable minimum score for Assistant Professors
Acceptable minimum score for Professors and above
- VII Institutional Planning and Administration:
- (i) Evaluate the changes in the job profile in engineering / technology, upcoming new knowledge, new fields of specialization, new potential areas for undergraduate, post graduate and advance certificate / post graduate diploma programmes in the selected branch of specialization.
 - (ii) Competencies in Educational Programme Planning, Development, Marketing, Implementation and Evaluation.
 - (iii) Developing new centers, departments and graduate schools, which will specialize in the upcoming fields through programmes and projects.
Acceptable minimum score for Lecturers.
Acceptable minimum score for Assistant Professors
Acceptable minimum score for Professors
Acceptable minimum score for Deans
- VIII Consultancy and Extension Services to the Industry, Government and Community:
- (i) Conduct evaluation studies on the current processes methods and products.
 - (ii) Develop new processes, sustainable development methods, patent innovative products, and license to implement in the mass scale in the industries / community.
Acceptable minimum score for Lecturers.
Acceptable minimum score for Assistant Professors
Acceptable minimum score for Professors and above
- IX Educational Leadership Development:
- (i) Cultivate educational leadership in higher education.
 - (ii) Encourage young research workers, scientists and teachers to plan for leading edge programmes and projects in engineering and technology.
 - (iii) Develop confidence to undertake field oriented projects and programmes.
 - (iv) Create vision, mission, goals, and objectives and become world-class leader in the selected branch of study.
Acceptable minimum score for Lecturers.
Acceptable minimum score for Assistant Professors
Acceptable minimum score for Professors and above
- X Educational Planning and Development of Regional, National and International programmes:
- (i) Assistant developing world-class institutions and universities.
 - (ii) Assistant developing Regional / National Institutions in specialized areas in arts, commerce and

science.

3.2 Procedures For Performance Appraisal System:

A performance appraisal system [1]-[2] for teachers should be sent up well integrated with institutional functioning and this should lead to the identification of individual training and development needs. This should also enable the identification of teachers whose performance is outstanding. Such performances and excellence should be well recognized and rewarded. All teacher educational

institutions should introduce a system for performance appraisal. The performance report should comprise the data such as the teachers' papers published, seminars paper reading, books authored, research contributions, patents, innovations, inventions and discoveries etc. This system should be followed by the management for career advancement of teachers[6].

3.3 Workload Norms For Engineering Faculty

The author has prepared the workload norms for teacher-educators. These are outcome of intensive discussions held during various seminars [2]. Given

below the workload norms for a faculty in teacher educational institutions to attend his/ her normal duties:

- | | |
|---|-----------------|
| 1. Teaching Workload | 16 hours / week |
| 2. Preparation Time | 16 hours / week |
| 3. Research work | 10 hours / week |
| 4. Organizing Science, History, Mathematical Tutorials/ Science outdoor/ indoor activities/ Exhibitions | 40 hours/week |
| 5. Co-ordination of extra- curricular activities | 6 hours/ week |

Given below the workload norms for the various levels of faculty / teachers in Teacher educational institutions

Table 1 .

Workload Norms For The Various Levels Of Faculty /Teacher-Educators In Teacher Educational Institutions

Duties	Lecturer	Asst.Professor	Professors/ HMs /Principal
Teaching workload conduct hours	20 hr/ week	18 hr/ week	10 hr/ week
Preparation Time	12 hr/ week	10 hr/ week	8 hr/ week
Research work	10 hr/ week	15 hr/ week	19 hr/ week
Teaching Administration	Nil	6 hr/ week	6 hr/ week
Organizing Tutorials/ Seminars/ Exhibitions	20 hr/ year	40 hr/ year	40 hr/ year
Co-ordination of extra- curricular activities	6 hr/ week	5 hr/ week	1 hr/ week
Teaching work load / Total credits	13 hr/ week	10 hr/ week	9 hr/ week

Given below the norms for teacher-educators in higher educational institutions to attend his normal duties as per the following schedules .

Table 2.
Teacher And Teacher-Educator – Workload Distribution Per Week

Sl. No.	Programme Activity	H.M/Principa l/ Professor HOD (Hours)	Sr. Teacher (Hours)	Jr. Teacher (Hours)	MIMIC
1	Total Contact Hours (Instructions) (TCH)	8-0-0	LTP 8-0-8	LTP 8-0-16	
		8	12	16	LTP
2	Preparation Assessment and Evaluation	6	10	14	PAE
3	Research and Project Guidance	14	8	4	RPG
4	Academic administration	2	2	0	AA
5	Counseling	2	2	1	C
6	Developmental Activities	3	2	1	DA
7	Exhibitions/Industrial Visits	1	1	1	IV
8	Seminars /Workshops/symposia	2	1	1	SW
9	Extra curricular activities	1	1	1	ECA
10	Consultancy	1	1	1	CON

Foot Note:

- o Wherever the senior teacher is not available in sufficient number, the department shall utilize Jr. Teacher for Academic Administration.
- o Semester Workload is 12 weeks. Trimester workload is 8 weeks.
- o Norms for correcting the test papers and assignments
 Time allocated per paper =15 min
 Time required for correcting 60 papers (one class) = 15 hrs.
 Total time required for 4 tests and assignments in a semester = 60 hrs

3.4 Procedures For Self-Assessment Report By A Teacher-Educator

Table 3,
Self-Assessment By The Faculty For Each Day’s Progress Workload Diary

Date	Time	Class	Subject	Student Present	Topic Covered	Remarks

1. Teacher should maintain the workload diary. In the work daily diary, the teacher should write clearly the details of the lectures engaged during the day, number of students present and topics covered.
2. If the lecture is not engaged remarks should be entered why the lecture was not taken and what arrangements is made for extra lecture.
3. Based on the daily work diary, details for a week that is weekly summary report should be prepared as per the following format given in Table .

Table 4, Weekly Summary Report

Class :	Subject:	Date : From ----- To-----
No. of lectures allocated		
No. of lectures engaged		
No. of lectures not engaged		
No. of extra lectures engaged		
No. of extra lectures to be engaged		
Remarks		

3.5 Tips For Preparing The Lecture Plans

1. The syllabus should be divided into the main topics and sub topics. Time required for the main topic, as a whole and each sub topic should be noted.
2. Curriculum of the various classes to be taught should be prepared. This is because same topic may be important for one class which may not be required for the other class.
3. The information should be up-dated for providing to the students. The new plans should be formulated. This should be prepared based with the current plans and additional material from new books, journals, publications and seminar proceedings[1].

Tips for preparing the weekly plans are similar to the yearly plans.

- o Tutorial timings are not fixed in advance at the beginning of the academic year/ semester/ trimester. Weekly schedule for the tutorials for that particular week is to be prepared as and when the information for the tutorials is made available [2].

Advantages of Daily Plans:-

1. The daily plan gives an idea what has to be done at a particular instant of time during a day whether a particular point has to be discussed in brief or in detail.
2. This avoids wastage of time.
3. This helps to complete the topic as per the time schedule
4. This benefit to efficiently complete the lecture.

Procedures For Preparation Of Lecture Notes And Lecture Notes Supplement

❖ **Preparing the Lecture Notes**

1. The lecture notes should be prepared on loose sheets with the papers relating to one lecture filed together. The papers should be numbered
2. On the right hand corner, a margin of 5cm is kept for putting remarks. The remark column should be used for entering the names of references from which the materials has been collected.
3. The lecture notes should be made up to date and self-informative.

❖ **Preparing Lecture Notes Supplement**

1. Each lecture notes should be prepared with a Supplement.
2. It should contain the details about the topic namely additional books, journals, publications and other relevant references for further reading.
3. It should contain the list of expected questions so as to enable the student to get prepared for answering all questions.
4. It should contain the list of instructional aids namely Overhead Projector, Charts and Models, Slide Projector and Photo Displays Board.
5. It should contain the summary of complete lecture as well as the topic covered.
6. It should contain the topics of next lecture.

3.7 Structure Of The Class Room Lectures

Time duration of the elements of a class room lecture and brief description is given below:

1. Introduction - 5 min
2. Actual Lecture - 40 min
3. Summarizing - 5 min
4. Students Queries - 5 min
5. Attendance - 5 min

1. Introduction

1. At the start of class lecture, introduction should be made in brief and interesting
2. The introduction should give an idea about the learning in the lecture.

2. Actual Lecture

1. During the lecture, simple questions should be asked to the students and link their answers to the topics to be taught.
2. All students must be involved with the lecture and understand it better.
3. The pace and content of the lecture should be planned and decided such that an average student is able to grasp the contents of the lectures.
4. Direct dictation should not be given from his notes.
5. All the points of the lectures should be explained while looking in the eyes of the students.

3. Summarizing

1. Summarization should be good as it again highlights the points covered in the lecture.
2. References should be given for additional details on the topic of the lecture.

4. Student Queries

Student queries should be attended. The doubts should be cleared.

Table 5, Strategies For Improved Class Room Instructions

Intellectual Level	Instructional Strategy
Verbal Information	Lecturing aided by text books, manuals, standard specifications
Intellectual skills in technician jobs Discrimination	Lecturing, demonstrations, questioning and answering
Concepts - Concrete - Defined	Lecturing with demonstrations, questions and answering and mini quizzes discussion
Rule learning with perfect to planning and design, problem solving	Lecturing with design problems, demonstrations, questioning and answering and completing the design, mini quizzes, tutorial, project method, case studies, brainstorming, planning issues, evaluation of cost, estimate and innovative solutions.
Area of Learning	Industrial Strategy
Attitudes with respect to professional execution of project and programmes	Group discussion, simulation, games, role playing, industrial visits, field trips, visiting industrial training centers, case studies from the
Motor skills for manufacturing, fabricating, constructing, assembling and maintaining	Laboratory, coaching, workshop based projects, laboratory based projects, internship and apprenticeship
Cognitive strategies for planning new products and manufacturing, and maintaining	Case method, student seminars, debate, small group activity, brainstorming, and innovative solutions.

By adapting proper instructional strategy, the students are encouraged to work mentally. Their cognitive skill increase. Their attitude towards the industrial jobs increases positively. This enables them to do their interviews well. They will be also to orient themselves to suit the job requirements easily and quickly.

3.8 Procedures For Computer Based E.Education

- There are timetabling, scheduling software have been designed to use the available teaching resources effectively,[2]
- Each teacher should maintain a course page and notify web address to the students.
- Lesson plans for theories; tutorials and practical shall be prepared as per the formats given in Table.

- They should upload lesson plans, lecture notes, supplements etc. So that they are available to the students. These locations or pages can also display their attendance, test marks, assignments and so on. It is encouraged that there can be a class group or course group for each subject (these are e-groups with all the members having mail ID and they communicate though e-mail). It is also advisable to make it compulsory that all students and faculty have e-mail ID.
- ACADIS, TEACHING SLOT & TEACHER-EDUCATOR CREDIT LOG CONCEPT for teacher-educational institutions.

Step – I: Preparation Of Academic Information System

Details of Academic courses are prepared which is called Academic Information system (ACADIS) during trimester / semester.

1. One lecture hour per week is rated as one credit hour.
2. Two tutorial or two practical hours per week are rated as one credit.

Example: - How to prepare the ACADIS

Step II : Preparation Of Teaching Slots: -

This is the one page information which shows the teaching slots of the teacher and free time slots (FTS).

1. The teaching workload is calculated as in terms of credit based contact hours.
2. One lecture hour per week is rated as one credit hour.
3. Two tutorial or two practical hours per week are rated as one credit.
4. The conduct hour is sum of theory tutorial and practical hours.
5. The conduct hour is interpreted as “One hour of practical / tutorial classes is treated as one hour of lecture”.
6. The departmental codes are identified in three letters.
7. The number of teaching slots is prepared as one line statement.

For example a teaching slot statement mentioned below is interpreted as

ECE4A- EC402-T1-3.5-ECE-SLT

ECE4A is the Branch code / semester / Sub-section

EC402 is the Subject code entitled

“ Transmission lines and Wave guides”

T1 is the main teacher / T2 is second assisting teacher / T3 is Third assisting teacher.

D1T1 is Day 1 main teacher / D1T3 is Day I third assisting teacher.

3.5 is the credit hours of the individual teacher

ECE is the handling department

SLT is the mnemonic of handling teacher.

Example :- How to prepare the Teaching Slots

Table 6, Example; Teaching Slots Of Department Even Semester (2008-2009)

S. No	Teaching Slots	S. No	Teaching Slots
1	ECE4A-EC402-T1-3.5-ECE-SLT	35	ECE6-6E1-D2T1-2.25-ECE-ASL
2	ECE4A-EC403-T1-3.5-ECE-DKS	36	ECE6-6E1-D2T2-1.5-ECE-AKT

Step- III : Faculty Credits Log Concept:

The teacher individual Teaching Workload and Projects Workload are given in credits.

4 Conclusion

In this research work, both the quantity and quality assurance mechanisms have been considered and innovative methods to improve the productivity of a teacher and quality of lectures in teacher educational institutions and universities [1]-[2]. Some of the conclusions are given below;

The institutions, which have adopted innovative methods, have turned out with improvements in their systems with special reference to productivity and quality. The quantity and quality assurance mechanisms may be practiced in schools, teacher education and higher educational institutions.

1. Formulated the competency profiles of the faculty and performance evaluation systems. Prepared workload norms of a teacher-educator. The norms should be adopted by the managements of various teacher-educational institutions. Regulatory agencies, councils and directorates should follow these norms.
2. The following methods improved the productivity of a teacher and his/her quality of lectures in teacher educational institutions.
 - (i) Lesson Plans concepts (yearly, weekly and daily). Lesson Action Plans for theories, Tutorials and Practicals.
 - (ii) Self assessment daily work diary
 - (iii) Weekly summary reports of teacher-educators
 - (iv) Structure of the classroom lecture.
 - (v) Preparation of lecture notes
 - (vi) Preparation of lecture notes supplements
 - (vii) Computer based e. education
 - (viii) Setting up of performance appraisal system
 - (ix) Training and development of teacher-educator
 - (x) Preparation of ACADIS, Teaching slots and faculty credit log
3. These methods further facilitate:
 - (i) Design oriented teaching
 - (ii) Exposure to practical field
 - (iii) Introduction of emerging fields

- (vi) New design and development of short term courses, addition of electives, non-credit Courses, self-learning materials, curriculum adaptation updating syllabi.

4. Development of continuing education programmes
5. Establishment of summer and winter projects

Some of the innovative methods presented in this research paper are:

1. Specifying workload norms for teacher-educators/ workload distribution per week/ filling up of 6 X 8 Matrix form weekly.
2. Preparation of lecture plans (yearly/semester wise, weekly & daily), lesson action plans for theory, tutorials, and practicals.
3. Reporting self-assessment by the teacher-educator for each day's progress (work diary) Table. Reporting weekly summary report by the teacher given in Table .
4. Structure of the classroom lecture. Methods for preparation of the lecture notes and methods for preparation of lecture notes supplement.
5. Computer oriented e.based education .
6. Setting up of performance appraisal system for the teachers .
7. Training and development for teacher –educators,
8. ACADIS (Academic Information System), teaching slots & teacher-educator credit log systems.

The information contained in this research paper will be useful to all the principals, professors, faculty, Teacher-Educators and teachers for improving the productivity in their institutions and quality and quantity of engineering education.

4.1 Recommendation

1. All the course materials are prepared for updating the knowledge of the teachers working in schools and educational institutions and for uplifting the standard of education and competence of professionals. Experts in the field with their vast experience and specialization in the subject area should

- prepare the course modules and adaptation of curriculum.
2. Self-learning modules cum course materials shall be prepared for teacher-educators to improve and update their knowledge.
 3. Research work, innovations, creativity, inventions and discoveries should be encouraged and stressed in school level itself among the school teachers and students.
 4. Lesson plans for theories; tutorials and practical shall be prepared as per the given formats.
 5. Weekly schedule for the tutorials for that particular week is to be prepared as and when the information for the tutorials is made available.
 6. Based on the daily work diary, details for a week that is weekly summary report should be prepared as per the format. This has to be handed over to the Head of Department.
 7. Formulating new design and development of short-term courses, addition of electives, updating the curriculum, preparation of new course material and educational innovations especially in emerging interdisciplinary areas.
 8. Introduction of the new courses and elective subjects as specialization on various emerging area. Development of new thrust areas are to be encouraged.
 9. The concept of Academic Information System (ACADIS), Teaching Slots (TSC) and Teacher Credit Log (FCL) for managing all the academic courses conducted for the various classes of teacher-educator institutions / higher levels during the semesters/ trimester/ yearly patterns have been established. These concepts viz.. ACADIS, TSC and FCL are computer based educational innovations developed by the author to manage the entire education.
 10. Most of the R&D work done by many scientists in teacher educational and R&D Institutions or significant findings found from the research establishments or R&D centers and educational innovations developed new process developed are stagnated and remained ineffective with them. There were no transfers of educational technologies/ innovations adopted by these educational institutions. Hence, there should be transfer of educational technologies.
 11. Training should be imparted by the teacher educator institutions during outside of the normal contact hours to teacher-educators those who are deficient in any particular courses. Part-time programmes shall also be conducted for this purpose.
 12. The academia continuing teacher-education programmes conducted by the summer & winter schools have to be designed in such a way that it should fulfill the specific requirements of the educational institutions/ teacher-educator institutions. If necessary, vocational courses may be conducted during the vocations. Summer and winter projects must be undertaken related to the problems faced by them in consultation with the private practitioners.
 13. Adaptation of syllabi and curriculum should be there wherever required. Special learning materials should be prepared as per the need.
 14. Introduction of non-credit courses in the syllabus/ curriculum for educating emerging aspects in consultation with the experienced teachers.
 15. Continuing education programmes training (CEP) centers shall be established for conducting short / long-term course for professionals. CEP-Programs may be conducted having the duration of one or two week or one or two-day seminars/ workshops to one year short term/ long-term courses.
 16. Teacher-educational institutions must encourage the interactions and academic partnership between the Professional Associations / Societies and Academic institutions and research institutions.
 17. Exhibitions and study tours must be undertaken by the teacher-educator institutions to carry out research on the survey of curriculum/ syllabi and for necessary adoption of curriculum in higher institutions as per the requirements and demands. They should also study the design problems.
 18. Teacher educators have to be assessed periodically by their Heads of Departments for their performances for career advancement. Their expectations with proper justifications regarding promotion to higher

cadre and/or award of increments/remuneration have to be specifically recommended during performance appraisal forms.

19. The recommended innovations in teaching and learning process are to be enforced and implemented by NCERT, SCERT, State Teacher Training and Research ,Establishments, State Higher educational Institutions, Primary Education centers, State Educational Directorates, All Universities, Schools and Colleges
20. The information recommended will be useful to all Policy makers, Planners, Principals, Academicians and teachers, teacher-educators and faculty of the University Departments.

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