TOWARDS AN INTERDISCIPLINARY CURRICULUM FOR PRINT EDUCATION - OUR EXPERIENCES AND RECOMMENDATIONS

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ABSTRACT

In recent times, with the advancements in the printing sector taking faster steps, it is necessary that education in Printing Technology is tuned accordingly. Drupa 2016 showcased certain new developments such as Xerox’s inkjet + sheetfed, HP’s inkjet + offset, Printed Electronics, Augmented Reality, Print 4.0 and more. It is clear that these are not the core topics of a general curriculum in Printing Technology. In order to prepare our students for the present day Print Industry, there is a serious need for including inter-disciplinary-but-essential courses in the Print Education. In our University, we have taken baby steps since 2011, in introducing interdisciplinary courses for students of the Four-year Undergraduate Engineering Programme in Printing Technology. Since then, two batches of students have graduated under this curriculum. In this paper, we share our experiences in the approach adopted in framing the curriculum, drafting the syllabus, teaching-learning methodology, and internships, right up to facilitating the employment of the students in the industry during the final year. Every stage of this process has been done keeping women in mind since ours is a women’s university and all our students are girls. From the lessons learnt during this process, we have made minor revisions to the curriculum in 2014 and are presently working on the next major revision this year. Based on our experiences we make certain recommendations that may be of use to those who are planning to delve into IDC curriculum.

Keyword: Print Education, Curriculum design, Interdisciplinary courses, women in printing sector.

1. INTRODUCTION

Printing is one of the oldest professions of mankind. Over the years, the art printing has become science and now technology. It is a service discipline to all other disciplines. However, very few educational institutions over the world, offer this programme. Also, the gap between the academia and the industry is large in the Print sector. A printing technologist is expected to know everything from science (colour science, material science), chemistry (ink composition, other printing chemicals), electrical, mechanical and computer engineering (machine design, pre-press operations), management and entrepreneurial skills, only to name a few. Yet, a Printing graduate is not completely ready for employment into the industry. The
primary reason is that most of the time, the curriculum is not updated with the advancements in the industry. Curriculum design for any programme must be done in a systematic manner, keeping in view the future of the learners [1]. In this paper, we present our experience in curriculum design which will bridge the gap between the academia and the industry.

2. BACKGROUND

In this Section, we present the academic setup in our University. Ours is a women's university that offers undergraduate, post graduate, and doctoral level programs exclusively for women, under seven Faculties: HomeScience, Science, Humanities, Management, Community Education, Engineering and Education. A total of forty departments function under all seven Faculties put together. One of the best practicies of the University is a common assembly every morning, for teachers and for students separately, during which all common announcements are made. This gives a natural opportunity for interaction among the persons from various departments and several initiatives and projects are undertaken by teachers across departments. Interdisciplinary curriculum design for specific departments, was one such initiative. In this paper, we present the implementation of an Inter-disciplinary Curriculum for students of the Four-year Undergraduate Engineering Programme in Printing Technology. This work was undertaken by the department of Printing Technology which has been offering this course since 1996.

3. Implementing IDC based Print Education

In 2011, a special student workshop on curriculum restructuring was conducted wherein student groups were allowed to make formal presentation of curriculum followed worldwide, their pros & cons and the need to adopt them in our University. The panel members who evaluated the presentations gave recommendations for curriculum restructuring. Some of the significant recommendations were: curriculum focus on providing industry-readiness, soft skills, courses other than core courses, foreign languages, sports and outreach programmes.

3a. Curriculum Framework:

Based on these recommendations, and with the model curriculum of AICTE [2] and UGC [3], the Curriculum Restructuring Committee prepared a Curriculum Framework. The framework consisted of

- Part 1: Language courses – English as mandatory language
- Part 2: Basic Sciences – Physics, Chemistry and Mathematics
- Part 3: Core Courses and Inter-disciplinary – in our case this is the core Printing courses and other allied courses in Electrical, Electronics, Computer and Mechanical specialisations
- Part 4: Other courses: student can has a basket of choices under this category to choose from.
  - Skill-based courses – technical skills, vocational skills and communication skills
    - Technical skill courses – these courses will be offered by each department, for students other than this department
    - Vocational skill courses - these are courses with 75% practical sessions
Communication skill courses – these are foreign language courses

  - Co-curricular course
    - General aptitude – meant for students who wish to appear for competitive exams
    - Professional Certification – meant for students who seek certification courses from outside agencies, but offered within the university and adds credits

  - Extra-curricular course
    - Sports - a dedicated course in sports
    - National Service Scheme - outreach program and community service

The number of courses under each category is indicated diagrammatically in Figure 1. It can be seen that core courses occupy 50% of the curriculum, the next major chunk is Inter-disciplinary courses (IDC) and Basic sciences. The remaining almost 1/5 part includes courses that help students improve their industry readiness.

![Figure 1. Pie-diagram indicating courses breakup](image)

3b. Syllabus and Scheme of Instruction:

The curriculum follows the Choice Based Credit System (CBCS) with a total of 200 credits, 3 or 4 credits for each of the core / IDC Theory courses and the practical courses are of 2 credits. The framework supports a maximum of two courses with integrated Theory and Practical component. One of the core courses is an Open Course, which is offered by another Engineering Department for students other than the parent department. One of the core courses is a self-study paper with one instruction hour, to facilitated self-directed learning. The curriculum also includes a Computer-based Test (CBT) which is a test conducted on the lines of competitive exams. There is an in-plant training for a minimum of 30 days split across two semesters, prior to 6th semester. The final year project spans across two semesters and mandates a small scale research component, periodic presentations, thesis submission and a viva-voce. The Part IV components constitute 10 credits. The significance of these courses are tabulated in Table 1.
<table>
<thead>
<tr>
<th>Course Category</th>
<th>Course Contents</th>
<th>Scheme of Instruction</th>
<th>Course Objective</th>
<th>Course Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>T+P course Theory integrated with Practical component</td>
<td>Theoretical course which requires hands on experience in the laboratory</td>
<td>3 Hrs of theory + 2 practical hours every week</td>
<td>Implement practically, what was learnt in the classroom</td>
<td>Experimentation ability is groomed along with learning ability</td>
</tr>
</tbody>
</table>
| Open Course                              | ● Core subject of another department  
● Student makes a choice among various open courses | 2 hours per week                            | An interdisciplinary course                                                      | Student will learn to make choices, mix with other student groups, learn and connect a new concept with her discipline |
| Self-study course (Print Finishing & Converting) | ● Core subject of the parent discipline  
● Theory paper                   | 1 hour of instruction per week              | The student will learn to read the syllabus and prepare for the exam, group work, seek and find learning material | Self-directed learning – lifelong learning skill, face the unknown concepts and understand them |
| Computer-based Test (CBT)                | ● Consolidation of core courses  
● Test pattern: objective type, on computer, auto-generated questions, and evaluation | Not a classroom oriented course             | Student must have a consolidated recall of all core courses  
Learn to Use computer, time sense                                             | Ability to recall, connect various topic across courses and to recent developments, to Face competitive exams |
| İn-plant training                        | ● In the industry for a minimum of 15 continuous days  
● Training / work  
● Make a Presentation upon completion | 30 days during semester break across two semesters | Student must know Work ethics, industry culture and state-of-the-art            | Ability to quickly adapt after employment                                      |
| Final year Project                       | ● Practical work, may be industry supported  
● Domain choice is left to the students | Preliminary work in 7th semester Completion in 8th semester | Understand and experience the stages of Project life cycle, team work, seek and solve challenges | Ability to handle projects after employment                                    |
| Part IV skill based courses              |                                                                                  |                                             |                                                                                  |                                                                                  |
### Value-added course

<table>
<thead>
<tr>
<th>Offered by a departments for students of other departments</th>
<th>40 hours per semester</th>
<th>60% practical orientation</th>
<th>Learn a technical skill other than core discipline</th>
<th>Equipped to apply interdisciplinary approaches</th>
</tr>
</thead>
</table>

#### Soft-skills and communication skill

| Offered by external agency | 40 hours per semester | Personality development, speech, written and cognitive communication skills | Better personnal presentation at work, society and home |

#### Add-on certificate

| A professional certification offered by Outside agency | 40 hours or more Outside working hours | Facilitating for external certifications, in house | Earns Additional certification Offered under one roof |

#### Quantitative aptitude

| Offered by a team of trained in house teachers | 40 hours outside working hours | Online test | Ability to face competitive exams for higher studies and employment |

#### NSS (National Service Scheme)

| Theory and exam | Choose between | NSS or Sports | One week camp at a village for social service | Societal awareness | Learn to serve the society, exposure to village lifestyle in India |

#### Sports

| Theory and exam | Choose between | NSS or Sports | All round and special game | Fitness, sport talent development or pursue | Opportunity to continue sports talent or inculcate a new talent |

### 3c. Teaching-learning Methods

Each course is taught in the classroom, either chalk and talk or using ICT-based tools (information & communication Technology), such as Powerpoint presentations, and Internet based content discussion. Apart from what is mandated in the scheme of instruction, each course is supplimented with i) atleast one guest lecture by a person from the industry, ii) a local visit to a relevant printing unit, iii) minimum two assignments with a presentation or an activity. Every semester atleast one hands-on student workshop supported by the industry, is conducted in the area relevent to the courses in that semester. This is true even with IDC courses. For instance we have conducted workshops on (i) Electrical components for Printing machines (ii) Printed Electronics and (iii) Microcontrollers, with industry support.
3b. Preparation for Employment and Career Plans

Preparation for placement is integrated through the four years of the programme by maintaining a close association with the industry and the state-of-the-art developments. Our guest speakers are from the industry, society big names or academia, whose sessions help to groom our girls wholistically. Students organise association activities, celebrations, events, and workshops thus imbibing team work and organising skills. Our close interaction with Printer associations such as AIFMP and COMPRIA help in attending their technical events, exhibitions and product launches, which keeps our girls up-to-date with developments. We are regular contributors of articles to many Printer magazines. Our teachers are members of technical committees and invited guests to technical events. Sharing these experiences motivates the students. Being a part of these, throughout the four years along with the curriculum, makes our girls industry ready.

Numerous vacancies are available for Printing engineers in the Print industry round the globe. However, our students are conservative and prefer to work close to home. Every year about 50% of the batch get employed, 25% enter into a post graduation programme and 25% settle down with family.

4. OUTCOME OF IDC-BASED PRINT EDUCATION

At an eagle’s view, our CBCS with emphasis on IDC, is a success. We have closely observed the 2011-15 batch and 2012-16 batch of students who underwent the CBSE-IDC curriculum and have listed out both the success stories and the avenues of change.

4a. Positive Outcomes:
Some of the positive outcomes are:

- Students are more involved in the classes, since there is a variety and dynamism in the course categories.
- They are not stuck to the department all the four years
- There is inter-departmental interaction and collaboration, especially during mini projects and healthy competition in academics
- Significant time after working hours is utilised in skill-based, co-curricular and extra-curricular courses. Otherwise this time is not utilised effectively
- The choice of internship companies were varied and students were willing to go in smaller batches, otherwise they would all group together and carryout internship in the same locality.
- Choice of student projects were heterogeneous, there were inter-disciplinary projects, projects that assisted differently-abled persons, fabrication of finishing machine, projects with environmental awareness, etc.
- Their ability to self-learn, collaborate, communicate and team work is put to use effectively for their final year project
  - Unlike in earlier batches, the students of the new curriculum were more outward and were able to do their project with more research flavour, and carrying our their work at various presses and testing centers
Their personality and all round development helped them to get placed in more challenging companies

Unlike earlier batches, in these batches students were placed outside India and in Multi-national Companies, located far from home.

4b. Lessons learnt

Although there is a significant overall development in the students, we find that, the following few avenues need a change:

- Slow learners are drastically affected. They are unable to effectively think laterally, or work extra hours.
- Students who perform well in practical courses than in theory courses are good in Part IV courses, but cannot perform well in the theory based Inter-disciplinary courses.
- Lack of self-learning skill – these students are not able to clear the self-study course and require rigorous remedial classes to complete the course. In one of our surveys, we found that the use of Information & Communication Technology based learning/study material in the library, can motivate self-learning skills in students [4].
- Conservative background – such students find it difficult to go out, away from home, for internship, or project. Hence their internships and projects are of low quality
- Low income family – part IV courses are offered at an additional fee. Some of the students parents show displeasure in paying this extra fees.

4c. Minor Revision

- A minor revision in the curriculum / teaching-learning process, was incorporated in 2014 to overcome some of the pitfalls listed above.
- An additional tutorial hour was included for ‘tough’ courses to help slow learners and credits were adjusted accordingly.
- An extra open hour after working hours was allotted for students to discuss and clarify doubts with their instructors.
- Tutors assisted students in identifying good, safe companies for internship and accommodation, by connecting with known persons in Printers associations, Alumni group etc.
- Option of taking up either the Project or Core courses for as many credits, was introduced so that students can either learn additional courses or carryout an experimental project.
- Scholarships were arranged for needy students through Printers associations and other NGOs

5. RECOMMENDATIONS

Our experiences in implementing Interdisciplinary curriculum for undergraduate Engineering programme is to a large extent applicable to our context, i.e., a women’s university and may not be applicable globally. Given this scenario, our recommendations are

- Inter-disciplinary curriculum is the mantra and there is not second thought to it
• Complexity, quantity, practical flavour, choices and flexibility in the courses should be determined based on the characteristics of the student group admitted to the programme (either past or predicted)
• the requirements of the industry group that recruits this student group
• the teaching resources available in the institution
• associating with the industry for workshops, guest lectures and visits for the IDC courses is a definite success for conducting the course
• course instructor for IDC courses must be able to connect the subject with Printing domain, otherwise students become lethargic and the objective is lost.
• Regular revision of the IDC courses is essential, a period of 3 years is recommended wherein either the syllabus or the entire course may be revised.
• While practical knowledge is essential, it is recommended to keep IDC papers as a single theory or Theory+practical papers rather as two papers - a theory paper and a practical paper. The single paper can be supplemented with practical assignments, and workshops.
• It is recommended to have few courses where students from multiple programmes can register for. In our case, Open course and Value-added course components are a success. Inter-departmental Interaction and collaboration increased. The students in the heterogenous group applied their respective domain knowledge during the classes.

6. CONCLUSION AND FUTURE WORK

In this paper we have shared our experiences in designing and implementing an Inter-disciplinary curriculum for undergraduate programme in Engineering in a women’s University. We have traced through the design considerations, course breakup, implementation strategies and outcome of implementation. Based on the experience for two batches of students, we have given our recommendations. Although the recommendations may not be applicable universally, the essence of each recommendation is of concern to any curriculum designer.

Our next step in this is making a major revision in the curriculum in 2017. We are presently studying the Industry requirements, academic developments and student enrollment statistic for the next 5 years, based on which the next revision is to be made.

7. References

2. All India Council for Technical Education (AICTE)’s Model curriculum: http://www.aicte-india.org/mugengg.php