

# Status of Welding Education at the University level in India

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## Abstract

The paper highlights the welding education that is prevalent in Indian Universities. The data collected after a survey through a questionnaire depicts the position of welding education that is offered at various levels. An overall view of the broad syllabus of the courses offered in this area is also brought out.

## 1.0 Introduction

During the deliberations of the International Institute of Welding Annual Assembly, in Boston, U.S.A. in July 1984, under the Commission XIV activity, it was decided to collect data on the level and content of welding education in the world over. The author was entrusted with the responsibility of collecting the data with regard to the position in the Indian Universities/Academic Institutions. Accordingly a questionnaire was sent to several universities and academic institutions in the country (Annexure-I) and the data was collected and synthesised and a report was sent to the Chairman, Commission XIV of the IIW. The present paper is a reproduction of the report as the matter is of general interest to all the welding fraternity in the country.

## 3.0 Course Content

The M.Tech/M.E. programmes in Welding Technology at these universities, generally consist of the following pattern: Duration: 3 semesters (2 semesters course work, 1 semester dissertation work)

60% credits to welding subjects (as listed below)

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## 2.0 Programme of Welding Education and Research Activities at the Indian Universities/Academic Institutions <sup>4</sup>

University/ Institution	Under- Graduate level as electives	Course progra- mmes as electives	Post- Graduate level leading to degree M.Tech.	Research programmes		
				M.S.	Ph.D.	Others
IIT M	∞	∞	∞	∞	∞	∞
IIT B	—	∞	—	∞	∞	—
IIT D	—	∞	—	∞	∞	∞
IIT K	∞	∞	—	—	—	∞
IISc.	∞	—	—	∞	—	—
Roorkee	—	∞	∞	∞	∞	∞
REC T	∞	∞	∞	—	∞	—

IIT M — Indian Institute of Technology, Madras.  
 IIT B — Indian Institute of Technology, Bombay.  
 IIT D — Indian Institute of Technology, Delhi.  
 IIT K — Indian Institute of Technology, Kharagpur.  
 IISc — Indian Institute of Science, Bangalore  
 Roorkee — University of Roorkee, Roorkee.  
 REC T — Regional Engineering College, Trichy.  
 ∞ — Programme offered.

At the under-graduate level no programme leading towards a degree in welding technology is offered in any Indian academic institutions.

20% credits to allied subjects like Non destructive testing, Computer applications, Failure analysis, etc.

20% dissertation work on welding topics.

The following are the welding subjects generally covered :

1. Welding processes-I (Fusion welding processes)
2. Welding processes-II (Pressure welding processes)

3. Welding Metallurgy
4. Stress Analysis and Weld Design
5. Application of Welding Technology
6. Safety Concepts of Welded Structure
7. Special Topics in Metal Joining
8. Welding Laboratory-I
9. Welding Laboratory-II

In addition to the above, the courses generally include Industrial Training (6-8 weeks) and Seminar, which carries 1 or 2 credits.

#### 4.0 Syllabus

The broad syllabus of the subjects covered in the post-graduate degree programme (M.Tech/M.E.) is indicated below :

1. Welding processes-I 3003 (Lectures : Tutorial: Practical : Credits) per week.

General survey and classification of welding processes. Conventional fusion welding processes, Principal heat sources. Gas welding and cutting. Manual Metal Arc Welding. Electrode coverings and their functions. Continuous processes based on above.

Submerged Arc Welding—types of fluxes and their compounding. Wire and strip electrodes.

Gas shielded welding: TIG, MIG and MAG/CO<sub>2</sub> Processes. Consideration of shielding gases, electrode polarity. Current setting, metal transfer and arc-length control. Plasma welding and cutting processes. Equipment maintenance, application of the above.

Electrical power sources for welding: General characteristics of transformer, transformer rectifier and motor-generator sets. Influence of power source characteristics on welding performance and use of pulsed currents.

2. Welding processes-II 3003  
Pressure welding processes: Solid phase bonding, friction welding, ultrasonic welding, Explosive welding, diffusion bonding and adhesive bonding.

Resistance welding: Spot, seam and projection welding. Flash and upset butt welding. Brazing & soldering. Electron beam, laser and infrared welding. Principles, Operational details, Process controls and applications of above processes.

3. Welding Metallurgy 3003  
Thermal cycles in welding, Metallurgical considerations in welding. Relevance of phase diagrams and structural transformations in iron carbon and principal non-ferrous systems, effects of alloying elements in transformations, microstructure and mechanical properties of steels. TTT/CCT curves and their significance for metal joining.

Weldability: Concept and evaluation, Schaeffler diagram etc. Weldability of cast steels and cast irons, of important non-ferrous materials. Defects in weldments. Causes, effects and remedies, cold and hot cracking, gases and their influence.

4. Stress Analysis in Welding Design 3003

Behaviour of metals under load, static and dynamic loading, uniaxial and multiaxial loading, yield criteria under combined stress conditions, stress concentration factor, two-dimensional problems, deformation behaviour under plane stress and plane strain conditions. General concepts of weld design ; Analysis of stresses in welded structures, permissible stresses, standards, calculation of the size of welds for static and dynamic loading,

location and orientation of welds in an assembly. Residual stresses, distortion and their control.

5. Application of Welding Technology 3003

Testing of weldments: Destructive and non-destructive; Fatigue behaviour of welded structures. Economics of welding : Cost evaluation and selection of process. Comparison with other fabrication techniques. Training of welding personnel, safety precautions. Quality control in welding, standards and codes. Application of welding technology in a few typical industries: Pressure vessel fabrication, chemical industry, nuclear reactors, ship building, aviation, automobile and rail road industries.

6. Safety Concepts of Welded Structure

Basic of safety concepts: Definition of safety, Mechanism of failure, safety relevance of toughness and flaws, specific problems related to weldments.

Conventional methods : Concepts of strength and toughness. Determination and consequences of stress and strain state, safety assessment of notched components in the elastic and the elastic-plastic range, semi-quantitative fracture diagrams.

Fracture Mechanics Methods : Principles of fracture mechanics, linear elastic fracture mechanics, plastic limit load calculation, Two criteria approach, cyclic crack growth: Effect of environment, Basis of elastic-plastic fracture mechanics, COD-Concept, j-integral concepts, R-curve, Tearing instability diagram.

Application of safety concepts of welded structures : Material,

- flow and stress states in welds, Code requirements, Examples of failures, consequences for manufacturing, Design and Service.
7. Special Topics in Metal Joining: 3003  
Welding and Cladding of dissimilar materials ; Lamellar tearing. Application of modern metallurgical tools for weld studies. Surfacing, cladding, overlaying, etc. Developments in processes, Corrosion of weldments.
8. Welding Laboratory-I 0031  
Safety practices in gas and arc welding, study of gas and arc welding using different joints and study of TIG, pulsed TIG, MIG, CO., Plasma, microplasma, SAW ESW processes.
- Resistance spot, seam and butt welding processes, other micro and special welding processes.
9. Welding Laboratory-II 0031  
Study of thermal cycles associated with different welding processes and for different materials. Metallurgical investigations of ferrous, and non-ferrous welded samples.
- Flame and Plasma cutting, use of jigs and fixtures in welding.
- Study of pre and post heat treatment in welding. Standard weldability tests.
- Tension test, Bend test, Impact test, Fracture toughness testing, Fatigue testing and corrosion testing of weldments.
- Annexure-I**
- Proforma for a data on welding education in India.**
- Are you offering any full-fledged programme in Welding Technology ?  
(a) Yes/No
  - What are the courses offered in the area of welding technology as ancillary subject  
Course title  
Level  
Course content (syllabus may please be attached)  
No. of hours/week  
Credit or % weightage  
No. of students participating in the course
  - List of the equipments/facilities available in the field.
- (b) If yes, indicate the level—  
—Under-Graduate  
—Post-Graduate
- (c) If yes, give details of the complete (M.Tech, M.E.) course contents including  
—Subjects covered  
—Lecture hour/week/subject  
—Laboratory work/week  
—Practical Training  
—Disertation/Thesis
- Thanking you for kind cooperation and effort.

## News Bulletins from IIW Branches

With growing membership of the IIW branches, it was felt that a communication link was necessary to keep alive the interest of the branch members particularly of the outstation members.

So long, there was only one, DWE EKAM, a bimonthly technical and news bulletin being published by IIW—Tiruchirappally regularly. Contents contained interesting technological information on welding, latest developments, cartoons & cross words.

Recently, two more IIW branches—Jamshedpur & Bombay also brought out “Welding Flashes” & “News letters” respectively. An interesting short article, “Industrial Ravages of Welding” has been published in the “Welding Flashes” vol, 2, April-August 1985 IIW—Jamshedpur. “News Letter” from IIW—Bombay vol. 1, October—1985, not only contained the activities, plans & programmes of the branch but also contained ‘News from other branches,

To get involved with the welding fraternity the opportunities are widening for the members. The members are now to suggest and take active role to improve it further.