

Materials Science and Engineering
UG Program
at
IIT Kanpur

Current Program

ELECTED CORE COURSES

1. Nature and Properties of Materials
2. Mechanics of Solids
3. Computational methods in Engineering
4. Quantum Physics
5. Introduction to Partial Differential Equations

LABORATORIES

1. Physical Metallurgy Laboratory
2. Functional Materials Laboratory
3. Mechanical Behavior Laboratory
4. Process Engineering Laboratory
5. Manufacturing Process Laboratory

BASIC COURSES

1. Thermodynamics & Phase Equilibria
2. Rate Processes
3. Structure & Characterization of Materials
4. Introduction of Biomaterials
5. Phase transformation
6. Mechanical Properties of Materials
7. Electronic & Magnetic Properties of Materials
8. Principles of Metal Extraction and Refining
9. Materials Processing

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Electives and UG Project Option

Industrial Tour and Training not required

Elective Streams

Devices and Bio-Engineering

1. Science and Technology of Thin Films and Device Fabrication
2. Energy Materials and Technologies
3. Electronic Devices and Characterization
4. Electroceramic Materials and Applications
5. Materials Science Technologies for Applications in Life Sciences

Metal Processing

1. Iron and Steel making
2. Selection and Design of Engineering Materials
3. Solidification Processing and Joining
4. Deformation Processing
5. Powder Metallurgy
6. Heat-treatment and Surface Hardening

Structure, Characterization and Properties

1. Symmetry and Properties of Crystals
2. Nanostructures and Nanomaterials: Characterization and Properties
3. Interfaces and Materials Properties
4. Materials Failure: Analysis and Prevention
5. Microscopy and Microanalysis of Materials
6. Dislocations and Plasticity

- **Guarantee of offering all these electives every academic year**
- **Students required to take five of these courses**

Previous Program

ELECTED CORE COURSES

1. Mechanics of Solids
2. Fluid Mechanics and Rate Processes

BASIC COURSES

1. Introduction to Profession
2. Thermodynamics of Materials
3. Metallurgical Kinetics
4. Materials Characterization
5. Mechanical Behavior of Materials
6. Principles of Metal Extraction and Refining
7. Phase Equilibria in Materials
8. Phase Transformation in Materials
9. Iron and Steel Making
10. Fundamental of Materials Processes
11. Manufacturing Processes: Selection and their Design
12. Electronic and Magnetic Properties of Materials
13. Materials Degradation and Its Prevention

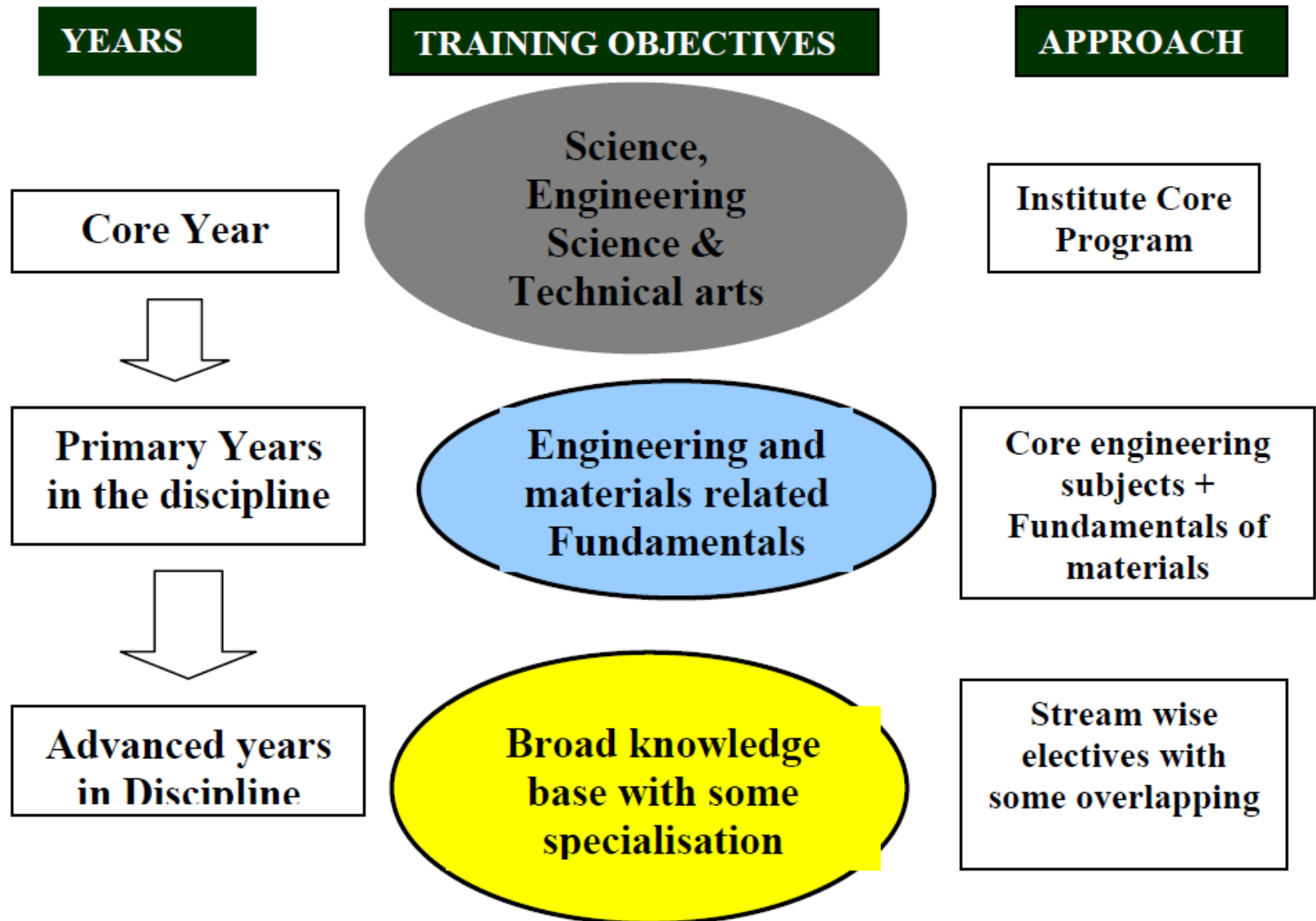
LABORATORIES

1. Physical Metallurgy Laboratory
2. Mechanical Behavior Laboratory
3. Process Metallurgy Laboratory
4. Phase Equilibria in Materials
5. Manufacturing Process Laboratory

Electives and Project Option

1. Industrial Tour
2. Project I & II
3. Three electives

Analysis

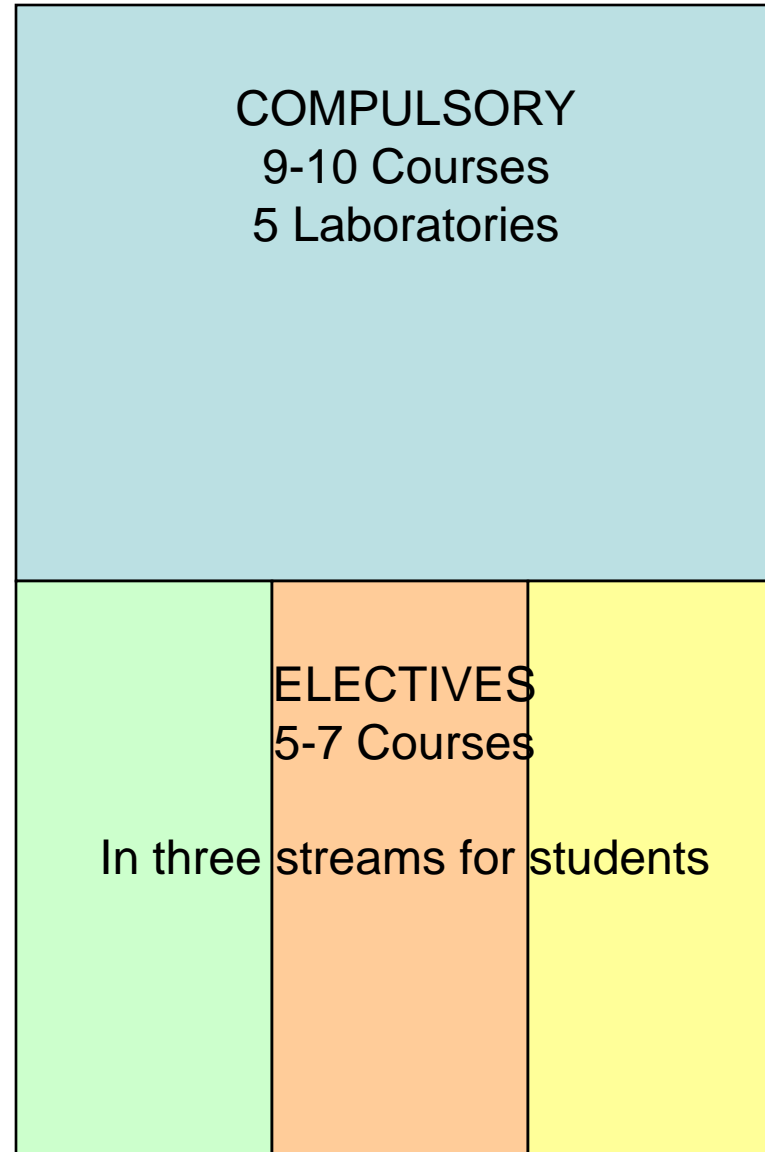


- Identify number of lectures in compulsory courses which are fundamentals, principles and quantitative
- This content can be delivered in 7 courses
- Can we call only these as compulsory and offer applications, engineering and technology as electives

Approach

1. Stress only on fundamentals
2. Are based on analysis
3. Are mathematical/quantitative

1. 90 students; need not train all students with identical course work; allow students in various shades
2. Three streams are feasible

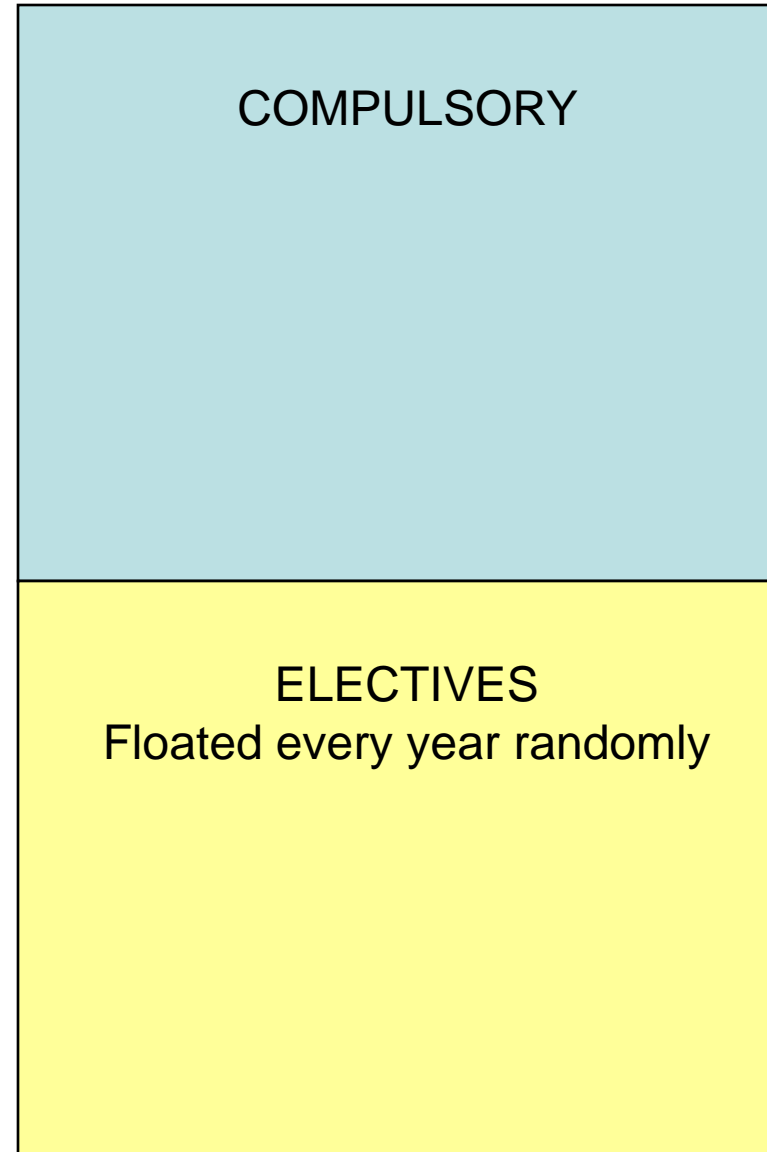


Model A

1. Conventional approach

Problems

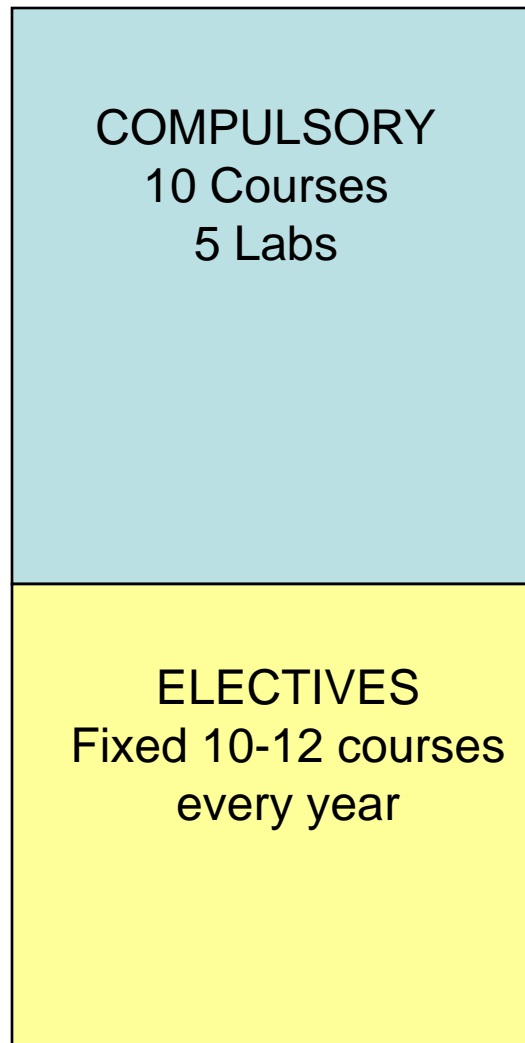
1. Compulsory space has effectively shrunk as MSE scope expands
2. Bottom line: can't satisfy the needs of MSE compulsory and can't satisfy faculty aspirations of training students in what we deem important



Model B

Faculty Perspective (Yearly)

1. Compulsory courses are 20-25
2. 9-10 are for all students, others are taken by fewer students but at least some do take these courses



Student Perspective (Duration of program)

1. Instead of random electives, clear choice of electives is known apriori
2. If additional, specific elective is desired, open elective option is available
3. Instead of fewer choices of department electives, more choices are available

Problem:

1. While compulsory will be fundamental courses, if a student focuses only in one area, he/she may graduate without knowing about many MSE areas; no broad based UG education
2. Solution is to offer electives in as many baskets as possible

Model C

1. Three baskets are feasible
2. If names are given, DON'T think of them as specialization as student can take couple of courses in one basket and couple in other

