

B.Tech.

in

METALLURGICAL AND MATERIALS ENGINEERING

FLEXIBLE CURRICULUM

(For students admitted from 2023-24 onwards)



**DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015**

TAMIL NADU, INDIA

Vision, Mission of the Institute

Vision of the Institute

- To provide valuable resources for industry and society through excellence in technical education and research

Mission of the Institute

- To offer state-of-the-art undergraduate, postgraduate and doctoral programmes
- To generate new knowledge by engaging in cutting-edge research
- To undertake collaborative projects with academia and industries
- To develop human intellectual capability to its fullest potential

Vision, Mission of MME department

Vision of the Department MME

- To evolve into a globally recognized department in the frontier areas of Metallurgical and Materials Engineering

Mission of the Department MME

- To produce Metallurgical and Materials Engineering graduates having professional excellence
- To carry out quality research having social & industrial relevance
- To provide technical support to budding entrepreneurs and existing industries

Summary of Flexible curriculum

Course Category	Courses	No. of Credits	Weightage (%)
GIR (General Institute Requirement Courses)	23	56	34.35
PC (Programme Core)	15**	49	30.06
Programme Electives (PE) / Open Electives (OE)	14 [§]	42	25.76
Essential Laboratory Requirements (ELR)	08 (Maximum 2 per session up to 6 th semester)	16	10
Total		163	100
Minor (Optional)	Courses for 15 credits	15 Additional credits	-
Honours (Optional)	Courses for 15 credits	15 Additional credits	-

**Minimum of 4 programme core courses shall be 4 credits each

§Out of 14 elective courses (PE/OE), the students should study at least eight programme elective courses (PE)

B.Tech. Curriculum Structure – Students admitted in 2023 – 2024

Semester I (July Session)

Sl. No.	COURSE	Credits	Category
1	English for Communication (Theory & Lab)	4	GIR
2	Matrices and Calculus	3	GIR
4	Chemistry (Non-Circuit)	3	GIR
5	Chemistry Lab (Non-Circuit)	2	GIR
6	Introduction to Metallurgical and Materials Engineering*	2	GIR
7	Basics of Electrical and Electronics Engineering	2	GIR
8	Engineering Graphics	3	GIR
	Total	19	

Semester II (January Session)

Sl. No.	COURSE	Credits	Category
1	Complex Analysis and Differential Equations	3	GIR
2	Physics (Non-Circuit)	3	GIR
3	Physics Lab (Non-Circuit)	2	GIR
4	Introduction to Computer Programming (Theory & lab) (Non-Circuit)	3	GIR
5	Basics of Civil Engineering (Non-Circuit)	2	GIR
6	Energy and Environmental Engineering	2	GIR
7	Engineering Practice	2	GIR
8	Metallurgical Thermodynamics and Kinetics	4	PC
	Total	21	

* Mandatory course, offered by Industrial Experts / Alumni

Semester III (July Session)

Sl. No.	COURSE	Credits	Category
1	Physical Metallurgy	4	PC
2	Engineering Mechanics and Strength of Materials	3	PC
3	Transport Phenomena	3	PC
4	Mechanical Behaviour and Testing of Materials	3	PC
5	Polymers, Composites and Ceramics	3	PC
6	Process Metallurgy Laboratory	2	ELR
7	Polymers, Composites and Ceramics Laboratory	2	ELR
8	Programme Elective	3	PE/OE
	Total	23	

Note: Department(s) to offer Minor (MI) Course and ONLINE Course (OC) to those willing students in addition to 23 credits.

Semester IV (January Session)

Sl. No.	COURSE	Credits	Category
1	Mathematics III	4	GIR
2	Iron Making and Steel Making	4	PC
3	Phase Transformation and Heat Treatment	3	PC
4	Material Characterization	3	PC
5	Metallography and Heat Treatment Laboratory	2	ELR
6	Materials Testing and Inspection Laboratory	2	ELR
7	Elective – II	3	PE/OE
8	Elective – III	3	PE/OE
	Total	24	

Note: Department(s) to offer MI/PE/OE/OC and Honours course as 2/3 credits to those willing students in addition to 24 credits.

Semester V (July Session)

Sl. No.	COURSE	Credits	Category
1	Industrial Economics and Foreign Trades	3	GIR
2	Metal Casting Technology	3	PC
3	Materials Joining Technology	3	PC
4	Metal Forming Technology	4	PC
5	Foundry and Welding Laboratory	2	ELR
6	Metal Forming and Particulate Processing Laboratory	2	ELR
7	Professional Ethics (Non-Circuit)	3	GIR
8	Elective – IV	3	PE/OE
	Total	23	

Note: Department(s) to offer MI/PE/OE/OC and Honours course as 2/3 credits to those willing students in addition to 23 credits.

Semester VI (January Session)

Sl. No.	COURSE	Credits	Category
1	Industrial Lecture	1	GIR
2	Non-Ferrous Physical Metallurgy	3	PC
3	Electrical, Electronic and Magnetic Materials	3	PC
4	Corrosion and Surface Engineering	3	PC
5	Non-Ferrous Metallography and Characterization Laboratory	2	ELR
6	Corrosion and Surface Engineering Laboratory	2	ELR
7	Elective – V	3	PE/OE
8	Elective - VI	3	PE/OE
9	Elective - VII	3	PE/OE
	Total	23	

Note: Department(s) may offer Minor (MI) Course, ONLINE Course (OC) and Honours Course (HO) to those willing students in addition to 23 credits

Semester VII (July Session)

Sl. No.	COURSE	Credits	Category
1	Summer Internship	2	GIR
2	Elective – VIII	3	PE/OE
3	Elective – IX	3	PE/OE
4	Elective – X	3	PE/OE
5	Elective – XI	3	PE/OE
	TOTAL	14	

Note: Department(s) may offer Minor (MI) Course, ONLINE Course (OC) and Honours Course (HO) to those willing students in addition to 14 credits

Semester VIII (January Session)

Sl. No.	COURSE	Credits	Category
1	Comprehensive Viva Voce	1	GIR
2	Project Work [§] / Equivalent no. of Electives	6	GIR
3	Elective – XII	3	PE/OE
4	Elective – XIII	3	PE/OE
5	Elective – XIV	3	PE/OE
	TOTAL	16	

Note: Department(s) may offer Minor (MI) Course, ONLINE Course (OC) and Honours Course (HO) to those willing students in addition to 10 credits

[§]Optional course

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credit	19	21	23	24	23	23	14	16	163

Note:

- Curriculum should have 4 programme core courses shall be 4 credits each.
- Out of 14 elective courses (PE/OE), the students should study **at least eight programme elective courses (PE)**.
- MI – Minor Degree: **15 credits over and above** the minimum credit as specified by the departments. The details of MINOR will be mentioned only in the transcript not in the Degree certificate.
- HO – Honours Degree: **15 credits over and above** the minimum credit as specified by the departments (163). The project work is compulsory.

GIR COURSES

S.No.	Name of the Course	Number of Courses	Max. Credits
1.	Mathematics	3	10
2.	Physics	1 Theory	3
		1 Lab	2
3.	Chemistry	1 Theory	3
		1 Lab	2
4.	Industrial Economics and Foreign Trade	1	3
5.	English for Communication	1 Theory	2
		1 Lab	2
6.	Energy and Environmental Engineering	1	2
7.	Professional Ethics	1	3
8.	Engineering Graphics	1	3
9.	Engineering Practice	1	2
10.	Basic Engineering	2	4
11.	Introduction to computer Programming	1	3
12.	Branch Specific Course [#] (Introduction to the branch of study)	1	2
13.	Summer Internship	1	2
14.	Project work*	1	6
15.	Comprehensive viva	1	1
16.	Industrial Lecture	1	1
17.	NSS/NCC/NSO	1	Compulsory Participation
Total		23	56

[#]Offered by Industrial Experts / Alumni of NITT, *Optional course

I. GENERAL INSTITUTE REQUIREMENTS (Course and Course details)

1. MATHEMATICS

Sl.No.	Course Code	Course Title	Credits
1.	MAIR11	Matrices and Calculus	3
2.	MAIR21	Complex Analysis and Differential Equations	3
3.	MAIRYY^s	Partial Differential Equations And Numerical Methods	4
Total			10

2. PHYSICS

Sl.No.	Course Code	Course Title	Credits
1.	PHIR11	Physics	3
2.	PHIR12	Physics Lab	2
Total			5

3. CHEMISTRY

Sl.No.	Course Code	Course Title	Credits
1.	CHIR11	Chemistry	3
2.	CHIR12	Chemistry Lab	2
Total			5

4. HUMANITIES

Sl.No.	Course Code	Course Title	Credits
1.	HSIR13	Industrial Economics and Foreign Trade	3
Total			3

5. COMMUNICATION

Sl.No.	Course Code	Course Title	Credits
1.	HSIR11	English for Communication (Theory)	2
2.	HSIRYY ^S	English for Communication (Lab)	2
Total			4

6. ENERGY AND ENVIRONMENTAL ENGINEERING

Sl.No.	Course Code	Course Title	Credits
1.	ENIR11	Energy and Environmental Engineering	2
Total			2

7. PROFESSIONAL ETHICS

Sl.No.	Course Code	Course Title	Credits
1.	HSIR14	Professional Ethics	3
Total			3

8. ENGINEERING GRAPHICS

Sl.No.	Course Code	Course Title	Credits
1.	MEIR12	Engineering Graphics	3
Total			3

9. ENGINEERING PRACTICE

Sl.No.	Course Code	Course Title	Credits
1.	PRIR11	Engineering Practice	2
Total			2

10. BASIC ENGINEERING

Sl. No.	Course Code	Course Title	Credits
1.	CEIR11	Basics of Civil Engineering	2
2.	EEIR11	Basics of Electrical and Electronics Engineering	2
Total			4

11. INTRODUCTION TO COMPUTER PROGRAMMING

Sl.No.	Course Code	Course Title	Credits
1.	CSIR11	Introduction to Computer Programming (Theory and Lab)	3
Total			3

12. BRANCH SPECIFIC COURSE

Sl.No.	Course Code	Course Title	Credits
1.	MTIR15	Branch Specific Course – Introduction to MME	2
Total			2

13. SUMMER INTERNSHIP#

Sl.No.	Course Code	Course Title	Credits
1.	MTIR16	Internship / Industrial Training / Academic Attachment	2
Total			2

The student should undergo industrial training/internship for a minimum period of two months during the summer vacation of 3rd year. Attachment with an academic institution within the country (IISc/IITs/NITs/IIITs and CFTIs) or university abroad is also permitted instead of industrial training.

To be evaluated at the beginning of VII semester by assessing the report and seminar presentations.

14. INDUSTRIAL LECTURE

Sl.No.	Course Code	Course Title	Credits
1.	MTIR17	Industrial Lecture	1
Total			1

A course based on industrial lectures shall be offered for 1 credit. A minimum of five lectures of two hours duration by industry experts will be arranged by the Department. The evaluation methodology, will in general, be based on quizzes at the end of each lecture.

15. COMPREHENSIVE VIVA

Sl.No.	Course Code	Course Title	Credits
1.	MTIR18	Comprehensive viva	1
Total			1

16. PROJECT WORK (OPTIONAL COURSE)

Sl.No.	Course Code	Course Title	Credits
1.	MTIR19	Project Work (Optional)	6
Total			6

17. NSS /NCC/ NSO

Sl.No.	Course Code	Course Title	Credits
1.	SWIR11	NSS / NCC/ NSO	0
Total			0

^s The last two digits YY to be allotted by the Department.

Programme Core Courses

Sl. No.	Course Code	Course Title	Credits				Pre requisites	Credits
			L	T	P	C		
1.	MTPC11	Metallurgical Thermodynamics and Kinetics	3	1	0	4	Nil	4
2.	MTPC12	Physical Metallurgy	3	1	0	4	Nil	4
3.	MTPC13	Engineering Mechanics and Strength of Materials	3	0	0	3	Nil	3
4.	MTPC14	Transport Phenomena	3	0	0	3	Nil	3
5.	MTPC15	Mechanical Behaviour and Testing of Materials	3	0	0	3	Nil	3
6.	MTPC16	Polymers, Composites and Ceramics	3	0	0	3	Nil	3
7.	MTPC17	Iron Making and Steel Making	3	1	0	4	MTPC11, MTPC14	4
8.	MTPC18	Phase Transformation and Heat Treatment	3	0	0	3	MTPC12	3
9.	MTPC19	Material Characterization	3	0	0	3	MTPC12	3
10.	MTPC20	Metal Casting Technology	3	0	0	3	Nil	3
11.	MTPC21	Materials Joining Technology	3	0	0	3	Nil	3
12.	MTPC22	Metal Forming Technology	3	1	0	4	MTPC15	4
13.	MTPC23	Non-Ferrous Physical Metallurgy	3	0	0	3	MTPC12	3
14.	MTPC24	Electrical, Electronic and Magnetic Materials	3	0	0	3	Nil	3
15.	MTPC25	Corrosion and Surface Engineering	3	0	0	3	Nil	3
Total								49

Programme Elective Courses (PE)

Sl.No.	Course Code	Course Title	Prerequisites	Credits
1.	MTPE11	Mineral Processing and Metallurgical analysis	Nil	3
2.	MTPE12	Non-ferrous Extractive Metallurgy	Nil	3
3.	MTPE13	Manufacturing Processes	Nil	3
4.	MTPE14	Non-destructive Testing	Nil	3
5.	MTPE15	Welding Metallurgy	MTPC21	3
6.	MTPE16	Materials for extreme environments	Nil	3
7.	MTPE17	Thermodynamics of Solidification	MTPC11, MTPC20	3
8	MTPE18	Design aspects of Welding and Casting	MTPC20, MTPC21	3
9.	MTPE19	Alloy Development	Nil	3
10.	MTPE20	Ceramic Materials	Nil	3
11.	MTPE21	Ceramic Processing	MTPC16	3
12.	MTPE22	High Temperature Materials	MTPC12	3
13.	MTPE23	Emerging Materials	Nil	3
14.	MTPE24	Automotive Materials	Nil	3
15.	MTPE25	Metallurgical Failure Analysis	Nil	3
16.	MTPE26	Biomaterials	Nil	3
17.	MTPE27	Stainless steels and Advanced Ferrous Alloys	Nil	3
18.	MTPE28	Special Steels and Cast Irons	MTPC18	3
19.	MTPE29	Economics of Metal Production Processes	MTPC17	3
20.	MTPE30	Special Casting Techniques	MTPC20	3
21.	MTPE31	Particulate Technology	Nil	3
22.	MTPE32	Special Topics in Metal Forming	MTPC22	3
23.	MTPE33	Additive Manufacturing	Nil	3
24.	MTPE34	Computational Materials Science	Nil	3
25.	MTPE35	Materials for New and Renewable Energy	Nil	3
26	MTPE36	Fatigue, Creep and Fracture Mechanics	MTPC15	3

27	MTPE37	Metallurgical Waste Management	Nil	3
28	MTPE38	Instrumentation and Control Engineering	Nil	3
29	MTPE39	Sustainable Materials	Nil	3
30	MTPE40	Integrated Computational Materials Engineering	Nil	3
31	MTPE41	Green Manufacturing	Nil	3

Open Elective Courses (Offered by Dept. of MME)

Sl.No.	Course Code	Course Title	Prerequisites	Credits
1.	MTOE11	Nanomaterials and Applications	Nil	3
2.	MTOE12	Mathematical Techniques in Materials Research	Nil	3
3.	MTOE13	Design and Selection of Materials	Nil	3
4.	MTOE14	New Product Development	Nil	3
5.	MTOE15	Introduction to Quality Management	Nil	3
6.	MTOE16	Surface Engineering	Nil	3
7.	MTOE17	Process Modelling and Applications	Nil	3
8.	MTOE18	Intellectual Property Rights	Nil	3
9.	MTOE19	Business and Entrepreneurship for Engineers	Nil	3
10.	MTOE20	History of Metals and Alloys	Nil	3
11.	MTOE21	Artificial Intelligence in Materials Engineering	Nil	3
12.	MTOE22	Materials in Indian Medicines	Nil	3
13.	MTOE23	Semiconductors Manufacturing	Nil	3

Essential Programme Laboratory Requirements (ELR)

Sl.No.	Course Code	Course Title	Pre-/Co-requisites	Credits
1.	MTLR30	Process Metallurgy Laboratory	Nil	2
2.	MTLR31	Polymers, Composites and Ceramics Laboratory	MTPC14	2

3.	MTLR32	Metallography and Heat Treatment Laboratory	MTPC15	2
4.	MTLR33	Materials Testing and Inspection Laboratory	MTPC17	2
5.	MTLR34	Foundry and Welding Laboratory	MTPC19, MTPC20	2
6.	MTLR35	Metal Forming and Particulate Processing Laboratory	MTPC21	2
7.	MTLR36	Non-Ferrous Metallography and Characterization Laboratory	MTPC22, MTPC23	2
8.	MTLR37	Corrosion and Surface Engineering Laboratory	MTPC24	2
Total				16

Minor Courses (MI)

Sl. No.	Course Code	Course Title	Prerequisites	Credits
1.	MTMI11	Materials Technology	Nil	3
2.	MTMI12	Fundamentals of Metallurgy	Nil	3
3.	MTMI13	Physical Metallurgy and Heat Treatment	Nil	3
4.	MTMI14	Deformation Processing	Nil	3
5.	MTMI15	Manufacturing Methods	Nil	3
6.	MTMI16	Testing and Evaluation of Materials	Nil	3
7.	MTMI17	Non-Metallic Materials	Nil	3

Advanced Level Courses for B.Tech. (Honours)

Sl.No.	Course Code	Course Title	Prerequisites	Credits
1.	MTHO10	Advanced Thermodynamics of Materials	MTPC11	4
2.	MTHO11	Crystallography	MTPC12	3
3.	MTHO12	Aerospace Materials	Nil	4

4.	MTHO13	Ladle Metallurgy and Continuous Casting of steels	MTPC17	4
5.	MTHO14	Recent Trends in Nano materials	Nil	4
6.	MTHO15	Advanced Solidification Processing	MTPC20	3
7.	MTHO16	Recent Developments in Welding Processes	MTPC21	3
8.	MTHO17	Recent Developments in Forming Processes	MTPC22	4
9.	MTHO17	Atomic Scale Modeling of Materials	Nil	3
10.	MTHO17	Metallurgy of Intermetallic Materials	Nil	4
11.	MTHO17	Phasefield Modelling	Nil	4

No.	Programme Educational Objectives (PEO)
I.	Choose their careers as practicing Metallurgical and Materials Engineers in traditional Metallurgical and Materials industries as well as in expanding areas of materials, environmental and energy-related industries.
II.	Engage in post-baccalaureate study and make timely progress toward an advanced degree in Metallurgical and Materials Engineering or a related technical discipline or business.
III.	Function effectively in the complex modern work environment with the ability to assume professional leadership roles.

No.	Programme Outcomes (PO)
PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustain ability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.