

Rayat Shikshan Sanstha's
**Karmaveer Bhaurao Patil,
College of Engineering, Satara.**

**An Autonomous Institute & Affiliated to DBATU Lonere
Accredited by NAAC with "B++" Grade**



**Two Years Master of Technology
in
Mechanical(Production) Engineering**

**Structure & Curriculum
(w.e.f. A.Y. 2026-27)
As Per NEP 2020
NCrF Level 7.0**

**Recommended in BOS (Mech) Meeting Dated: 19th June 2026
&
Approved in Academic Council Meeting Dated: 20th July 2026**


**Mrs. M.Y. Shinde
BOS Chairman (Mech)**


**Dr. S. J. Modi
Member Secretary
Academic Council**


**Dr. A. C. Attar
Principal**

Rayat Shikshan Sanstha's

**KARMAVEER BHAURAO PATIL
COLLEGE OF ENGINEERING, SATARA**

Accredited by NAAC with B++ Grade

(An Autonomous Institute and Affiliated to DBATU, Lonere)



**DEPARTMENT OF MECHANICAL
ENGINEERING**

STRUCTURE AND CURRICULUM

for

Master of Technology in

MECHANICAL-PRODUCTION ENGINEERING

(W. E. F. Academic Year 2026 - 2027)





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Vision of the Department

To be a centre of excellence in Mechanical Engineering education, innovation, and research by developing globally competent engineers capable of addressing industrial and societal challenges with ethical and sustainable solutions.

Mission of the Department

M1: To provide quality Mechanical Engineering education through effective teaching-learning processes, skill development, and experiential training for global employability and lifelong learning.

M2: To promote research, innovation, and interdisciplinary learning by establishing an atmosphere that is favourable to the development of knowledge and the progress of technology.

M3: To promote industry-institution collaboration for mutual development, entrepreneurship, consulting, and training.

M4: To nurture professional ethics, social responsibility, leadership, and sustainable practices among students, faculty, and staff for the betterment of society.

Programme Educational Objectives

PEO 1: Graduates will establish successful professional careers in Mechanical Engineering and allied domains by applying engineering knowledge, technical skills, and ethical practices to meet the evolving needs of industry and society.

PEO 2: Graduates will exhibit entrepreneurial mind-set, leadership qualities, and innovative thinking to develop sustainable engineering solutions and create value for industry and society.

PEO 3: Graduates will pursue higher studies, research, and continuous professional development to enhance their competencies and contribute to advancements in engineering and technology.

Programme Outcomes (POs)

The post-graduate students will demonstrate:

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the programme.

Programme Specific Outcomes

PSO 1: Apply Mechanical Engineering knowledge, modern engineering tools, and professional practices to understand, analyze, and effectively address challenges encountered in industrial environments.

PSO 2: Develop technically feasible, sustainable, and cost-effective solutions to engineering problems faced by manufacturing and allied industries, particularly small and medium enterprises (SMEs), thereby contributing to regional industrial and societal development.





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Programme Details

Particular	Details
Programme Name	M. Tech. in Mechanical-Production Engineering
Duration	2 Years
Number of Semesters	4
NCrF Level	Level 7
Total Credits	80 Credits
Curriculum Pattern	CBCS + OBE + NEP Framework
Mode	Full-Time
Structure	Theory + Practical + Seminar + Dissertation

Curriculum Framework

List of Abbreviations

Sr. No.	Abbreviation	Type of Course
1	PCC	Programme Core Course
2	PEC	Programme Elective Course
3	RM	Research Methodology
4	RS	Research Seminar
5	DP	Dissertation Phase



**M.Tech. (Mechanical-Production Engineering)**

(For Autonomous Engineering Institutes as per NEP 2020, UGC CCFPG, AICTE Model Curriculum and CBCS Framework)

The Curriculum and Credit Framework for the Postgraduate Programme shall consist of a two-year (four-semester) M.Tech. Programme with a total credit requirement of 80 credits

Credit Distribution for M.Tech. Programme

Sr. No.	Curriculum Component	Category	Percentage	Credits
1	Program Core Courses (PCC)	Course Work (58.75%)	33.75%	27
2	Program Elective Courses (PEC)		17.5%	14
3	Laboratory Courses (PCC)		2.5%	02
4	Research Methodology (RM)		5.0%	04
5	Dissertation Phase-I (DP)-I	Research (41.25%)	13.75%	11
6	Dissertation Phase-II (DP)-II		25%	20
7	Research Seminar (RS)		2.5%	02
Total Credits			100%	80

Semester-Wise Credit Structure

Semester	Components	Credits
Semester I	Core Courses + Labs	20
Semester II	Core Courses + Labs + Programme Electives	19
Semester III	Programme Elective + Dissertation Phase-I + Seminar	21
Semester IV	Dissertation Phase-II	20
	Total	80





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Credit Norms (as per UGC/AICTE Practices)

Activity	Credit Norm
1 Hour Theory / Week	1 Credit
2 Hours Laboratory / Week	1 Credit
1 Hours Tutorial	1 Credit

UGC's revised PG curriculum framework under NEP 2020 recommends flexible and research- oriented postgraduate programmes and an approximate **80-credit structure for a 2-year PG degree**.

Evaluation Scheme

For Theory Courses

Component	Weightage
Continuous Assessment	10%
Mid Semester Examination	30%
End Semester Examination	60%

For Laboratory Courses

Component	Weightage
Continuous Assessment	60%
End Semester Examination	40%

Other Courses

Component	Weightage
Seminar / Presentation / Viva Voce	As per the course structure
Dissertation Evaluation	Internal + External Assessment





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

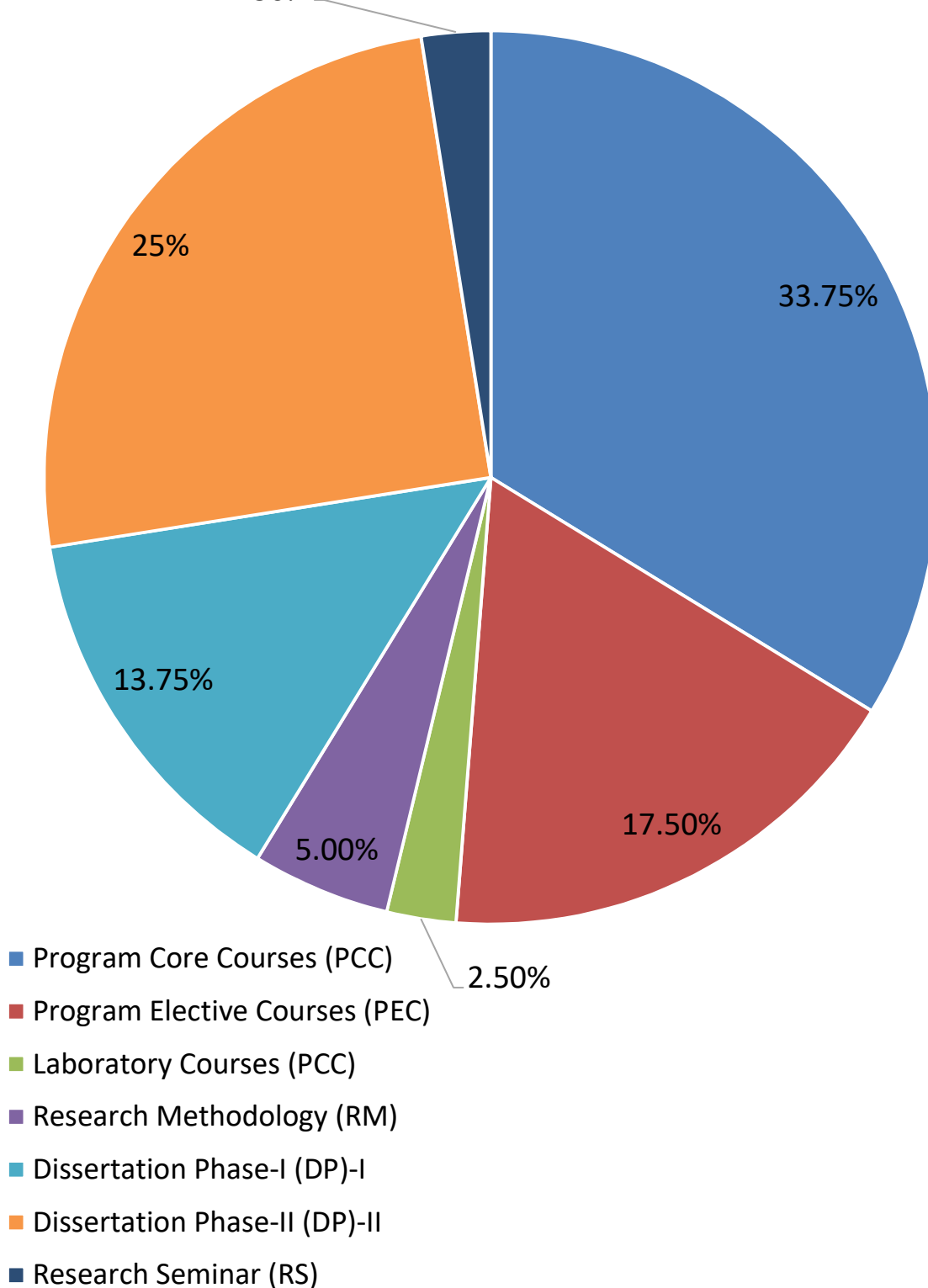
Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Credit Distribution Chart





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Semester-I (w.e.f. 2026-27)

Sr. No.	Course Category	Course Code	Course Name	Teaching Scheme (Weekly Hour)				Cr	Evaluation Scheme (Weightage in Marks)			
				L	T	P	S		ISE	MSE	ESE /POE	Total
1	Programme Core Course (PCC)	26205PCC101	Additive Manufacturing	3	-	-	1	3	10	30	60	100
2		26205PCC102	Advanced Materials and Processing	3	-	-	-	3	10	30	60	100
3		26205PCC103	Lasers in Manufacturing	3	-	-	-	3	10	30	60	100
4		26205PCC104	Sustainable Manufacturing	3	-	-	-	3	10	30	60	100
5		26205PCC105	Abrasive Machining and Finishing Processes	3	-	-	-	3	10	30	60	100
6		26205PCC106L	CAD/CAM/CAE Laboratory	-	-	2	-	1	60	-	40	100
7	Research Methodology (RM)	26205RM107	Research Methodology	4	-	-	1	4	10	30	60	100
			Total	19	-	2	2	20	120	180	400	700

Legends: L-Lecture, T-Tutorial, P-Practical, Cr-Credits S-Self Study

- | | |
|---------------------------------------|--|
| - Total Contact Hours/Week: 21 | - Total Credits:20 |
| - ISE: In Semester Evaluation | - ESE: End Semester Examination |





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Semester-II (w.e.f. 2026-27)

Sr. No	Course Category	Course Code	Course Name	Teaching Scheme (Weekly Hour)				Cr	Evaluation Scheme (Weightage in Marks)			
				L	T	P	S		ISE	MSE	ESE /POE	Total
1	Programme Core Course (PCC)	26205PCC201	Non-Conventional Machining	3	-	-	-	3	10	30	60	100
2		26205PCC202	Advanced Joining Technology	3	-	-	1	3	10	30	60	100
3		26205PCC203	Lean Manufacturing and Six Sigma	3	-	-	1	3	10	30	60	100
4		26205PCC204	Composite Materials	3	-	-	-	3	10	30	60	100
5		26205PCC205L	Advanced Manufacturing Practices Lab	-	-	2	-	1	60	-	40	100
6	Programme Elective Course (PEC)	26205PEC206A	Programme Elective-I	3	-	-	-	3	10	30	60	100
		26205PEC206B										
		26205PEC206C										
7		26205PEC207A	Programme Elective-II	3	-	-	-	3	10	30	60	100
		26205PEC207B										
		26205PEC207C										
			Total	18	-	2	2	19	120	180	400	700

Legends: L-Lecture, T-Tutorial, P-Practical, Cr-Credits S-Self Study

- Total Contact Hours/Week: 20	- Cumulative Credits:20+19=39
- ISE: In Semester Evaluation	- ESE: End Semester Examination

Programme Elective-I			Programme Elective-II		
Sr. No	Course Code	Course Title	Sr. No	Course Code	Course Name
1	26205PEC206A	Material Characterization Techniques	1	26205PEC207A	MEMS and Fabrication of Smart Materials
2	26205PEC206B	Surface Engineering	2	26205PEC207B	Finite Element Methods
3	26205PEC206C	Robotics And Automation	3	26205PEC207C	Design of Experiments





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Semester-III (w.e.f. 2027-28)

Sr No	Course Category	Course Code	Course Name	Teaching Scheme (Weekly Hour)				Cr	Evaluation Scheme (Weightage in Marks)			
				L	T	P	S		ISE	MSE	ESE /POE	Total
1	Programme Elective Course (PEC)**	27205PEC301A	Program Elective Course- III (Online)	4	-	-	-	4	-	-	100	100
		27205PEC301B										
		27205PEC301C										
2	Programme Elective Course (PEC)**	27205PEC302A	Program Elective Course- IV (Online)	4	-	-	-	4	-	-	100	100
		27205PEC302B										
		27205PEC302C										
3	Research	27205RS303	Research Seminar	-	-	4	-	2	60	-	40	100
4		27205DP304	Dissertation Phase-I	-	-	22	-	11	60	-	40	100
			Total	8	-	26	-	21	120	-	280	400

Legends: L-Lecture, T-Tutorial, P-Practical, Cr-Credits S-Self Study

**** Note: 100% ESE of 3 hours or credit transfer**

- Total Contact Hours/Week: 34	- Cumulative Credits:39+21=60
- ISE: In Semester Evaluation	-ESE: End Semester Examination

Course list: <https://nptel.ac.in/courses> (June - Dec Slot)

Note: At that time, whoever is available should be chosen.

Tentative List of PEC-III & IV

Programme Elective-III		
Sr. No	Course Code	Course Title
1	27205PEC301A	Laser-Assisted Measurements and Micro Manufacturing, IIT Indore https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me111
2	27205PEC301B	Automation In Manufacturing, IIT Guwahati https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_me139
3	27205PEC301C	Industrial Engineering and Operations Research - IIT Guwahati https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me193

Programme Elective-IV		
Sr. No	Course Code	Course Title
1	27205PEC302A	Fundamentals of Casting and Solidification, IIT Kanpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me107
2	27205PEC302B	Industrial Robotics: Theories for Implementation, IIT-ISM Dhanbad https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me167
3	27205PEC303C	Applied Numerical Methods, IIT Kanpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me153

Note: The NPTEL/SWAYAM courses mentioned in the curriculum are subject to change, as the course offerings are revised periodically by NPTEL/SWAYAM. The course selected by the student shall depend on the availability of the relevant course in the NPTEL/SWAYAM course list published during the respective academic session.





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

****Note for Program Elective Course**

The Programme Elective Course offered in Semester–III of the M.Tech. programme shall be mandatorily completed through the SWAYAM/NPTEL platform. Every student shall enroll in and successfully complete an approved SWAYAM/NPTEL course from the respective Programme Elective basket.

1. **Enrollment in an approved SWAYAM/NPTEL course is mandatory for all students.** The selected course shall be from the respective **Programme Elective (PEC)** basket as notified by the Department.
2. Since **Massive Open Online Course-I & II** carries **04 credits**, the selected **SWAYAM/NPTEL course must be of a minimum duration of 12 weeks only.**
3. **Submission and successful completion of all SWAYAM/NPTEL assignments is mandatory** and shall be considered for the **Internal Semester Evaluation (ISE).**
4. **Students shall appear for the SWAYAM/NPTEL proctored examination and submit the Course Completion Certificate/Grade Card** issued by SWAYAM/NPTEL after successfully completing the course.
5. **Successful completion of the prescribed SWAYAM/NPTEL course is mandatory** for fulfilling the Massive Online Courses (Program Electives) requirement and earning the associated academic credits.
6. **The department reserves the right to approve the list of eligible SWAYAM/NPTEL courses** and issue detailed guidelines regarding **enrollment, assessment, and credit transfer** from time to time.





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Semester-IV (w.e.f. 2027-28)

Sr No	Course Category	Course Code	Course Name	Teaching Scheme (Weekly Hour)				Cr	Evaluation Scheme (Weightage in Marks)			
				L	T	P	S		ISE	MSE	ESE /POE	Total
1	Research	27205DP401	Dissertation Phase-II ***	-	-	40		20	120	-	80	200
			Total	-	-	40		20	120	-	80	200

Legends: L-Lecture, T-Tutorial, P-Practical, Cr-Credits S-Self Study

- Total Contact Hours/Week: 40	- Cumulative Credits: 60+20=80
- ISE: In Semester Evaluation	-ESE: End Semester Examination

*****Research Publication / Intellectual Property Requirement**

As a part of the **M.Tech. (Mechanical-Production Engineering)** programme, every student shall mandatorily fulfill any one of Clauses 1 to 3, based on the research work carried out under the guidance of the Research Guide.

Fulfill any one of the following:

1) Publish One research papers in blind peer-reviewed journals approved by the Research Guide.

OR

2) Publish One research paper in reputed conference proceedings or publications of IEEE / Springer / CRC Press / Science Direct (Elsevier) / ASCE / ASME.

OR

3) Publish and Grant one patent based on the research work carried out during the programme.

Note: Award of the M.Tech. degree shall be subject to the successful fulfillment of any one of the mandatory publication requirements specified in **Clauses 1 to 3**.





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

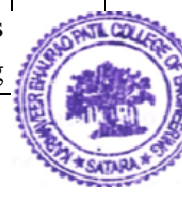
Course: F. Y. M.Tech.	Semester: I	L	T	P	Credits
Course Code: 26205PCC101	Course Name: Additive Manufacturing	3	-	-	3

Course Outcomes: At the end of the course, students will be able to

CO	Statement	BL
CO1	Explain Additive Manufacturing fundamentals, classifications, materials and applications	1
CO2	Analyze geometric modeling and reverse engineering processes	3
CO3	Analyze liquid-based and solid-based AM systems	3
CO4	Evaluate powder-based AM technologies for engineering applications	3
CO5	Apply AM techniques in rapid casting and biomedical applications	4
CO6	Design and optimize products using Design for Additive Manufacturing (DfAM) principles	4

Prerequisites: None

Unit No.	Description	Hrs.
1	Introduction to Additive Manufacturing: Introduction Overview- Historical Development - Need - Classification - Additive Manufacturing Technology in product development - Materials for Additive Manufacturing Technology - Traditional v/s Additive Manufacturing - Tooling - Benefits and Applications.	6
2	Geometric Model & Reverse Engineering for Additive Manufacturing: Basic Concept - Digitization Techniques - Model Reconstruction - Data Processing for Additive Manufacturing Technology, CAD model preparation - Interface Formats - Part Orientation and support generation - Model Slicing - Tool path generation - Software for Additive Manufacturing Technology: RP software.	7
3	Liquid Based and Solid Based Additive Manufacturing Systems: Classification - Liquid based system - Stereolithography Apparatus (SLA) - Principle, process, advantages and applications - Solid based system - Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing.	7
4	Powder Based Additive Manufacturing Systems: Selective Laser Sintering (SLS) - Principle, process, advantages and applications - Three-Dimensional Printing - Principle, process, advantages and applications - Laser Engineered Net Shaping (LENS), Electron Beam Melting - Shape deposition manufacturing, Laser deposition, Lamination, Electro-optical sintering.	7
5	Rapid Casting and Bio-Additive Manufacturing: Rapid Casting and Segmental Object Manufacturing, Visible Slicing Implementation Rapid casting using wax patterns, acrylic patterns, dense polystyrene patterns - Expanded polystyrene process - Rapid manufacturing of metallic objects. Medical and Bio-Additive Manufacturing	6





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Unit No.	Description	Hrs.
	Customized implants and prosthesis, Design and production, Bio-Additive Manufacturing - Computer Aided Tissue Engineering (CATE) - Case Studies.	
6	Design for Additive Manufacturing (DfAM): Need for DfAM, General Guidelines for DfAM, Design to Minimize Print Time, Design to Minimize Post-processing, Design Guidelines for Part Consolidation, DfAM Guidelines for AM Tooling Design, Design for Improved Functionality, Design for Minimal Material Usage, Lattice Structures in AM, Generative Design and AM, Topology Optimization for AM, Polymer AM Design Guidelines, Metal AM Design Guidelines, Modelling and Optimization of AM Processes, Guidelines for AM Process Selection.	7

Text / Reference Books:

1. Chua C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gephardt A., "Rapid Prototyping", Hanser Gardener Publications, 2003.
3. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
3. C. P. Paul, A. N. Jinoop, Additive Manufacturing- Principles, Technologies and Applications, 1st Edition, 2021, McGraw Hill
4. A Practical Guide to Design for Additive Manufacturing, Diegel, Olaf, Axel Nordin, and Damien Motte, Springer, 2020.
5. Additive Manufacturing Technologies, Ian Gibson, David Rosen, Brent Stucker, and Mahyar Khorasani, 3rd Edition, Springer, 2021.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	-		
CO2	2	2	1	1	1
CO3	2	2	-	1	1
CO4	2	2	2	1	
CO5	2	2	2	1	1
CO6	2	2	2	1	1





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: I	L	T	P	Credits
Course Code: 26205PCC102	Course Name: Advanced Materials and Processing	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO1	Analyze the structure, properties, and performance of advanced engineering materials for various applications
CO2	Evaluate advanced processing techniques for metals, polymers, ceramics, and composites.
CO3	Apply material characterization techniques to investigate microstructural and functional properties of advanced materials
CO4	Analyze the behavior and applications of nanomaterials, smart materials, and biomaterials in engineering systems
CO5	Select suitable materials and processing routes for specific engineering applications considering performance, cost, and sustainability
CO6	Design innovative material-processing solutions for advanced manufacturing and research applications

Prerequisites: -

Unit No.	Description	Hrs.
1	Advanced Engineering Materials: Structure-property relationships, High-strength low-alloy steels, Superalloys, Titanium and magnesium alloys, Intermetallics and shape memory alloys, Functional materials and emerging materials	7
2	Advanced Processing of Materials: Rapid solidification processing, Powder metallurgy and advanced sintering techniques, Spray forming and metal injection molding, Severe plastic deformation, Additive manufacturing of metallic materials, Near-net-shape manufacturing	7
3	Advanced Ceramics and Polymer Processing: Engineering ceramics and glass ceramics, Ceramic forming and sintering processes, High-performance polymers, Thermoplastic and thermosetting processing, Polymer blends and polymer composites, Processing challenges and applications.	7
4	Composite Materials and Smart Materials: Metal matrix composites (MMC), Polymer matrix composites (PMC), Ceramic matrix composites (CMC), Fabrication techniques of composites, Smart materials and structures, Piezoelectric, magnetostrictive, and shape memory materials.	7
5	Nanomaterials and Material Characterization: Classification and synthesis of nanomaterials, Top-down and bottom-up approaches, Carbon nanotubes, graphene, and quantum dots, Characterization techniques: XRD, SEM, TEM, AFM, DSC/TGA, Microstructural analysis	6





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Unit No.	Description	Hrs.
6	Sustainable Materials and Advanced Applications: Green materials and sustainable processing, Recycling and circular economy, Materials selection methodologies, Biomaterials and biomedical applications, Materials for aerospace, automotive, and energy sectors, Recent trends in advanced materials and Industry 4.0	6

Text Books:

1. Callister, William D., Jr., and Rethwisch, David G. *Materials Science and Engineering: An Introduction*, 10th Edition, Wiley, 2018.
2. Francis, Lorraine F. *Materials Processing: A Unified Approach to Processing of Metals, Ceramics and Polymers*, Academic Press, 2015.
3. Kalpakjian, Serope, and Schmid, Steven R. *Manufacturing Engineering and Technology*, 8th Edition, Pearson, 2020.
4. Poole, Charles P., Jr., and Owens, Frank J. *Introduction to Nanotechnology*, Wiley-Interscience, 2003.
5. Chawla, Krishan K. *Composite Materials: Science and Engineering*, 3rd Edition, Springer, 2012.
6. Gandhi, M. V., and Thompson, B. S. *Smart Materials and Structures*, Springer, 1992.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	3	2		
CO2	3	3	2	1	
CO3	2	3	-		1
CO4	3	3	2		
CO5	2	3	3	1	1
CO6	2	3	3	1	1





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: I	L	T	P	Credits
Course Code: 26205PCC103	Course: Lasers in Manufacturing	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain the need and significance of Laser in manufacturing processes	2
CO2	Explain the mechanism of laser welding process	2
CO3	Explain the mechanism of surface modification using laser	2
CO4	Explain the additive manufacturing technique by using laser	2
CO5	Explain the laser assisted machining	2
CO6	Apply laser material processing methods	4

Prerequisites: -

Unit No.	Description	Hrs.
1	Lasers in manufacturing: Importance and application, Fundamentals of Laser Technology, Laser system: Construction and types, Principle of operation, Types of laser cutting and kerf geometry, Types of Lasers in material removal, process and performance parameters	7
2	Mechanisms of laser welding, effects of process parameters during laser welding and study of defects in weld beads, Material forming and fundamental of laser forming, process parameters and their effects on the performance of laser forming	7
3	Surface treatment and applications of lasers, laser surface hardening, laser surface alloying, Laser cladding	7
4	Additive manufacturing techniques, Laser scanning stereolithography, selective laser sintering and selective laser melting, process and performance parameters of laser based additive manufacturing techniques	7
5	Lasers in manufacturing automation, CNC for laser-based manufacturing, CAD for laser-based manufacturing, Laser assisted material forming, effect of coatings, 3D laser forming and micro forming.	6
6	Laser Material Processing Applications; process characteristics, mode of material removal: Laser Cutting and Drilling; Laser Surface Modifications; Laser Additive Manufacturing; Laser shock peening; Laser Etching and Paint Stripping; LCVD and LPVD; Laser hybrid machining	6





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Reference Books:

1. Steen, W. M., Laser Material Processing, Springer-Verlag, London, 2005.
2. Dahotre, N. and Samant, A., Laser Machining of Advanced Materials, CRC Press, London, 2015.
3. Joshi, S. N. and Dixit, U. S., Laser Based Manufacturing, Springer India, 2015.
4. Sugioka, K., Meunier, M., and Piqué, A., Laser Precision Microfabrication, Springer-Verlag, Berlin, Heidelberg, 2010.
5. Ion, J. C., Laser Processing of Engineering Materials, Elsevier, 2005
6. Laser Material Processing By W. M. Steen and J. Mazumder, Springer, 4th Ed. 2010

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	1			1	
CO2	1			1	
CO3	1			1	1
CO4	1			1	1
CO5	1	1	2	1	2
CO6	1	2	2	1	2





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Course: F. Y. M. Tech.	Semester: I	L	T	P	Credits
Course Code: 26205PCC104	Course Name: Sustainable Manufacturing	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain the principles and significance of sustainable manufacturing.	1
CO2	Apply life cycle assessment and sustainability evaluation tools for products and processes.	3
CO3	Analyze and select green manufacturing technologies and resource-efficient processes.	4
CO4	Implement lean and energy-efficient practices for sustainable operations.	3
CO5	Apply circular economy concepts, waste management techniques, and sustainable supply chain practices.	3
CO6	Evaluate smart manufacturing solutions and Industry 4.0 technologies for sustainable manufacturing systems.	4

Prerequisites: Concepts in Manufacturing Processes, Production and Operations Management, Industrial Engineering, Engineering Materials, Environmental Science.

Unit No.	Description	Hrs.
1	Fundamentals of Sustainable Manufacturing: Introduction to sustainability and sustainable development; Triple Bottom Line (Economic, Environmental and Social Sustainability); Evolution and need of sustainable manufacturing; Manufacturing systems and sustainability challenges; Global sustainability initiatives; Sustainable Development Goals (SDGs); Green manufacturing, clean manufacturing, eco-manufacturing and sustainable manufacturing; Sustainability metrics and indicators; Regulatory and policy frameworks.	7
2	Sustainable Product Design and Life Cycle Assessment: Sustainable product development; Design for Environment (DfE); Design for Sustainability (DfS); Eco-design principles; Product life cycle stages; Life Cycle Assessment (LCA) methodology; Goal and scope definition; Life Cycle Inventory (LCI); Life Cycle Impact Assessment (LCIA); Interpretation of LCA results; Carbon footprint and environmental footprint assessment; Case studies.	7
3	Green Manufacturing Technologies and Resource Efficiency: Green manufacturing concepts and methodologies; Environmentally conscious manufacturing; Green machining and eco-friendly cutting fluids; Dry and near-dry machining; Cryogenic machining; Resource-efficient manufacturing; Material selection for sustainability; Energy and material flow analysis; Exergy analysis; Sustainable process planning; Environmental performance metrics.	7





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Unit No.	Description	Hrs.
4	Lean Manufacturing, Energy Management and Sustainable Operations: Lean manufacturing principles; Value stream mapping; Waste identification and elimination; Lean-green integration; Energy consumption in manufacturing systems; Energy auditing; Renewable energy applications in manufacturing; Sustainable facility planning; Green productivity; Sustainable operations management; Industrial case studies.	7
5	Waste Management and Sustainable Supply Chain: Industrial waste generation and characterization; Waste minimization strategies; 3R, 6R and circular economy concepts; Recycling, remanufacturing, refurbishment and recovery; End-of-life product management; Extended Producer Responsibility (EPR); Green logistics; Sustainable packaging; Green supply chain management; Sustainability reporting and eco-labels.	6
6	Smart and Sustainable Manufacturing Systems: Industry 4.0 and sustainability; Smart factories and digital manufacturing; Internet of Things (IoT) in sustainable manufacturing; Digital twins and simulation for sustainability assessment; Sustainable manufacturing performance indicators; Sustainability assessment frameworks; ESG concepts in manufacturing industries; Emerging trends and future directions; Industrial case studies.	6

Text Books:

1. Davim, J. P., *Sustainable Manufacturing*, Wiley, 2010.
2. Dornfeld, D. A., *Green Manufacturing: Fundamentals and Applications*, Springer, 2012.

Reference Books:

1. Ibrahim Garbie, *Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0*, Springer, 2016.
2. Günther Seliger, *Sustainable Manufacturing: Shaping Global Value Creation*, Springer, 2012.
3. Ashby, M. F., *Materials and the Environment: Eco-Informed Material Choice*, Elsevier, 2012.
4. David R. Hillis and J. Barry DuVall, *Improving Profitability Through Green Manufacturing*, Wiley, 2012.
5. Günther Seliger, Marwan M. K. Khraisheh and I. S. Jawahir, *Advances in Sustainable Manufacturing*, Springer, 2011.

CO-PO Matrix

	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
Course Outcome	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	3	2	-	3	1
CO2	3	3	2	2	2
CO3	3	3	3	3	3
CO4	2	3	3	3	3
CO5	2	2	3	3	2
CO6	2	2	2	2	3





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Course: F.Y. M.Tech.	Semester: I	L	T	P	Credits
Course Code: 26205PCC105	Course Name: Abrasive Machining and Finishing Processes	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Analyze abrasive materials, wheel structures, and grinding wheel specifications for different machining applications.	4
CO2	Evaluate grinding mechanics, wheel wear mechanisms, thermal effects, and process stability in abrasive machining.	4
CO3	Apply analytical and experimental approaches for process modeling, optimization, and performance evaluation of grinding operations.	4
CO4	Assess precision finishing processes such as honing, lapping, polishing, and superfinishing for ultra-high surface quality applications.	3
CO5	Investigate advanced abrasive machining processes and their suitability for difficult-to-machine materials.	3
CO6	Design and optimize abrasive machining and finishing systems considering productivity, sustainability, and surface integrity requirements.	4

Prerequisites: Undergraduate-level knowledge of Manufacturing Processes, Machine Tools, Materials Engineering, Mechanics of Machining, Metrology and Quality Control, and basic Engineering Mathematics/Statistics. Familiarity with CNC machining and manufacturing automation will be advantageous.

Unit No.	Description	Hrs.
1	Abrasive Materials and Grinding Wheel Technology: Evolution and scope of abrasive machining, Conventional abrasives: Aluminum oxide, Silicon carbide, Super abrasives: Diamond and Cubic Boron Nitride (CBN), Abrasive grain characteristics and selection, Grinding wheel constituents and wheel structures, Bonding systems and wheel manufacturing, Grinding wheel specifications and standards, Selection of grinding wheels for advanced engineering materials	7
2	Grinding Mechanics and Process Modeling: Grinding kinematics and mechanics, Chip formation in grinding, Grain-workpiece interaction, Grinding forces and specific energy, Material removal mechanisms, Grinding temperature and thermal damage, Surface generation mechanisms, Grinding process modelling, Numerical and analytical approaches in grinding analysis	7
3	Grinding Performance, Surface Integrity and Process Optimization: Surface roughness and topography generation, Grinding wheel wear mechanisms, Wheel loading, glazing, and wear monitoring, Dressing and truing technologies, Grinding fluids and sustainable lubrication techniques, Surface integrity and residual stresses, Dimensional accuracy and process capability, Statistical methods in grinding	7





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Unit No.	Description	Hrs.
	optimization, Case studies in industrial grinding operations	
4	Precision Finishing and Superfinishing Processes: Fundamentals of precision finishing, Honing process: mechanics, tooling, and applications, Lapping process and slurry characteristics, Single-side and double-side lapping, Polishing mechanisms and abrasive media, Chemical Mechanical Polishing (CMP), Superfinishing and micro-finishing technologies, Surface characterization techniques, Applications in aerospace, biomedical, and semiconductor industries	7
5	Advanced Abrasive Machining Processes: Abrasive Jet Machining (AJM), Ultrasonic Machining (USM), Abrasive Water Jet Machining (AWJM), Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magnetorheological Finishing (MRF), Elastic Emission Machining (EEM), Process capabilities and limitations, Comparative performance analysis	6
6	Hybrid Abrasive Machining and Emerging Trends: Hybrid machining concepts, Rotary Ultrasonic Grinding, Electrochemical Grinding (ECG), Electrolytic In-Process Dressing (ELID) Grinding, Laser-Assisted Grinding, Ultrasonic-Assisted Grinding, Sustainable and green abrasive machining, Industry 4.0, AI-based monitoring, digital twins, and future trends in abrasive machining	6

Text Books:

1. Grinding Technology: Theory and Applications of Machining with Abrasives by Stephen Malkin,
2. Changsheng Guo, Industrial Press Inc., New York
3. Advanced Machining Processes by V.K. Jain, Allied Publishers Pvt. Ltd.
4. Modern Machining Processes, by P.C. Pandey, H.S. Shan, Tata McGraw-Hill Education

Reference Books:

- a. Handbook of Machining with Grinding Wheels by Ioan D. Marinescu, Mike Hitchiner, Eckart Uhlmann, W. Brian Rowe, Ichiro Inasaki, CRC Press
- b. Principles of Modern Grinding Technology, W. Brian Row, William Andrew (Elsevier)
- c. Nontraditional Manufacturing Processes, by Gary F. Benedict, Marcel Dekker Inc.

CO-PO Matrix

Course Outcome	PO1	PO2	PO3
CO1	2	1	3
CO2	2	1	3
CO3	3	2	3
CO4	2	1	3
CO5	3	2	3
CO6	3	2	3





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: I	L	T	P	Credits
Course Code: 26205PCC106L	Course Name: CAD/CAM/CAE Laboratory	-	-	2	1

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Apply CAD software tools to create solid models of structural and machine components.	3
CO2	Develop and assemble mechanical components using modeling software.	3
CO3	Analyze component properties such as mass, volume, and center of gravity.	4
CO4	Apply CAM software for generation and simulation of CNC turning and milling operations.	3
CO5	Analyze and interpret results of structural, thermal, dynamic, and modal analyses.	4

Prerequisites: None

Perform the following experiments (Any Ten)

- Experiment No.1: Generation and preparation of STL models from CAD geometry for additive manufacturing using any software (Ultimaker Cura, Pronterface etc.)
- Experiment No. 2: Solid modeling of structural components using modeling software.
- Experiment No. 3: Solid modeling of machine components using modeling software.
- Experiment No. 4: Develop assembly of a given product using modeling software.
- Experiment No. 5: Modeling of component and determination of mass properties.
- Experiment No. 6: Drafting of parts OR assembly using any one of the CAD software.
- Experiment No. 7: Demonstration of multi axes CNC machining process.
- Experiment No.8: Generation and simulation of CNC turning operation using computer aided part programming CAM software.
- Experiment No.9: Generation and simulation of CNC milling operation using computer aided part programming CAM software.
- Experiment No. 10: Static Structural Analysis of machine components using ANSYS, LSDyna etc. software.
- Experiment No. 11: Dynamic Analysis of machine components using ANSYS, LSDyna etc. software.
- Experiment No. 12: Thermal Analysis of machine components using CAE Software.
- Experiment No. 13: Modal Analysis of machine components using CAE Software.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	-	1	1
CO2	2	3	2	1	1
CO3	2	2	-	1	1
CO4	2	2	2	1	1
CO5	2	2	2	1	1





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: I	L	T	P	Credits
Course Code: 26205RM107	Course Name: Research Methodology	4	-	-	4

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Understand the fundamentals, objectives, and significance of research and identify various types of research methodologies.	1
CO2	Formulate research problems, define research objectives, and conduct an effective literature review using appropriate sources.	2
CO3	Design and plan research studies by selecting suitable research methods, sampling techniques, and data collection tools.	3
CO4	Apply statistical and analytical techniques for data processing, interpretation, and validation of research findings.	4
CO5	Utilize modern research tools, software, and ethical practices in conducting scientific and engineering research.	3
CO6	Prepare and present technical reports, research papers, dissertations, and project proposals following standard academic and professional guidelines.	4

Prerequisites: -

Unit No.	Description	Hrs.
1	Unit 1: Research Methodology : Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, an illustration.	6
2	Unit 2: Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.	7
3	Unit 3 Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Techniques, Multidimensional Scaling, Deciding the Scale. Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method	6





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Unit No.	Description	Hrs.
4	Unit 4 Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi-Square Tests.	7
5	Unit 5 Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Report	6
6	Unit 6 Research Ethics, IPR and Publication: Research ethics and ethical issues, Plagiarism and plagiarism detection tools, Intellectual Property Rights (IPR), Patents, copyrights, trademarks, Research paper writing and publication process, Journal selection, indexing (Scopus, SCI, WoS), Citation styles and reference management tools (Mendeley, Zotero, EndNote)	7

References:

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018.
2. Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), Ranjit Kumar, SAGE Publications, 3rd Edition, 2011.
3. Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
4. Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	-		
CO2	2	3	2		
CO3	2	2	3		
CO4	2	3	2		
CO5	-	-	1		
CO6	1	1	1		





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Semester: II

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PCC201	Course Name: Non-Conventional Machining	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain the non-conventional mechanical processes	2
CO2	Describe the abrasive finishing processes	2
CO3	Explain the chemical non-conventional machining processes	2
CO4	Explain the non-conventional machining processes based on thermal energy	2
CO5	Describe the non-conventional machining processes based on electrical energy	3
CO6	Analyze non-conventional forming and powder metallurgy processes.	4

Prerequisites: None

Unit No.	Description	Hrs.
1	Mechanical Processes: Ultrasonic Machining -Water Jet Machining -Abrasive Jet Machining -Abrasive Water Jet Machining -Ice Jet Machining	6
2	Non-conventional finishing processes: Abrasive flow finishing (AFF), Magnetorheological finishing (MRF), Magnetic Abrasive Finishing, Electro chemical grinding, working principle, merits, demerits and applications.	7
3	Chemical and Electrochemical Processes: Chemical Milling -Photochemical Milling -Electropolishing -Electrochemical Machining -Electrochemical Drilling - Shaped Tube Electrolytic Machining –working principle, merits, demerits and applications.	7
4	Thermal Processes: Electric Discharge Machining -Laser Beam Machining -Electron Beam Machining -Plasma Beam Machining -Ion Beam Machining –working principle, merits, demerits and applications.	7
5	Hybrid Processes: Electrochemical Grinding, Honing, Superfinishing and Buffing -Ultrasonic Assisted ECM –Electro erosion Dissolution Machining -Abrasive Electro discharge Machining -EDM with Ultrasonic Assistance -Laser Assisted Machining –working principle, merits, demerits and applications	6
6	Non-Conventional Forming Processes: Explosive forming, electro hydraulic forming, magnetic pulse forming, superplastic forming, rubber forming, flow forming -Principles and process parameters-Advantages, Limitations and Applications. Overview of powder metal forming technique-Advantages-applications-Powder perform forging-Hot and cold Isostatic pressing powder rolling-Tooling and process parameters.	6





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Text / Reference Books:

1. Bhattacharya "Metal Cutting Theory and Practice", New Central Book Agency (p) Ltd., Calcutta 1984.
2. Boothroyd .D.G. and Knight. W.A "Fundamentals of Machining and Machine tools", Marcel Dekker, New York, 1989.
3. Hassan Abdel –Gawad El-Hofy "Advanced Machining Processes", McGraw, New York, 2005.
4. Jain, V.K "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2007.
5. Kalpakjian, S "Manufacturing Process for Engineering Materials", MA:Addison-Wesley, 1997.
6. Brown, J "Advanced Machining Technology Handbook", New York: McGraw-Hill, 1998.
7. Xichun Luo and Yi Qin "Hybrid Machining: Theory, Methods, and Case Studies", Academic press, 2018.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	1	-	3	1	
CO2	2	-	3	1	
CO3	3	-	3	1	
CO4	3	1	3	1	
CO5	3	1	3	1	
CO6	3	2	3	1	





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PCC202	Course Name: Advanced Joining Technology	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Select the appropriate welding process for the application	2
CO2	Select the appropriate input parameters for enhancing weld quality	2
CO3	Describe the melted and heat affected zone of a metal	2
CO4	Describe the welding defects	3
CO5	Analyze the stresses in welding structures	4
CO6	Understand and analyze underwater and space welding processes and their challenges.	2

Prerequisites: -

Unit No.	Description	Hrs.
1	Welding processes classification, arc welding processes-solid state welding processes, plasma arc welding and ultrasonic welding -Resistance welding process-different types weld joints, welding positions. Brazing, soldering and adhesive bonding, process principles & applications.	6
2	Electron beam welding -Laser beam welding -Hybrid welding -CMT welding – Spin Arc GMAW –Tandem GMAW -Activated TIG welding-Hot wire TIG welding-Diffusion bonding -Weld Surfacing & cladding.	7
3	Friction Surfacing, Friction stir spot welding, Explosive Welding, Welding of Al and Mg based alloys -Dissimilar welding of Non-ferrous alloys -Friction welding with Cu interlayer.	7
4	Magnetically impelled arc butt (MIAB) welding -Under water welding -Welding of Cu, Al, Ti and Ni alloys –Dissimilar welding of ferrous alloys -processes, difficulties, microstructures, defects and remedial measures -Hydrogen embrittlement –Lamellar tearing –Residual stress –Distortion and its control.	7
5	Heat transfer and solidification -Analysis of stresses in welded structures –Pre and post welding heat treatments –Weld joint design –Welding defects- Inspection & testing of weld joints -Safety aspects in welding. Thermit Welding: Basic principle, thermit mixtures, pressure thermit welding, applications.	7
6	Underwater Welding: Introduction, problems encountered in underwater welding, types of underwater welding, Processes that can be applied for under water welding, applications of Underwater welding, introduction to underwater cutting process. Welding in space: Introduction, need of space welding, problems encountered in space welding. Zero-gravity processes that can be applied to space welding.	6





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Textbooks:

1. Dr R. S. Parmer "Welding Processes and Technology" Khanna Publishers.
2. H.S.Bawa "Manufacturing Technology-I" Tata McGraw Hill Publishers New Delhi, 2007.
3. S.V.Nadkarni, Modern Arc Welding Technology, Oxford & IBH Publishing Co. Pvt. Ltd.
4. Cornu, J. Advanced welding systems –Volumes I, II and III, JAICO Publishers, 1994.
5. Lancaster, J. F. –Metallurgy of welding –George Allen & Unwin Publishers, 1980
6. Carry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
7. P .L. Jain "Principles of Foundry Technology" Tata McGraw-Hill Publishers.
8. S. V. Nadkarni, "Modern Arc Welding Technology, Oxford & IBH.
9. H. B. Cary, "Modern Arc Welding Technology", Englewood Cliffs, Prentice Hall.
10. Leonard P Connor, Welding Handbook, Volume 1-Jll, AWS.
11. Metals Handbook, Volume 6, American Society of Metals.
12. Dave Smith, "Welding skills and technology", McGraw-Hill

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	2	1	3	1	
CO2	2	1	3	1	1
CO3	3	2	3	1	2
CO4	2	1	3	1	
CO5	2	1	3	1	
CO6	3	2	3	1	2





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PCC203	Course Name: Lean Manufacturing and Six Sigma	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain Lean Manufacturing principles and identify different types of waste in manufacturing systems.	1
CO2	Apply Lean tools such as 5S, Kaizen, Visual Management, and Poka-Yoke for workplace organization and process improvement.	3
CO3	Analyze manufacturing processes using Value Stream Mapping, Kanban, and Just-In-Time techniques.	4
CO4	Describe Six Sigma methodology, process capability, and organizational roles for quality improvement.	2
CO5	Apply DMAIC methodology and statistical quality tools to solve manufacturing and service-related problems.	4
CO6	Integrate Lean and Six Sigma concepts to improve productivity, quality, and operational efficiency in industrial environments.	3

Unit No.	Description	Hrs.
1	Introduction to Lean Manufacturing: Evolution of Manufacturing Systems, Concept of Lean Manufacturing, Lean Philosophy and Principles, Value and Value Stream, Types of Manufacturing Waste (Muda, Mura, Muri), Benefits and Challenges of Lean Implementation	7
2	Lean Tools and Techniques: 5S Methodology, Kaizen and Continuous Improvement, Visual Management, Standardized Work, Poka-Yoke (Mistake Proofing), Cellular Manufacturing and Line Balancing	7
3	Value Stream Mapping and Just-In-Time : Value Stream Mapping (Current and Future State), Takt Time and Cycle Time, Pull Production System, Kanban System, Just-In-Time (JIT) Manufacturing, Inventory Reduction Techniques	7
4	Introduction to Six Sigma: Quality Concepts and Evolution, Fundamentals of Six Sigma, Sigma Levels and Process Capability, Roles and Responsibilities (Champion, Green Belt, Black Belt), Voice of Customer (VOC), Critical to Quality (CTQ) Characteristics	7
5	DMAIC Methodology and Statistical Tools: Define, Measure, Analyze, Improve, and Control (DMAIC), Process Mapping, Pareto Analysis, Cause-and-Effect Diagram, Histogram, Check Sheets and Control Charts, Basic Statistical Concepts	6
6	Lean Six Sigma Applications and Case Studies: Integration of Lean and Six Sigma, Lean Six Sigma Framework, Productivity Improvement Projects, Cost Reduction and Quality Enhancement, Industrial Case Studies, Emerging Trends in Lean Manufacturing and Industry 4.0	6





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Text Books:

1. Lean Thinking: Banish Waste and Create Wealth in Your Corporation – James P. Womack & Daniel T. Jones, Revised Edition, Simon & Schuster, New York.
2. The Lean Six Sigma Pocket Toolbook – Michael L. George, John Maxey, David Rowlands & Malcolm Upton, 1st Edition, McGraw-Hill Education.
3. Lean Six Sigma: Combining Six Sigma Quality with Lean Speed – Michael L. George, 1st Edition, McGraw-Hill Education.
4. The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer – Jeffrey K. Liker, 2nd Edition, McGraw-Hill Education.
5. Introduction to Statistical Quality Control – Douglas C. Montgomery, 8th Edition, John Wiley & Sons.
6. Design and Analysis of Experiments – Douglas C. Montgomery, 10th Edition, John Wiley & Sons.
7. Lean Production Simplified – Pascal Dennis, 3rd Edition, CRC Press / Productivity Press.
8. Juran's Quality Handbook – Joseph M. Juran & Joseph A. De Feo, 7th Edition, McGraw-Hill Education.
9. Operations Management – Nigel Slack, Stuart Chambers & Robert Johnston, 9th Edition, Pearson Education.
10. Lean Six Sigma for Service – Michael L. George, 1st Edition, McGraw-Hill Education.

Reference Books:

1. Venkatesh, V. C. and Izman, S. Precision Engineering, McGraw-Hill.
2. Dornfeld, D. and Min, S. Green Manufacturing: Fundamentals and Applications, Springer.
3. Micromachining of Engineering Materials Author: J. A. McGeough Publisher: CRC Press Useful for hybrid machining applications in precision and micro-manufacturing.
4. [5] Janocha, H. Actuators: Basics and Applications for MEMS and Smart Systems, Springer.

CO-PO Articulation Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	1	1	2
CO2	3	2	2	1	2
CO3	3	3	2	1	2
CO4	3	2	1	1	2
CO5	3	3	2	1	2
CO6	3	3	3	1	2





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PCC204	Course Name: Composite Materials	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain the fundamentals of composite materials, their constituents, classifications, and engineering applications.	1
CO2	Analyze the basic mechanical behavior of composite materials using rule of mixtures, laminate concepts, and failure mechanisms.	4
CO3	Select appropriate processing techniques for fabrication of Polymer Matrix Composites (PMCs) based on material and application requirements.	3
CO4	Describe the processing methods, characteristics, and applications of Metal Matrix Composites (MMCs) and Ceramic Matrix Composites (CMCs).	2
CO5	Apply mechanical testing, characterization, and non-destructive evaluation techniques for assessment of composite materials.	3
CO6	Evaluate advanced composite materials such as nanocomposites, CNT/graphene-based composites, and their applications in aerospace, automotive, marine, biomedical, and energy sectors.	4

Prerequisites: Concepts in Manufacturing Processes, Engineering Materials, Polymer Processing, Solid Mechanics

Unit No.	Description	Hrs.
1	Introduction to Composite Materials: Introduction to composite materials, need and advantages of composites over conventional engineering materials. Classification of composites based on matrix and reinforcement. Study of Polymer Matrix Composites (PMC), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC), natural fiber composites and carbon-carbon composites. Matrix materials including thermosetting polymers, thermoplastics, metals and ceramics. Reinforcement materials such as glass, carbon, aramid, boron and ceramic fibers. Role of matrix, reinforcement and interface in determining composite properties. Engineering applications of composites in aerospace, automotive, marine and energy sectors.	7
2	Mechanics of Composite Materials: Basic concepts of micromechanics of composites. Rule of mixtures and prediction of elastic properties of composites. Longitudinal and transverse properties of unidirectional composites. Stress-strain behavior of fiber reinforced composites. Concept of lamina and laminate. Symmetric , balanced, cross-ply and angle-ply laminates. Failure mechanisms in composites including matrix cracking, fiber fracture, fiber-matrix debonding and delamination. Introduction to failure criteria for composite materials.	7





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Unit No.	Description	Hrs.
3	Processing of Polymer Matrix Composites: Manufacturing methods for thermosetting and thermoplastic matrix composites. Hand lay-up and spray-up processes for open mould fabrication. Compression moulding, Resin Transfer Moulding (RTM) and Vacuum Assisted Resin Transfer Moulding (VARTM). Filament winding and pultrusion processes for structural composite components. Injection moulding and thermoforming of thermoplastic composites. Prepreg technology and sandwich construction. Process parameters affecting product quality, common manufacturing defects and their prevention.	7
4	Metal Matrix and Ceramic Matrix Composites: Introduction to Metal Matrix Composites (MMCs), their characteristics, advantages and applications. Selection of matrix and reinforcement materials for MMCs. Fabrication of MMCs through powder metallurgy, stir casting and squeeze casting techniques. Introduction to Ceramic Matrix Composites (CMCs), their properties and engineering applications. Processing techniques including sintering, hot pressing and Chemical Vapour Deposition (CVD). Carbon-carbon composites, their fabrication routes, properties and applications in high-temperature environments.	6
5	Testing and Characterization of Composites: Mechanical characterization of composite materials through tensile, compressive, flexural and impact testing. Evaluation of interlaminar shear strength and fracture behavior. Study of failure analysis and damage mechanisms in composites. Non-destructive testing techniques including visual inspection, ultrasonic testing, X-ray radiography and thermography. Quality assurance procedures, material qualification and assessment of manufacturing defects in composite structures.	6
6	Advanced Composite Materials and Applications: Introduction to advanced composite materials including nanocomposites, carbon nanotube reinforced composites and graphene-based composites. Multifunctional composites with enhanced electrical, thermal and sensing capabilities. Smart composites and self-sensing materials. Post-processing operations such as machining, drilling, bonding and joining of composite structures. Applications of advanced composites in aerospace, automotive, marine, biomedical, sports and renewable energy sectors. Recent developments and future trends in composite materials and processing technologies.	7

Text Books:

1. K. K. Chawla, Composite Materials: Science and Engineering, Springer, 3rd Edition, 2013.
2. P. K. Mallick, Fiber-Reinforced Composites: Materials, Manufacturing and Design, CRC Press, 4th Edition, 2008.
3. M. Balasubramanian, Composite Materials and Processing, CRC Press, 2014.

Reference Books:

1. D. Hull and T. W. Clyne, An Introduction to Composite Materials, Cambridge University Press.
2. Autar K. Kaw, Mechanics of Composite Materials, CRC Press.
3. R. M. Jones, Mechanics of Composite Materials, Taylor & Francis.
4. F. L. Matthews and R. D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall.
5. William D. Callister Jr., Materials Science and Engineering: An Introduction, Wiley India.
6. T. W. Clyne and P. J. Withers, Introduction to Metal Matrix Composites, Cambridge University Press.





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	3	2	-	2	1
CO2	3	3	2	2	2
CO3	2	2	3	3	3
CO4	2	2	2	3	2
CO5	2	3	1	2	2
CO6	2	2	3	3	3





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PCC205L	Course Name: Advanced Manufacturing Practices Lab	-	-	2	1

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain PLC automation, robot coordinates, frames and calibration.	2
CO2	Apply robot programming, pick-and-place and trajectory planning.	3
CO3	Conduct machining and advanced manufacturing experiments.	3
CO4	Analyze quality, machining, vision and simulation results.	4
CO5	Design robotic automation and smart manufacturing solutions.	6

Pre-Requisites: None

Perform the following experiments (Any Ten)

1. PLC-Based Manufacturing Automation and Sequential Process Control
2. Robot coordinate systems, frames of reference and calibration.
3. Pick-and-place operation programming.
4. Robot path planning and trajectory generation.
5. Experimental Study of an Advanced Non-Conventional Machining Process (like EDM/Wire EDM/Laser etc.)
6. Machine Vision-Based Automated Inspection and Quality Classification
7. Cutting force determination using force dynamometer in CNC Milling Operation.
8. Cutting force determination using force dynamometer in CNC Turning Operation.
9. Robot simulation using RoboDK.
10. Development of robotic automation cell (Mini Project).
11. Use of statistical quality control software for process optimization
12. Metal casting simulation using PROCAST or any software
13. AGV/AMR navigation and material handling simulation.
14. Experimental Determination of Tool Wear and Tool Life under Different Cutting Conditions
15. 3-D Scanning and Reverse Engineering of a Mechanical Component
16. Study of Friction Stir Welding under Parametric Variations

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	3	3	
CO2	3	-	3	3	
CO3	3	1	3	3	
CO4	3	2	3	3	
CO5	3	2	3	3	





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Text / Reference Books

1. Groover M. P., **"Industrial Robotics: Technology, Programming and Applications"**, McGraw-Hill Education, 2010.
2. Craig J. J., **"Introduction to Robotics: Mechanics and Control"**, 4th Edition, Pearson Education, 2018.
3. Niku S. B., **"Introduction to Robotics: Analysis, Control and Applications"**, 3rd Edition, Wiley India, 2020.
4. Siciliano B., Sciavicco L., Villani L. and Oriolo G., **"Robotics: Modelling, Planning and Control"**, Springer, 2010.
5. Spong M. W., Hutchinson S. and Vidyasagar M., **"Robot Modeling and Control"**, 2nd Edition, Wiley, 2020.
6. Corke P., **"Robotics, Vision and Control: Fundamental Algorithms in MATLAB® and Python"**, 3rd Edition, Springer, 2023.
7. Bolton W., **"Programmable Logic Controllers"**, 7th Edition, Newnes-Elsevier, 2021.
8. Groover M. P., **"Automation, Production Systems and Computer-Integrated Manufacturing"**, 5th Edition, Pearson Education, 2020.
9. Angerer A., Hoffmann A. and Reif W., **"RoboDK for Industrial Robotics Simulation and Offline Programming"**, Springer, 2022.
10. Quigley M., Gerkey B. and Smart W. D., **"Programming Robots with ROS: A Practical Introduction to the Robot Operating System"**, O'Reilly Media, 2015.





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Programme Elective-I

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PEC206A	Course Name: Material Characterization Techniques	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain the fundamentals of materials characterization techniques.	1
CO2	Analyze crystal structures and phases using X-ray and electron diffraction.	3
CO3	Apply thermal analysis techniques to characterize material behavior.	4
CO4	Evaluate microstructural and mechanical properties using SEM.	5
CO5	Analyze microstructural and crystallographic features using TEM.	4
CO6	Evaluate material properties using FTIR, DMA, AFM, and other advanced characterization techniques.	5

Prerequisites: None

Unit No.	Description	Hrs.
1	Introduction to Materials Characterization: Fundamentals and Overview of Techniques, Structural characterization: phase transformation, electron microscopy, crystallography by using modern techniques. Properties: mechanical properties (like fatigue, fracture toughness, integrity assessment) relating to structure and processing, corrosion evaluation.	7
2	X-ray and Electron Diffraction: Characterization technique: X-ray diffraction (XRD), selected area electron diffraction, Bragg's law and diffraction principles, Properties of X-Rays, peak intensity, crystal structure/size and phase identification, residual stress measurement and other applications, Electron Diffraction - principles, Selected Area Electron Diffraction (SAED), convergent beam electron diffraction	7
3	Thermal Characterization: Instrumentation and principles of techniques used for thermal analysis, Outline of thermal analysis technique, Glass transition, melting and crystallization behavior, Thermal stability and degradation analysis, description of DTA/DSC/TGA techniques and instrumentation, applications and case studies, Thermal characterization of metals, polymers, composites, ceramics, and nanomaterials; Industrial and research applications of thermal analysis.	7
4	Scanning Electron Microscopy (SEM): Theory and principles, construction, controls and operation of scanning electron microscopy, Optical microscopy light optics, microscope components, possibilities and limitations. Scanning Electron Microscopy Optics and performance of a SEM, image interpretation, crystallographic information in a SEM, analytical microscopy. Principles and characterization techniques related to tensile, compressive, hardness, fatigues and fracture toughness properties.	6
5	Transmission Electron Microscopy (TEM): Theory and principles, construction and controls, Types of electron sources, Focusing systems for parallel beams and probes,	6





Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Unit No.	Description	Hrs.
	image contrast, Construction and operation of a TEM, Electron diffraction, image interpretation, High-Resolution Transmission Electron Microscopy (HRTEM); Scanning Transmission Electron Microscopy (STEM), Microstructural, crystallographic, and compositional characterization of materials, Applications of TEM in advanced materials research and characterization, IR- and Raman spectroscopy.	
6	Other Characterization Techniques: Rheological and viscoelastic properties of materials importance of characterization for polymer systems, measurement techniques, melt flow index, Viscoelastic characterization using Dynamic Mechanical Analysis (DMA), Fundamentals of Fourier Transform Infrared Spectroscopy (FTIR): Principle of infrared spectroscopy; Molecular vibrations and IR absorption; Instrumentation and working of FTIR spectrometer; Sample preparation techniques; Interpretation of FTIR spectra; Identification of functional groups; Spectral library matching and data analysis; Applications of FTIR in material characterization. Atomic Force Microscopy (AFM): Basic principles and applications, Spectroscopy Techniques (XPS, XRF, WDS and EDS)	7

Text / Reference Books:

1. An Introduction to Materials Characterization, P. R. Khangaonkar; Penram Publishers, 2010.
2. G.E. Dieter, Mechanical Metallurgy, McGraw-Hill Book Co. (Third edition), 1988.
3. 3.K. W. Andrews, Physical Metallurgy Techniques and Applications, Vol. 1 and 2, George Allen
4. & Unwin, London, 1973
5. E. N. Kaufmann (Ed. in chief), Characterization of Materials, Vol 1. and 2, John Wiley and Sons
6. Publication, New Jersey, 2003
7. Metals handbook, Vol. 9, Characterization of Materials, 10th Ed., American Society of Metals,
8. Metals Park, OH, USA, 1986.
9. H.H. Willard, L.L. Merrit, J.A. Dean and F.A. Settle, Instrumental Methods of Analysis, 6th
10. Ed., CBS Publishers & Distributors, Delhi, 1986.
11. S.J.B. Reed: Electron Microprobe Analysis, Cambridge University Press, London, 1975.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	2	1	
CO2	3	1	2	1	2
CO3	3	1	2	1	2
CO4	3	2	2	1	2
CO5	3	2	2	1	2
CO6	3	2	2	1	2





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PEC206B	Course Name: Surface Engineering	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain the significance of surface engineering, surface characteristics, and degradation mechanisms.	1
CO2	Analyze surface integrity and evaluate surface preparation methods for engineering applications.	3
CO3	Apply thermal, mechanical, diffusion, and irradiation-based surface modification techniques.	4
CO4	Compare and select suitable coating and thin-film deposition techniques for specific applications.	5
CO5	Characterize engineered surfaces and coatings using physical, mechanical, and tribological testing methods.	3
CO6	Recommend appropriate surface engineering solutions for improving wear, corrosion resistance, and service life of components.	3

Prerequisites: Concepts in Manufacturing Processes, Materials Science and Metallurgy

Unit No.	Description	Hrs.
1	Fundamentals of Surface Engineering and Surface Degradation: Introduction to Surface Engineering: Definition, significance, role in enhancing component performance, functional characteristics of engineering surfaces, classification of surface engineering techniques. Nature of Engineering Surfaces: Deformed layer, Beilby layer, chemically reacted layer, physisorbed layer, chemisorbed layer. Surface Degradation Mechanisms: Causes and consequences of surface degradation, adhesive wear, abrasive wear, corrosive wear, erosive wear, fretting wear, surface fatigue wear; governing wear laws and wear evaluation techniques.	7
2	Surface Preparation, Surface Integrity and Surface Engineering Materials: Surface Preparation Techniques: Importance of surface preparation, selection Criteria, chemical cleaning methods, mechanical cleaning methods, removal of contaminants, cleanliness assessment techniques. Surface Integrity: Definition, importance, factors affecting surface integrity, residual stresses, metallurgical and tribological aspects, visual and dimensional characteristics, macro and microscopic examination methods. Materials for Surface Engineering: Wear-resistant materials, material selection criteria, multilayer coatings, functionally graded materials (FGMs), thermal barrier coatings, intermetallic coatings, smart coatings and compositionally complex coatings.	7
3	Thermal and Mechanical Surface Modification Techniques: Thermal Surface Modification: Laser hardening, electron beam hardening, induction hardening, laser glazing, laser alloying, laser cladding, laser remelting. Mechanical Surface Modification: Shot peening, burnishing, surface rolling, process variables, equipment and industrial applications. Conventional Surface Engineering Practices: Material removal methods such as grinding, polishing and etching; material addition methods including hot dipping and diffusion treatments.	7
4	Diffusion-Based and Thin Film Surface Engineering Techniques: Diffusion-Based Treatments: Carburizing, nitriding, plasma nitriding, cyaniding, boriding.	7





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Unit No.	Description	Hrs.
	Ion Implantation: Principle, equipment, advantages, limitations and applications. Thin Film Deposition Techniques: Physical Vapour Deposition (PVD): Evaporation, sputtering, ion plating. Chemical Vapour Deposition (CVD): Principles, reactions, process variants, Plasma Enhanced CVD (PECVD), Laser Enhanced CVD (LECVD), Metal Organic CVD (MOCVD). Applications of thin-film coatings.	
5	Coating Technologies and Advanced Surface Engineering Processes: Weld Surfacing Techniques: SMAW, SAW, GMAW-based surfacing. Thermal Spray Coatings: Flame spraying, electric arc spraying, plasma spraying, detonation gun spraying, High Velocity Oxy Fuel (HVOF) spraying, Cold Gas Spray Method (CGSM). Electrochemical Coatings: Electroplating, electroless plating, anodizing. Advanced Coatings: Hard coatings, soft coatings, multilayer coatings, thermal Carrier coatings. Post-Coating Treatments: Heat treatment, furnace treatment, hot isostatic pressing (HIP), flame remelting, sealing, grinding, polishing and lapping.	6
6	Characterization, Testing and Industrial Applications of Engineered Surfaces: Characterization of Engineered Surfaces: Measurement of coating thickness, porosity, adhesion, residual stresses, surface roughness and topography. Microstructural Characterization: Optical microscopy, SEM, spectroscopic techniques. Mechanical Characterization: Hardness, nanoindentation, adhesion testing, strength evaluation. Tribological Characterization: Friction, wear and corrosion testing. Industrial Applications: Automotive, aerospace, marine, biomedical, power generation and tooling industries; case studies on surface engineering solutions.	6

Textbooks:

1. Dwivedi, D. K., *Surface Engineering: Enhancing the Life of Tribological Components*, Springer, New Delhi, 2018.
2. Rao, T. Srinivasa, *Surface Engineering*, Daya Publishing House, New Delhi, 2017.
3. Budinski, K. G., *Surface Engineering for Wear Resistance*, Prentice Hall, New Jersey, 1988.

Reference Books:

1. ASM International, *ASM Handbook, Volume 5: Surface Engineering*, ASM International, Materials Park, Ohio, Latest Edition.
2. Davis, J. R., *Surface Engineering for Corrosion and Wear Resistance*, ASM International, 2001.
3. Burakowski, T. and Wierzchon, T., *Surface Engineering of Metals: Principles, Equipment, Technologies*, CRC Press, Boca Raton, Florida, 1999.
4. Bhushan, B. and Gupta, B. K., *Handbook of Tribology: Materials, Coatings and Surface Treatments*, McGraw-Hill, New York.
5. Holmberg, K. and Matthews, A., *Coatings Tribology: Properties, Techniques and Applications in Surface Engineering*, Elsevier Science, Amsterdam, 1994.
6. Ohring, M., *The Materials Science of Thin Films*, Academic Press, 2005.
7. Bunshah, R. F., *Handbook of Hard Coatings: Deposition Technologies, Properties and Applications*, Noyes Publications, 2001.
8. Rickerby, D. S. and Matthews, A., *Advanced Surface Coatings: A Handbook of Surface Engineering*, Blackie Academic & Professional, London, 1991.
9. Grainger, S. and Blunt, J., *Engineering Coatings: Design and Application*, Woodhead Publishing, Cambridge, 1998.
10. Takadom, J., *Materials and Surface Engineering in Tribology*, John Wiley & Sons, 2008.





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	3	2	-	2	-
CO2	3	3	-	2	1
CO3	3	3	2	3	2
CO4	3	3	3	3	3
CO5	2	3	-	2	2
CO6	2	3	3	2	3





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PEC206C	Course Name: Robotics & Automation	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain robot configurations and applications.	1
CO2	Analyze forward and inverse kinematics of robotic manipulators.	4
CO3	Evaluate robot dynamics and control strategies.	5
CO4	Develop robotic programs for industrial automation.	3
CO5	Integrate robots with sensors, PLCs and smart manufacturing systems.	3
CO6	Design and optimize automation using Industry 4.0 principles	3

Prerequisites: None

Unit No.	Description	Hrs.
1	Introduction to Robotics: History and evolution of robotics - Robot classifications and configurations - Components of industrial robots - Robot anatomy and degrees of freedom - Applications in manufacturing and service sectors	6
2	Robot Kinematics: Coordinate transformations - Homogeneous transformation matrices - Forward kinematics - Inverse kinematics - Workspace analysis	7
3	Robot Dynamics and Control: Dynamic modeling of manipulators - Lagrangian and Newton-Euler approaches - Trajectory planning - Motion control - PID and advanced control strategies	7
4	Sensors, Actuators and Robot Programming: Position, force and vision sensors - Servo, stepper and pneumatic actuators - Robot programming methods - Offline programming - Robot Operating System (ROS) fundamentals	7
5	Automation Systems: PLC architecture and programming - SCADA systems - Flexible Manufacturing Systems (FMS) - Automated Guided Vehicles (AGVs) - Machine vision systems	6
6	Industry 4.0 and Collaborative Robotics: Cyber Physical Systems - Digital Twins - Collaborative Robots (Cobots) - AI in robotics - Smart factories and future trends	6

Text / Reference Books:

1. Groover M. P., "Industrial Robotics: Technology, Programming and Applications", McGraw-Hill Education, 2010.
2. Craig J. J., "Introduction to Robotics: Mechanics and Control", 4th Edition, Pearson Education, 2018.
3. Niku S. B., "Introduction to Robotics: Analysis, Control and Applications", 3rd Edition, Wiley India, 2020.
4. Siciliano B., Sciavicco L., Villani L. and Oriolo G., "Robotics: Modelling, Planning and Control", Springer, 2010.
- 5.





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

6. Spong M. W., Hutchinson S. and Vidyasagar M., "Robot Modeling and Control", 2nd Edition, Wiley, 2020.

Text / Reference Books:

7. Fu K. S., Gonzalez R. C. and Lee C. S. G., "Robotics: Control, Sensing, Vision and Intelligence", McGraw-Hill International, 1987.
8. Asfahl C. R. and Rieske D. W., "Robots and Manufacturing Automation", 2nd Edition, Wiley, 2010.
9. Bolton W., "Programmable Logic Controllers", 7th Edition, Newnes-Elsevier, 2021.
10. Mikell P. Groover, "Automation, Production Systems and Computer-Integrated Manufacturing", 5th Edition, Pearson Education, 2020.
11. Corke P., "Robotics, Vision and Control: Fundamental Algorithms in MATLAB® and Python", 3rd Edition, Springer, 2023.

Suggested NPTEL References

1. **Industrial Robotics: Theory and Applications**, IIT Kharagpur.
2. **Industrial Robotics: Theories for Implementation**, IIT (ISM) Dhanbad.
3. **Automation in Manufacturing**, IIT Guwahati.
4. **Microrobotics**, IIT Indore.
5. **Robot Mechanics and Control**, NPTEL Online Certification Course.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	1	-	3		
CO2	2	-	3		
CO3	3	-	3		
CO4	3	1	3		
CO5	3	1	3		
CO6	3	2	3		





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
 An Autonomous Institute & Affiliated to DBATU, Lonere
 Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
 (With Effect From 2026-27)

Programme Elective-II

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PEC207A	Course Name: MEMS and Fabrication of Smart Materials	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain MEMS fabrication processes.	1
CO2	Design basic MEMS devices.	4
CO3	Analyze smart material behavior.	4
CO4	Select suitable smart materials for engineering applications.	3
CO5	Develop microsystem-based solutions.	3

Prerequisites: None

Unit No.	Description	Hrs.
1	Introduction to MEMS: MEMS overview and evolution- Introduction to MEMS and Microsystems Historical development of MEMS technology- Comparison of MEMS - NEMS and conventional systems - Advantages and limitations of MEMS devices - Microsystems and applications - Scaling laws - Geometric scaling - Surface area-to-volume ratio effects - Mechanical, thermal and electrical scaling effects - Challenges associated with miniaturization - MEMS design considerations - Material selection - Fabrication constraints - Reliability and packaging requirements - Design flow for MEMS products	7
2	Microfabrication Techniques: Silicon wafer technology - Crystal structure of silicon - Wafer preparation and cleaning - Single crystal and polycrystalline silicon - Silicon-on-Insulator (SOI) wafers – Photolithography - Photoresist materials - Mask generation - Exposure and development processes - Resolution and alignment issues - Thin-film deposition - Physical Vapor Deposition (PVD) - Chemical Vapor Deposition (CVD) - Atomic Layer Deposition (ALD) - Electroplating techniques - Etching processes - Wet chemical etching - Dry etching - Reactive Ion Etching (RIE) - Deep Reactive Ion Etching (DRIE) - Micromachining techniques - Bulk micromachining - Surface micromachining - LIGA process - Emerging fabrication methods	7
3	MEMS Sensors and Actuators: MEMS sensors - Principles of sensing - Pressure sensors - Temperature sensors - Chemical and biosensors - Inertial sensors – Accelerometers – Gyroscopes – Inclometers - Navigation applications - MEMS actuators - Electrostatic actuators - Thermal actuators - Piezoelectric actuators - Magnetic actuators - RF MEMS - RF switches – Resonators - MEMS antennas - Wireless communication applications - Performance evaluation –	7





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Unit No.	Description	Hrs.
	Sensitivity – Resolution - Accuracy and repeatability - Reliability analysis	
4	Smart Materials: Introduction to smart materials - Characteristics and classifications - Sensing and actuation mechanisms - Adaptive and intelligent structures - Shape Memory Alloys (SMA) - Shape memory effect – Superelasticity - NiTi alloys - Engineering applications - Piezoelectric materials - Direct and invers - piezoelectric effect - Piezoelectric ceramics and polymers - Sensors and actuators - Magnetostrictive materials - Magnetostriction phenomenon - Giant magnetostrictive materials - Industrial applications - Electroactive polymers - Ionic EAPs - Electronic EAPs - Artificial muscles - Smart composites - Embedded sensors and actuators - Self-monitoring structures - Multifunctional composites	7
5	Fabrication and Characterization of Smart Materials: Material synthesis techniques - Sol-gel process - Powder metallurgy - Chemical synthesis methods - Thin-film growth techniques - Thin-film fabrication – Sputtering – Evaporation - Spin coating - Electrochemical deposition - Nanostructured smart materials - Nanocomposites – Nanocoatings - Nanostructured piezoelectric materials - Functional nanomaterials - Characterization methods - X-Ray Diffraction (XRD) - Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Atomic Force Microscopy (AFM) - Reliability issues - Fatigue behavior - Environmental degradation - Failure mechanisms - Life prediction techniques	6
6	Applications and Emerging Trends: Biomedical MEMS - Implantable devices - Drug delivery systems – Microfluidics – Biosensors - Lab-on-Chip systems - Microfluidic channels - Sample preparation - Chemical and biological analysis - Point-of-care diagnostics - Smart structures - Structural health monitoring - Adaptive aerospace structures - Intelligent transportation systems - Vibration control applications - Energy harvesting systems - Piezoelectric energy harvesting - Electromagnetic harvesting - Thermoelectric harvesting - Self-powered sensors - IoT-enabled MEMS devices - Wireless sensor networks - Smart manufacturing applications - Industry 4.0 integration - Cyber-physical systems - Recent advances - Nano-MEMS and NEMS - Flexible MEMS devices - AI-assisted smart systems - Future research directions	6





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Text / Reference Books:

1. Hsu T. R., "MEMS and Microsystems: Design, Manufacture and Nanoscale Engineering", 3rd Edition, Wiley India, 2020.
2. Madou M. J., "Fundamentals of Microfabrication and Nanotechnology", 3rd Edition, CRC Press, 2018.
3. Gardner J. W., Varadan V. K. and Awadelkarim O. O., "Microsensors, MEMS and Smart Devices", Wiley, 2001.
4. Bhushan B., "Springer Handbook of Nanotechnology", 4th Edition, Springer, 2017.
5. Ounaies Z., Shahinpoor M. and Schneider H. J., "Intelligent Materials", Royal Society of Chemistry, 2008.
6. Gandhi M. V. and Thompson B. S., "Smart Materials and Structures", Springer, 1992.
7. Leo D. J., "Engineering Analysis of Smart Material Systems", Wiley, 2007.
8. Senturia S. D., "Microsystem Design", Kluwer Academic Publishers, 2001.
9. Korvink J. G. and Paul O., "MEMS: A Practical Guide to Design, Analysis and Applications", William Andrew Publishing, 2006.
10. Lyshevski S. E., "MEMS and NEMS: Systems, Devices and Structures", CRC Press, 2018.

Suggested NPTEL References

1. MEMS and Microsystems Design, IIT Bombay.
2. Micro and Smart Systems Technology, IIT Madras.
3. Smart Materials and Intelligent Systems, IIT Kanpur.
4. Nanotechnology in Manufacturing, IIT Roorkee.
5. Sensors and Actuators for Smart Systems, NPTEL Online Certification Course

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	3	3	2
CO2	3	1	3	3	3
CO3	2	-	3	3	2
CO4	2	1	3	3	3
CO5	3	2	3	3	3





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PEC207B	Course Name: Finite Element Method	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Explain the basic concepts, formulation procedures, and mathematical foundations of FEM.	1
CO2	Develop finite element models for one-dimensional structural and thermal problems.	3
CO3	Formulate and solve two-dimensional and three-dimensional finite element problems.	2
CO4	Analyze static, dynamic, and heat transfer problems using finite element techniques.	4
CO5	Apply isoparametric formulations, numerical integration, and mesh generation concepts.	4
CO6	Perform engineering analysis using commercial FEA software such as ANSYS, ABAQUS, or COMSOL and interpret results effectively.	3

Prerequisites:

Unit No.	Description	Hrs.
1	Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles - discrimination - Raleigh - Ritz method of functional approximation. Principles of Elasticity: Stress equations - strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.	7
2	One dimensional FEM: Stiffness matrix for beam and bar elements - shape functions for 1D elements. Two dimensional FEM: Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions - convergent and compatibility requirements - geometric invariance - natural coordinate system - area and volume coordinates - generation of element stiffness and nodal load matrices.	7
3	Isoparametric formulation: Concept - different isoparametric elements for 2D analysis - formulation of 4-noded and 8-noded isoparametric quadrilateral elements - Lagrange elements - serendipity elements. Axi Symmetric Analysis: bodies of revolution - axi symmetric modeling - strain displacement relationship - formulation of axi symmetric elements. Three dimensional FEM: Different 3-D elements-strain-displacement relationship- formulation of hexahedral and isoparametric solid element.	7
4	Three-Dimensional and Axisymmetric Elements: Three-dimensional elasticity problems, Tetrahedral and hexahedral elements, Axisymmetric formulation, Modeling of solids, Stress analysis of machine components, Practical engineering	7





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Unit No.	Description	Hrs.
	applications	
5	Dynamic and Thermal Analysis: Consistent and lumped mass matrices, Free vibration analysis, Forced vibration analysis, Modal analysis, Steady-state heat conduction, Transient heat transfer problems, Coupled field analysis	6
6	Advanced FEA and Software Applications: Nonlinear finite element analysis, Contact analysis, Mesh refinement techniques, Error estimation and convergence, Pre-processing, solution, and post-processing, Introduction to ANSYS/ABAQUS, Industrial case studies in mechanical engineering	6

REFERENCES:

1. Concepts and Applications of Finite Element Analysis by Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons.
2. Finite element Methods by OC Zienkiewicz
3. Finite element analysis, theory and programming by GS Krishna Murthy.
4. Introduction to Finite element Method by Tirupathi Chandra Patila and Belugunudu.
5. Introduction to Finite element Method by JN Reddy.

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome(PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	-	1	
CO2	3	3	2	1	
CO3	3	3	3	1	
CO4	3	3	2	1	2
CO5	3	3	2	1	2
CO6	2	2	3	1	2





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Course: F. Y. M.Tech.	Semester: II	L	T	P	Credits
Course Code: 26205PEC207C	Course Name: Design of Experiments	3	-	-	3

Course Outcomes: At the end of the course student will be able to

CO	Statement	BL
CO1	Apply principles of statistics, probability, and design of experiments to solve engineering problems	3
CO2	Analyze experimental data using hypothesis testing, sampling distributions, and ANOVA techniques	4
CO3	Design and conduct experiments such as factorial design, response surface, and Taguchi methods	6
CO4	Investigate and interpret results using statistical tools like t-test, F-test, and chi-square test	4
CO5	Use modern statistical and computational tools for modeling and analysis of experimental data	3
CO6	Evaluate and optimize engineering processes for quality improvement using DOE and Taguchi techniques	5

Prerequisites: -

Unit No.	Description	Hrs.
1	Introduction to Designed Experiments: Strategy of experimentation, Typical applications, Basic principles and guidelines for designing experiments Basic statistical concepts: Descriptive Statistics, Sampling and Sampling Distributions, Tests of Hypotheses	6
2	Simple Comparative Experiments: Sampling and sampling Distribution, Test of significance for single mean and for difference of means of two samples, Inferences about the Differences in means: randomized designs, Inferences about the Differences in means: Paired comparison Designs, Inferences about the Variances of Normal Distributions. Test of significance based on t, F and Chi square distribution.	7
3	Factorial Design: Basic definition and principles, Advantages of factorials, Types of factorial design: Full factor factorial design and fraction factorial design, Design Matrix, Development of mathematical model, Regression model diagnostics.	7
4	Response Surface Design: Method of Steepest Ascent, Second-Order Response Surface, Experimental Designs, Computer Models, Mixture Experiments, Evolutionary Operations	6
5	TAGUCHI Method: Introduction, Concept design, Parameter design, Tolerance design, Orthogonal array experiments Taguchi quality loss function, Signal-to Noise ratio, Quality characteristics, Parameter optimization experiment, Parameter design case study.	7
6	Analysis of Variance (ANOVA): Introduction, One way ANOVA process, Two way ANOVA process, Degrees of freedom, Case studies on Factorial design, Taguchi Method and ANOVA.	7





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

REFERENCES:

1. Design and Analysis of Experiments, D. C. Montgomery, John Wiley & Sons, Wiley Student Edition, International Student Version, 7th Edition, 2009
2. Experimental Design: From User Studies to Psychophysics, D. W. Cunningham and C. Wallraven, CRC Press, 2011
3. Design of Experiments: An Introduction Based on Linear Models, M. Morris, Chapman & Hall/CRC Texts in Statistical Science, First Edition, 2010
4. Experiments: Planning, Analysis, and Optimization C. F. J. Wu and M. S. Hamada, Wiley Series in Probability and Statistics, Wiley, 2009
5. Statistics for Experimenters: Design, Innovation, and Discovery, G. E. P. Box, J. S. Hunter, and W. G. Hunter, Wiley, 2nd Edition, 2005

CO-PO Matrix

Course Outcome	Programme Outcome (PO)/ Programme Specific Outcome (PSO)				
	PO1	PO2	PO3	PSO1	PSO2
CO1	3				
CO2	3				
CO3	3		1		
CO4	3		1		1
CO5	3	1	1		1
CO6	3	1	1		1





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Course: S. Y. M.Tech.	Semester: III	L	T	P	Credits
Course Code: 27205PEC301A/B/C	Course Name: Program Elective Course - III (Online)	4	-	-	4

**** Note: 100% ESE of 3 hours or credit transfer**

Course list: <https://nptel.ac.in/courses> (June - Dec Slot)

Tentative List of PEC-III

Programme Elective-III		
Sr. No	Course Code	Course Title
1	27205PEC301A	Laser-Assisted Measurements and Micro Manufacturing, IIT Indore https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me111
2	27205PEC301B	Automation In Manufacturing, IIT Guwahati https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_me139
3	27205PEC301C	Industrial Engineering and Operations Research - IIT Guwahati https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me193

Note: The NPTEL/SWAYAM courses mentioned in the curriculum are subject to change, as the course offerings are revised periodically by NPTEL/SWAYAM. The course selected by the student shall depend on the availability of the relevant course in the NPTEL/SWAYAM course list published during the respective academic session.

****Note for Program Elective Course**

1. Enrollment in an approved SWAYAM/NPTEL course is mandatory for all students. The selected course shall be from the respective Programme Elective (PEC) basket as notified by the Department.
2. Since Massive Open Online Course-I & II carries 04 credits, the selected SWAYAM/NPTEL course must be of a minimum duration of 12 weeks only.
3. Submission and successful completion of all SWAYAM/NPTEL assignments is mandatory and shall be considered for the Internal Semester Evaluation (ISE).
4. Students shall appear for the SWAYAM/NPTEL proctored examination and submit the Course Completion Certificate/Grade Card issued by SWAYAM/NPTEL after successfully completing the course.
5. Successful completion of the prescribed SWAYAM/NPTEL course is mandatory for fulfilling the Massive Online Courses (Program Electives) requirement and earning the associated academic credits.
6. The department reserves the right to approve the list of eligible SWAYAM/NPTEL courses and issue detailed guidelines regarding enrollment, assessment, and credit transfer from time to time.





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Course: S. Y. M.Tech.	Semester: III	L	T	P	Credits
Course Code: 27205PEC302A/B/C	Course Name: Program Elective Course - IV (Online)	4	-	-	4

**** Note: 100% ESE of 3 hours or credit transfer**

Course list: <https://nptel.ac.in/courses> (June - Dec Slot)
Note: At that time, whoever is available should be chosen.

Tentative List of PEC-IV

Programme Elective-IV		
Sr. No	Course Code	Course Title
1	27205PEC302A	Fundamentals of Casting and Solidification, IIT Kanpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me107
2	27205PEC302B	Industrial Robotics: Theories for Implementation, IIT-ISM Dhanbad https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me167
3	27205PEC303C	Applied Numerical Methods, IIT Kanpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me153

Note: The NPTEL/SWAYAM courses mentioned in the curriculum are subject to change, as the course offerings are revised periodically by NPTEL/SWAYAM. The course selected by the student shall depend on the availability of the relevant course in the NPTEL/SWAYAM course list published during the respective academic session.

****Note for Program Elective Course**

1. Enrollment in an approved SWAYAM/NPTEL course is mandatory for all students. The selected course shall be from the respective Programme Elective (PEC) basket as notified by the Department.
2. Since Massive Open Online Course-I & II carries 04 credits, the selected SWAYAM/NPTEL course must be of a minimum duration of 12 weeks only.
3. Submission and successful completion of all SWAYAM/NPTEL assignments is mandatory and shall be considered for the Internal Semester Evaluation (ISE).
4. Students shall appear for the SWAYAM/NPTEL proctored examination and submit the Course Completion Certificate/Grade Card issued by SWAYAM/NPTEL after successfully completing the course.
5. Successful completion of the prescribed SWAYAM/NPTEL course is mandatory for fulfilling the Massive Online Courses (Program Electives) requirement and earning the associated academic credits.
6. The department reserves the right to approve the list of eligible SWAYAM/NPTEL courses and issue detailed guidelines regarding enrollment, assessment, and credit transfer from time to time.





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Course: S. Y. M.Tech.	Semester: III	L	T	P	Credits
Course Code: 27205RS303	Course Name: Research Seminar	-	-	4	2

CO	Statement	BL
CO1	Identify and compare technical and practical issues related to the area of course specialization.	3
CO2	Prepare a well-organized report employing elements of technical writing and critical thinking.	3
CO3	Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.	2

Objective: To assess the debating capability of the student to present a technical topic. Also, to impart training to a student to face audience and present ideas and thus creating self-esteem, self-confidence and courage that are essential for an engineer.

Individual students are required to choose a topic of their interest from Manufacturing Systems Management related topics preferably from outside the M.Tech syllabus or an extension of syllabus and give a seminar on that topic for about 30 minutes. The Seminar can also be a case study from a manufacturing organization. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his / her seminar topic. One copy shall be returned to the student after duly certifying it by the Chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.





Rayat Shikshan Sanstha's
Karmaveer Bhaurao Patil College of Engineering, Satara
An Autonomous Institute & Affiliated to DBATU, Lonere
Accredited by NAAC with "B++" Grade
M.Tech. in Mechanical-Production Engineering
Curriculum Structure & Evaluation Scheme
(With Effect From 2026-27)

Course: S. Y. M.Tech.	Semester: III	L	T	P	Credits
Course Code: 27205DP304	Course Name: Dissertation Phase-I	-	-	22	11

CO	Statement	BL
CO1	Identify methods and materials to carry out experiments/develop code.	3
CO2	Reorganize the procedures with a concern for society, environment and ethics.	3
CO3	Analyze and discuss the results to draw valid conclusions.	4
CO4	Prepare a report as per recommended format and defend the work	2
CO5	Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.	3

Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Dissertation phase I can be a design project, experimental project, computer simulation project or an empirical study involving data collection and analysis from manufacturing organisations. The topic should be on Manufacturing Systems Management or any of the topics related with manufacturing stream. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute. If found essential they may be permitted to continue their project outside the parent institute subject to the conditions of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The student is required to undertake the masters research project phase-I during the third semester and the same is continued in the 4th semester (Phase-II). Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.





Rayat Shikshan Sanstha's Karmaveer Bhaurao Patil College of Engineering, Satara

An Autonomous Institute & Affiliated to DBATU, Lonere

Accredited by NAAC with "B++" Grade

M.Tech. in Mechanical-Production Engineering

Curriculum Structure & Evaluation Scheme

(With Effect From 2026-27)

Course: S. Y. M.Tech.	Semester: IV	L	T	P	Credits
Course Code: 27205DP401	Course Name: Dissertation Phase-II***	-	-	40	20

Course Outcomes: At the end of the course, students will be able to

CO	Statement	BL
CO1	Identify methods and materials to carry out experiments/develop code	3
CO2	Reorganize the procedures with a concern for society, environment and ethics.	3
CO3	Analyze and discuss the results to draw valid conclusions.	4
CO4	Prepare a report as per recommended format and defend the work	2
CO5	Explore the possibility of publishing papers in peer reviewed journals/conference proceedings.	3

***Research Publication / Intellectual Property Requirement

As a part of the **M.Tech. (Mechanical-Production Engineering)** programme, every student shall **mandatorily fulfill any one of Clauses 1 to 3**, based on the research work carried out under the guidance of the Research Guide.

Fulfill any one of the following:

1) **Publish One research papers** in blind peer-reviewed journals approved by the Research Guide.

OR

2) **Publish One research paper** in reputed conference proceedings or publications of **IEEE /**

Springer / CRC Press / Science Direct (Elsevier) / ASCE / ASME.

OR

3) **Publish and Grant one patent** based on the research work carried out during the programme.

Note: Award of the M.Tech. degree shall be subject to the successful fulfillment of any one of the mandatory publication requirements specified in **Clauses 1 to 3**.

Objectives: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Dissertation phase II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. A technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

