Quest for Excellence

MAHARASHTRA INSTITUTE OF TECHNOLOGY, AURANGABD

An Autonomous Institute Affiliated to
Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad, Maharashtra (India)

M. Tech. (Manufacturing Engineering) Syllabus

w.e.f. 2022-2023

Chairman Board of Studies
Mechanical Engineering
MIT Aurangabad
(An Autonomous Institute)

Chairman Academic Council
MIT Aurangabad
(An Autonomous Institute)

Maharashtra Institute of Technology, Aurangabad
(An Autonomous Institute)

FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus Structure w.e.f. 2022-2023 (Choice Based Credit System)

M. Tech. (Manufacturing Engineering)

Semester-I

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks							Credits			
		Theory	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	TH	TUT	TW/PR	Total
MFG101	Research Methodology and IPR	3	1	-	15	15	20	50	-	-	100	3	1	-	4
MFG102	Advanced Manufacturing Processes	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MFG103	Digital Manufacturing	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MFG104	Quality System and Reliability Engineering	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MFG121 to MFG123	Professional Elective-I	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MFG111	Lab-I:Data Analytics Lab (R Programming)	-	-	2	-	-	-	-	25	-	25	-	-	1	1
MFG112	Lab-II: - Master CAM software	-	-	2	-	-	-	-	25	-	25	-	-	1	1
MFG113	Lab-III: -MATLAB	-	-	2	-	-	-	-	25	-	25	-	-	1	1
MFG114	Seminar	-	-	4	-	-	-	-	-	50	50	-	-	2	2
Total (Semester-I)		**15**	**1**	**10**	**75**	**75**	**100**	**250**	**75**	**50**	**625**	**15**	**1**	**5**	**21**

Semester-II															
Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks							Credits			
		Theory	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	TH	TUT	TW/PR	Total
MFG141	Advanced Optimization Techniques	3	1	-	15	15	20	50	-	-	100	3	1	-	4
MFG142	Green Manufacturing	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MFG143	Characterization of Materials	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MFG144	Theory of Metal Forming	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MFG161 -163	Professional Elective-II	3	-	-	15	15	20	50	-	-	100	3	-	-	3
MFG151	Lab-IV (Advanced Optimization Techniques)	-	-	2	-	-	-	-	25	-	25	-	-	1	1
MFG152	Lab-V (Characterization of Materials)	-	-	2	-	-	-	-	25	-	25	-	-	1	1
MFG153	Lab-VI: (Advanced MATLAB)	-	-	2	-	-	-	-	25	-	25	-	-	1	1
MFG154	Mini Project	-	-	4	-	-	-	-	-	50	50	-	-	2	2
	Total (Semester-II)	**15**	**2**	**10**	**75**	**75**	**100**	**250**	**75**	**50**	**625**	**15**	**1**	**5**	**21**
M. Tech (First Year)															
	Grand Total	**30**	**3**	**20**	**150**	**150**	**200**	**500**	**150**	**100**	**1250**	**30**	**2**	**10**	**42**

MSE- Mid Semester Exam, ESE- End Semester Examination, TH-Theory, OR- Oral, TA-Teacher Assessment, TW- Term Work, PR- Practical, Tut- Tutorial

Semester-III															
Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks							Credits			
		Theory	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	TH	TUT	TW/PR	Total
MFG201	MOOC Course	3	-	-	-	-	-	100	-	-	100	3	-	-	3
MFG211	Dissertation-I	-	--	18	-	-	-	-	50	100	150	-	-	9	9
	Total (Semester-III)	3	--	18	-	-	-	100	50	100	250	-	-	9	12
Semester-IV															
Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks							Credits			
		Theory	Tutorial	Practical	MSE-I	MSE-II	TA	ESE	TW	PR/OR	Total	TH	TUT	TW/PR	Total
MFG251	**Dissertation II**	-	-	24	-	-	-	-	100	100	200	-	-	12	12
	Total (Semester IV)	-	-	24	-	-	-	-	100	100	200	-	-	12	12
M.Tech Second Year															
	Grand Total	3	-	42	-	-	-	100	150	200	450	3	-	21	24
MSE- Mid Semester Exam, ESE- End Semester Examination, TH-Theory, OR- Oral, TA-Teacher Assessment, TW- Term Work, PR- Practical, Tut- Tutorial															

Professional Elective-I

Course Code	Course Name
MFG121	Product life cycle management
MFG122	Sensors for Intelligent Manufacturing and Monitoring
MFG123	Non Conventional Machining

Professional Elective-II

Course Code	Course Name
MFG161	Intelligent Industrial Systems
MFG162	Mechatronics and Robotics
MFG163	Finite Element Method

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Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code: MFG101	Credits: 3-1-0 (4)
Course: Research Methodology & IPR	Mid Semester Examination-I: 15 Marks
Teaching Scheme:	Mid Semester Examination-II: 15 Marks
Theory: 3 Hrs/week	Teacher Assessment: 20 Marks
Tutorial: 1 Hr./week	End Semester Examination: 50 Marks
	End Semester Examination (Duration): 02 Hrs

Unit-1	**Research Problems and Research Design** Meaning of research, types of research, steps in involved in research process, criteria of good research, importance of ethics in research, codes and policies for research ethics. Selection of research problem, steps involved in defining research problem, need for research design, types of research designs, basic principles of experimental design, formal and informal experimental design. (05 Hrs)
Unit-2	**Sampling Design** Need for sampling, steps in sampling design, different types of sampling designs, sampling distributions, concept of central limit and standard error, sources of errors, population mean and proportion, sample size calculations, tests of measurements for validity, reliability and practicality. (05 Hrs)
Unit-3	**Data collection, Processing and Analysis** Methods for collection of data, selection of data collection method, data processing operations, statistics in research, confidence level, measures of central tendency, dispersion, asymmetry and relationship. Spearman's and Pearson's coefficient of correlation, simple & multiple regression analysis, analysis of variance (ANOVA), factor analysis methods. (08 Hrs)
Unit-4	**Hypothesis Test and Report Writing**

	Concept of research hypothesis, concept of testing of hypothesis, Parametric tests (z, t, F and chi-square tests), Hypothesis testing of means and correlation coefficient, Non parametric tests, significance of research report writing, types of reports, structure of the research report, steps in report writing, precautions and ethics in writing report. (07 Hrs)				
Unit-5	**Introduction to IPR** Origin and evolution of IPR to its present form and use, Different Tools of IPR and what is the nature of these rights, Balancing Rights and Responsibilities, Societal implications of IPR (05 Hrs)				
Unit-6	**Patents** Concept of inventions/discoveries, patents protect; benchmarks for patentability of inventions; Exceptions to patentability; Patenting issues in Biotechnology and computer based inventions, process to apply for patents in India and in other countries around the world, The steps to granting of a patent; Opposing grant of a patent; term of a patent; rights of a patent holder; challenging validity of a patent licensing of patent rights; using patent rights in the market place; compulsory license. (06 Hrs)				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1	Research Methodology: Methods and Techniques	C. R. Kothari and G. Garg	New Age International, 2019	4th Edition
	2	Research Methodology	R. Pannerselvam	PHI Learning, 2014	2nd Edition
	3	Research Methodology-As Theoretical Approach	D. Napolean & B. Narayan	Laxmi Publications,	1st Edition

				2014	
	4	Research Methods and Statistics	Bernard C. Beins & Maureen A. McCarthy	Pearson Education Inc., 2012	1st Edition
	5	Research Methods Handbook	Stuart MacDonald & Nicola Headlam	CLES	1st Edition
	6	Intellectual Property Rights--Unleashing the Knowledge Economy	Ganguli Prabuddha	Tata McGrawHill, 2001	1st Edition
	7	Intellectual Property Rights	Neeraj Pandey and Khushdeep Dharni	PHI Learning, 2014	1st Edition
	8	Fundamentals of Intellectual Property Rights	Ramakrishna B	Notion Press, 2017	1st Edition

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Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code:MFG102 Course: Advanced Manufacturing Processes **Teaching Scheme:** Theory: 3 Hrs/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Unit-1	**Advanced Casting Processes Vacuum mould casting** Vacuum mould casting, Evaporative pattern casting, Ceramic shell casting, Counter-gravity flow - pressure casting, Semisolid metal casting, rheocasting. (06Hrs)
Unit-2	**Advanced Metal Forming Processes** Details of high energy rate forming (HERF) process. Electro-magnetic forming, explosive forming, electro-hydraulic forming, stretch forming, contour roll forming. (06Hrs)
Unit-3	**Advanced Welding Process** EBW, LBW, USW, Explosion welding, ESW and EGW, Cold pressure welding, FSW, UWW: wet and dry. Automation in welding, Remote welding, Robotic welding, Gravity welding and Fire cracker welding, selecting welding system. (06Hrs)
Unit-4	**Surface Treatment**

	Scope, Cleaners, Methods of cleaning, Surface coating types, Economics of coating, CVD, PVD, Thermal spray coating, Ion implantation, Diffusion coating, Diamond coating and cladding. (06Hrs)
Unit-5	**Non-conventional Machining Processes** Introduction, Need, Process capabilities, Parametric analysis, Advantages and Disadvantages, Applications of: AJM, WJM, USM, EDM, WEDM, LBM, ECM, ECG, CHM, PAM. (06Hrs)
Unit-6	**High-end Manufacturing Processes** E-manufacturing Nano-technology, Etching techniques: wet etch and dry etch, Lithography, Micromachining, HSM, Additive Manufacturing, 3-D Printing. (06Hrs)

References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1	Manufacturing Processes for Engineering Materials	Serope Kalpak jain and Steven R. Schmid	Pearson Education India	5th Edition
	2	Manufacturing Processes and Systems	Philip F. Ostwald and Jairo Munoz	Wiley Student Edition	9th Edition
	3	Manufacturing Technology: Foundry, Forming and Welding	P. N. Rao	McGraw Hill Education	5th Edition

	4	The 3D Printing Handbook: Technologies, Design and Applications	Ben Redwood Fileman Schoffer Brian Garrot	3D Hubs	1st Edition

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Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code:MFG103 Course: Digital Manufacturing **Teaching Scheme:** Theory: 3 Hrs/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Unit 1	**Digital design:** Geometrical design of curves, Surfaces and solids, Introduction to computer aided engineering analysis and optimum design. Consideration of manufacturing and assembly aspects in design (06Hrs)
Unit 2	**Shape digitization:** 3D object scanning, Solid reconstruction from point cloud and tessellated data, Downstream applications (06Hrs)
Unit 3	**Digital manufacturing:** Subtractive manufacturing: Basic architecture, Control hardware and software details, Tooling, Sculptured surface machining (06Hrs)
Unit 4	**Additive Manufacturing:** Basics, Hardware details and capabilities of commercial systems, Planning of material addition, Rapid tooling solutions (06Hrs)
Unit 5	**Computer Aided Process Planning:** CAPP and route sheet development, CAPP system, Computer aided plant layout, Computer Aided Production Planning and Control, Algorithms for CAPP (06Hrs)
Unit 6	**Product Database Management Systems:** Types, Management Information System, Manufacturing data preparation, Shop-floor control, automatic identification systems (sensors, trackers), Product life cycle management; and

	Introduction of Industry 4.0 (06Hrs)				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1	Fundamentals of Digital Manufacturing Science	Z. Zhou, S. Xie, D. Chen	Springer, 2012	1st Edition
	2	Rapid Prototyping: Principles and Applications	C.K. Chua, K.F. Leong, C.S. Lim	John Wiley, 2010	4th Edition
	3	Mastering CAD CAM	Ibrahim Zeid	McGraw Hill, 2005	2nd Edition
	4	Automation, production systems, and computer-aided manufacturing	M P Groover	Pearson, 2016	4th Edition
	5	Additive Manufacturing Technologies	Ian Gibson · David Rosen, Brent Stucker	Springer, 2015	2nd Edition
	6	Additive Manufacturing	C. P. Paul, A. N. Jinoop	McGraw Hill, 2021	1st Edition

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Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code:MFG104 Course: Quality System& Reliability Engineering. **Teaching Scheme:** Theory: 3 Hrs/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Unit 1	**Fundamental of Quality** Concept of quality, Contribution of Quality Gurus, Acceptance Sampling Plans for Attribute and Variable, Taguchi Quality Loss Function and Concept of Robust Design, Concept of Six Sigma, FMEA, QFD, Poka Yoke, ISO 9000 Series of Standard, QS 9000, TQM, Quality Circles. (06Hrs)
Unit 2	**Statistical Quality Control (SQC)** Definition, Benefits and Limitation of SQC, Quality Assurance, Quality Cost, Variation in Process & Process Capability, Theory of Control Chart, Uses of Control Chart, Control Chart for Variables-X Chart, R Chart and S Chart, Analysis using control charts and reasoning. (06Hrs)
Unit 3	**Process Control for Attributes** Control Chart for Attributes, Control Chart for Proportion or Fraction Defectives - p Chart and np Chart, Control Chart for Defects - C and U Charts, State of Control and Process Out of Control Identification in Charts, Inferences using control charts. Acceptance Sampling, Lot By Lot Sampling, Types – Probability of Acceptance in Single, Double, Multiple Sampling Techniques, O.C. Curves, Standard Sampling Plans for AQL and LTPD, Applications of Standard Sampling Plans.

	(06Hrs)
Unit 4	**Fundamentals of Reliability** Concept of Reliability, Failure data analysis; Failure rate; Bath tub curve; Concept of burn in period; Useful life and wear out phase of a system; Mean time to failure (MTTF); Mean time between failure, (MTBF) and mean time to repair (MTTR); Reliability in terms of Hazard rate and failure density, Conditional probability, Discrete probability distributions. (06Hrs)
Unit 5	**Time to failure distributions and Parametric Reliability Models** Introduction, Failure time estimation methods, The Likelihood Function, Method of Least Squares, Bayesian Approach, Generation of Failure-Time Data. Various distributions like Exponential Distribution, Rayleigh Distribution, Weibull Distribution, Normal distribution. Concept of Availability, Dependent Failures, Redundancy and Standby. Parametric reliability models - Approaches based on Historical Data, Operational Life Testing, Burn-In Testing and Accelerated Life Testing. (06Hrs)
Unit 6	**System Reliability Evaluation** Reliability black diagrams, Series system, Parallel systems, Mixed-parallel systems, Consecutive k-out-of-n: F systems, Reliability of k-out-of-n systems, Reliability of k-out-of-n balanced systems, Complex reliability systems, Redundancy, Important measures of components. (06Hrs)

References

Sr. No.	Title	Author	Publication	Edition
1.	Quality Control & Application	B. L. Hanson & P. M. Ghare	Prentice Hall of India.	2nd Edition
2.	Total Quality Management	D.H. Besterfiled	Pearson Education	5th Edition

	3.	Statistical Quality Control	Grant and Leavenworth	Hill Publishing Company Ltd	7thEdition
	4.	Statistical Quality Control	Montgomery D.C.	Wiley Publication	8th Edition
	5.	Statistical Quality Control	R.C. Gupta	Khanna Publishers, Delhi	10th Edition
	6.	An Introduction to Reliability & Maintainability Engineering	C. Ebling	McGraw Hill Publication	12th Edition
	7.	Reliability engineering	Elsayed A Elsayed	John Wiley & Sons Inc. Publication	2nd Edition
	8.	Reliability Engineering	L.S. Srinath	Affiliated East West Press, New Delhi.	4th Edition

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science and Technology) Syllabus of M. Tech. (Manufacturing Engineering) Semester-I	
Course Code: MFG121 Course: Product Life Cycle Management **Teaching Scheme:** Theory: 3 Hrs/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs
Unit 1	Introduction, Product Life Cycle, Product Management. Teams. Product Master plan, Case Study (05Hrs)
Unit 2	Industry, Competition, Market Segments. Product Requirements & Feasibility Case Study. (05Hrs)
Unit 3	Production and Manufacturing for PLM. Regulatory Environment, Product Warranties. Case Study (08 Hrs)
Unit 4	Marketing for Product Managers, Post Launch Analysis and Management, Case Study (07Hrs)
Unit 5	Survey of PLM Tools and Software. Matching to needs; Supply Chain Management for Product Managers case Study (05 Hrs)
Unit 6	Customer Service, End of Product Life. Product Portfolio Management. Case Study (06Hrs)

References	Sr. No.	Title	Author	Publication	Edition
	1.	Product Lifecycle Management	Martin Elinger and Ralph Stelzer	Springer-Verlag,2009	1st Edition
	2.	Product Lifecycle Management	M.Grieves	TMH	2nd Edition

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Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code: MFG122 Course: Sensors for Intelligent Manufacturing and Monitoring **Teaching Scheme:** Lecture: 3 Hrs/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Unit 1	**Basic Characteristics of Sensors** Introduction and role of sensors and continuous detection in manufacturing automation, sensor terminology, static and dynamic characteristics of transducers, signal processing and signal conditioning, operational amplifiers, filters, protection devices, analog to digital converter, and digital to analog converter. (06Hrs)
Unit 2	**Types of sensors and their Applications in Automation** Principles of different sensors such as electrical, optical, surface acoustic waves, pneumatic, magnetic, vision sensors, electro-optical, inductive, capacitive, resistive, photo sensors, through-beam detection, reflex detection, proximity detection, ultrasonic and microwave sensors for effectiveness in manufacturing automation processes. (06Hrs)
Unit 3	**Advanced Sensors in Manufacturing Systems** Sensors principles and condition monitoring parameters in manufacturing systems, sensors for monitoring force, vibration and noise, laser production, characteristics of lasers, types of laser sensors, bar code sensors, benefits of bar coding, transponder, RFID, electromagnetic identifier, optical encoders, colour sensors, unit colour measurement, colour comparator, colour sensing algorithm, fuzzy logic colour sensor, fuzzy logic for optoelectronic colour sensor in manufacturing automation.

	(06Hrs)
Unit 4	**Sensors for Special Applications** A multi objective approach for selection of sensors in manufacturing, cryogenic manufacturing applications, semiconductor absorption sensors, semiconductor temperature detector using photoluminescence temperature detectors using point contact, sensors in process manufacturing plants, measurement of high temperature, robot control through sensors, other sensors, collection and generation of process signals in decentralized manufacturing system. (06Hrs)
Unit 5	**Sensors for Precision Manufacturing Applications** Sensors for CNC machine tools, linear and angular position and velocity sensors, automatic identification techniques for shop floor control, bar code scanners, radio frequency systems, optical character and machine vision sensors, smart/intelligent sensors, integrated sensors, and adaptive control of machine tools. (06Hrs)
Unit 6	**Role of Sensors and Control Technology in CIM** CIM plan, manufacturing enterprise model, design of CIM from viewpoints of sensors and control systems, decision support system for CIM, analysis of CIM with sensors and control system, data acquisition for sensors and control systems in CIM, and developing CIM strategies with emphasis on sensors role in manufacturing. (06Hrs)

Reference	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Sensors and Control systems in Manufacturing	S. Soloman	McGraw Hill International EditionsUSA, 1987	2nd Edition
	2.	Standard Handbook of Industrial Automation	D. M. Considiene, G.	Chapman and Hall, 1975.	1st Edition

			D. Considine		
	3.	Tool and Manufacturing Engineers HandbookVol. I, II, III and IV	Charles Wick, CMfgE Raymond F Veilleux	Tata McGraw-Hill1985	4th Edition
	4.	In-process Measurement and Control	S. D. Murphy	Marcel Dekker, 1983.	1st Edition
	5.	Applying Machine Vision Sensor Technology Handbook	N. Zuech	Jon S. Wilson	1st Edition
	6.	Mechanical measurement	Thomas Beckwith Roy Marangoni	Pearson	6th Edition
	7.	Sensors and Transducers	Ian Sinclair	Newnes	3rd Edition

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Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code: MFG123 Course: Non Conventional Machining **Teaching Scheme:** Lecture: 3 Hrs/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Unit 1	**Introduction** Needs for nontraditional machining processes, classification and comparative analysis of AJM, WJM, Ultrasonic Machining ECM, EDM, Laser Machining Processes. (06Hrs)
Unit 2	**Abrasive jet machining** Fundamental principle, application process parameters, MRR models. Water jet machining: Fundamental principle, application process parameters. (06Hrs)
Unit 3	**Chemical machining** Principle of operation, etch ants and mask ants, photochemical process, equipment, applications. Process principle Dynamics of ECM Process, Analysis of material removal in Electrochemical machining, tool design, applications. (06Hrs)
Unit 4	**Ultrasonic machining** Physical principles Physical principles of USM, Process parameters, Transducers types materials and design, Horn design: Shaws model of MRR, other applications of Ultrasonic machining. (06Hrs)
Unit 5	**Electrical discharge machining**

	Operating principles of EDM, Effects of Dielectric fluids, Electrode materials ,power generators, process parameters and their effects, flashing, wire EDM process, applications. Laser Beam Machining. (06Hrs)
Unit 6	**Lasing process** Types of lasers (Gas and solid state), lasing mediums, laser material processing-cutting, drilling, surface treatment, special applications. (06Hrs)

References

Sr. No.	Title	Author	Publication	Edition
1.	Modern Machining Processes	P.C. Pandey & H.S. Shan	Tata McGraw Hill	1st Edition
2.	Advanced Machining Processes	Vijay K.Jain	Allied Publishers	2nd Edition
3.	Non traditional Manufacturing Processes	G.F. Benedict, Marcel Dekker Inc	CRC Press	1st Edition
4.	Advanced Methods of Machining	McGeough, Joseph A	Chapman and Hall, London 1988	1st Edition
5.	New Technology	A. Bhattacharya	Institute of Engineers, India,1973	1st Edition
6.	Material & Processes in Manufacturing	Paul De Garmo, J.T. Black and Ronald A. Kohser	Prentice Hall College Div	8th Edition
7.	Advanced Machining Processes	Hassan Abdel-Gawad El-Hofy	Tata McGraw Hill	1st Edition

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Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code:MFG111 Course: Lab-I (Data Analytics Lab: -R Programming) **Teaching Scheme:** Practical: 2 Hrs /week	Credits: 0-0-1 (1) Credits: 1 Practical/Oral Exam: -NA Teacher's Assessment/Term Work: 25 Marks

Course Objectives:

1. Understand the R Programming Language.
2. Exposure on visualizing data science problems.
3. Understand the classification and Regression Model.

Contents

No of Particles to be performed not less than 10

1. Introduction to R Programming and Study of basic Syntax in R
2. R as a Calculator application:
   a. Using with and without R objects on console
   b. Using mathematical functions on console
   c. Write an R script, to create R objects for calculator application and save in a Specified location in disk.
3. Descriptive Statistics In R
   a. Write an R script to find basic descriptive statistics using summary, str, quartile function
   b. Write an R script to find subset of dataset by using subset (), aggregate () functions on sample dataset
4. Reading and Writing Different Types of Datasets
   a. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location.

b. Reading Excel data sheet in R.

c. Reading XML dataset in R.

5. Visualizations

a. Find the data distributions using box and scatter plot.

b. Find the outliers using plot.

c. Plot the histogram, bar chart and pie chart on sample data

Study and implementation of various control structures in R and calculate mean mode median for a dataset

6. Correlation and Covariance

a. Find the correlation matrix.

b. Find the outliers using plot.

c. Plot the correlation plot on dataset and visualize giving an overview of relationships among data.

7. Regression Model

Import a data from web storage. Name the dataset and now do Linear/Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her entrance score

8. Classification Model

a. Install relevant package for classification.

b. Choose classifier for classification problem.

c. Evaluate the performance of classifier.

9. Clustering Model

a. Clustering algorithms for unsupervised classification.

b. Plot the cluster data using R visualizations.

10. Mini Project

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Syllabus of Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code:MFG112	Credits: 0-0-1 (1)
Course: Lab-II:-Master CAM	Term work: 25 Marks
Teaching Scheme:	
Practical: 02 Hr/week	

Course Content:

The lab work consists of the assignments/experiments related to

Lathe:

2D Geometric Modelling, File conversions (Data conversions),tool paths for Turning, Facing, Grove cutting, drilling, taping and tool paths verification and CNC Part Program generation.

Mill:

2D and 3D Geometric Modelling, Tool paths for 2D machining like countering, pocketing, Island pocketing, Drilling, Plane milling,

Surface Modelling 3D surfaces (Coons, Ruled, Revolved, Tabulated etc), Tool paths for 3D machining, Surface machining, Verification and CNC part program generation.

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Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code:MFG113	Credits: 0-0-1 (1)
Course : Lab-III[MATLAB]	Term work: 25 Marks
Teaching Scheme:	
Practical: 02 Hr/week	

Course Content:

The lab work consists of the assignments/experiments related to

Introduction to MATLAB Software

1. MATLAB window: Command window, Workspace, Command history, setting directory, Working with the MATLAB user interface
2. Basic commands, Assigning variables, Operations with variables
3. Data Types: Character and string, Arrays and vectors, Column vectors, Row vectors
4. Basic Mathematics: BODMAS Rules, Arithmetic operations, Operators and special characters, Mathematical and logical operators, Solving arithmetic equations
5. Operations on matrix: Crating rows and columns Matrix, Matrix operations, Finding transpose, determinant and inverse, Solving matrix
6. Other operations: Trigonometric functions, Complex numbers, fractions, Real numbers, Complex numbers
7. Plots: Plotting vector and matrix data, Plot labelling, curve labelling and editing, 2D plots: Basic Plotting Functions, Creating a Plot, Plotting Multiple Data Sets in One Graph, Specifying Line Styles and Colours, Graphing Imaginary and Complex Data, Figure Windows, Displaying Multiple Plots in One Figure, Controlling the Axes

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(Faculty of Science & Technology)

Syllabus of M. Tech. (Manufacturing Engineering) Semester-I

Course Code: MFG114 Course: Seminar **Teaching Scheme:** Practical: 04 Hr/week	Credits: 0-0-2 (2) Pr-Oral : 50 Marks

Objective:

To train students in identification, analysis, and prepare report of it.

The course content of seminar shall be from emerging / thrust areas, topics of current relevance having research aspects or shall be based on industrial visits.

Students can also choose live problems from manufacturing organizations as their seminar topic.

At the end of the semester, the students should submit a report and appear for End Semester **Examination.**

End Semester Examination will be assessed by Examiner appointed by University and internal guide. Seminar will have end Semester examination of 50 marks.

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(Faculty of Science & Technology)

Syllabus of M. Tech. (Manufacturing Engineering) Semester-II

Course Code:MFG141 Course: Advanced Optimization Techniques **Teaching Scheme:** Lecture: 3 Hrs/week Tutorial: 1 Hr/week	Credits: 3-1-0 (4) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Unit1	**Introduction** Optimal Problem Formulation, engineering optimizations Problems, Optimization Algorithms Single Variable Optimization Algorithms**:** Optimality criteria, bracketing methods, region elimination methods, point estimation methods, gradient base methods, root finding using optimization techniques. (06Hrs)
Unit 2	**Multivariable optimization Algorithms** Optimality criteria, unidirectional search, direct search methods, gradient based methods. (06Hrs)
Unit 3	**Constrained Optimization Algorithms** Kuhn-Tucker conditions, transformation methods, Sensitivity Analysis, direct search for constrained minimization, linearized search techniques, feasible direction method, generalized reduced gradient method, and gradient projection method. (06Hrs)
Unit 4	**Fuzzy Logic** Introduction to Fuzzy logic: Fuzzy sets and membership functions, operations on fuzzy sets, fuzzy relations, rules, propositions, implications and inferences, defuzzification techniques, fuzzy logic controller design, some applications of fuzzy

	logic. (06Hrs)
Unit 5	**Special Optimization Algorithms** Integer programming, geometric programming, Genetic Algorithm, Simulated annealing, Global optimization, ant colony optimization. (06Hrs)
Unit 6	**Optimization in Operations Research** Linear Programming Problems, simplex method, artificial variable technique, dual phase method, sensitivity analysis. (06Hrs)

References

Sr. No.	Title	Author	Publication	Edition
1.	Optimization for Engineering Design	Deb Kalyanmoy	PHI, New Delhi	2nd Edition
2.	Engineering Optimization	Rao S.S.	John Wiley, New Delhi	3rd Edition
3.	Multi-Objective Algorithms using Evolutionay Algorithms	Deb Kalyanmoy	John Wiley, New Delhi.	1st Edition
4.	Principles of Optimum Design: Modelling and Computation	Paplambross P. Y. and Wilde D. J.	Cambridge University Press, UK	2nd Edition
5.	Optimization concepts and Applications in Engineering	Ashok D Belegundu Tirupathi R. Chandupatla	Cambridge University Press	3rd Edition

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of M. Tech. (Manufacturing Engineering) Semester-II	
Course Code: MFG142 Course: Green Manufacturing **Teaching Scheme:** Lecture: 3 Hrs/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs
Unit 1	Introduction to green processes Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage alternate biodegradable materials Emission less manufacturing- Industrial Ecology – Pollution prevention – Reduction of toxic emission – design for recycle. (06Hrs)
Unit 2	Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution from industry point of view. Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment, and properties, Natural and Anthrogenic Noise Sources, Masking of sound, Types, Kinetics, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts. (06Hrs)
Unit 3	Principles of sustainable operations - Life cycle assessment manufacturing and service activities - Influence of product design on operations - Process analysis - Capacity management - Quality management -Inventory management - Just-In-Time systems - Resource efficient design - Consumerism and sustainable well-being. (06Hrs)
Unit 4	Green supply Chains – Need for Green Supply Chains – Implications of modern

	supply chain management – The supply chain strategy – Ingredients of green supply chain strategy. Evaluating the impact of GSCM activities on sustainability – Economic, Environmental and social impacts of GSCM Stages of GSCM - performance measurement. (06Hrs)				
Unit 5	Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration – Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act. (06Hrs)				
Unit 6	Recyclable materials, bioplastics, tapping into renewable energy sources, embracing digital manufacturing, Application of AI in manufacturing, AR and VR (Augmented reality and virtual reality), Basics of Environmental accounting national, global and corporate. (06Hrs)				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Industrial Ecology	Gradel.T.E. and B.R. Allenby	Prentice Hall -2010	
	2.	World Commission on Environment and Development (WCED), Our Common Future		Oxford University Press, 2005	1st Edition
	3.	Costing the Earth: The Challenge for	Frances Cairncross	Harvard Business	

		Governments, the Opportunities for Business		School Press –1993	
	4.	Environmental Pollution Control Engineering	Rao CS	Wiley Eastern Ltd., New Delhi, 2006.	2nd Edition
	5.	Industrial noise control, Fundamentals and applications	Lewis H Bell and Douglas H Bell	Marcel Decker, 1994.	2nd Edition
	6.	Environmental Accounting: Energy and Environmental Decision Making	Odum, H.T.	Wiley, U.S.A.	
	7.	Green Supply Chain Management	Charisios Achillas, Dionysis D. Bochtis, Dimitrios Aidonis, Dimitris Folinas		
	8.	Environmental Policy New Directions for the Twenty-First Century	Norman J. Vig - Carleton College, Minnesota,Michael E. Kraft - University of Wisconsin, Green Bay, USA, Barry G. Rabe - University of Michigan, USA	Sage Publication	11th Edition

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (Faculty of Science & Technology) Syllabus of M. Tech. (Manufacturing Engineering), Semester-II	
Course Code:MFG143 Course Title: Characterization of Materials Teaching Scheme: Theory: 3 Hrs./week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs
Course Objectives	1. To study basic description of a range of common characterization techniques and analysis of results. 2. To provide a thorough introduction to the principles of diffraction. 3. To understand the basics of surface texture and techniques to analyze texture.
Unit 1	Importance of characterization studies in materials science – Applications in industry and research, review of materials science fundamentals – crystal structures, defects in crystal structure, structure and property correlation, structure sensitive/ insensitive properties. Introduction to Elemental composition techniques – AAS, AES. (06Hrs)
Unit 2	Principles of image formation – brightness, contrast, resolution, depth of field, focus, aberrations (spherical, chromatic and astigmatism), remedial measures for aberrations, levels of characterization (macro, meso and micro). OM, PLOM. (04Hrs)
Unit 3	SEM – working principle and construction, advantages/ disadvantages as compared to OM, types of electron gun feature and comparison, beam-sample interaction, interaction volume concept, Imaging modes (secondary and backscattered), effect of spot size, apertures, accelerating voltage on SEM image. (08Hrs)

Unit 4	Elemental analysis techniques using SEM – WDS, EDS, EPMA, XRF. Introduction to Surface analysis methods – AES, XPS. (08Hrs)
Unit 5	XRD – generation of X-rays, characteristic X-ray spectrum, Bragg's Law, diffraction methods - powder method, applications in crystal structure, macro-texture and residual stress determination. (04Hrs)
Unit 6	Thermal analysis techniques – DSC, DMA, DTA and TGA. Chemical characterization – FTIR and Raman spectroscopy. (06Hrs)

References

Sr. No.	Title	Author	Publication	Edition
1.	Introduction to Materials Characterization	Yang Leng	John Wiley & Sons	1st Edition
2.	Metallography: Principle and practice	George F , Vander Voort	Mc Graw Hill Inc.	4th Edition
3.	Fundamental of Light Microscopy and Electronic Imaging	Douglas B. Murphy, Michael W. Davidson	John Wiley & Sons	2nd Edition
4.	Elements of X-ray Diffraction	B. D. Cullity and S. R. Stock	Prentice Hall, Inc.	1st Edition
5.	ASM Handbook Volume 10 Materials Characterization	R. E. Whan (Editor)	ASM international, USA	2019 Edition
6.	Differential Scanning Calorimetry	G. Hohne, W.F. Hemminger	Springer	1st Edition

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

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Syllabus of M. Tech. (Manufacturing Engineering), Semester-II

Course Code:MFG144 Course: Theory of Metal Forming **Teaching Scheme:** Lecture: 3 Hrs/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Unit 1	Stress-strain relations in elastic and plastic deformation, Yield criterion for ductile material. Relationship between tensile and shear yield stresses. Introduction and Fundamentals of metal forming, Mechanics of metal working, Forming equipments, Presses- (Mechanical and Hydraulic) (06Hrs)
Unit 2	Theory of Plasticity: Mechanical behavior of Metals and alloys under plastic deformation, Strain hardening hypothesis, Flow stress and flow curves, Material incompressibility. Introduction of super plastic metal forming, super plastic metal forming working principle, super plastic metal forming types, it's advantages and applications. (06Hrs)
Unit 3	Formulation of plastic deformation problem, Application of theory of plasticity and solving metal forming problems using slab method, Upper and lower bound methods, slip line field theory, Effect of temperature and strain rate in metal working. (06Hrs)
Unit 4	Analysis of a) Rolling- Determination of Rolling Pressure, Roll separating Force, Driving torque and power, Power loss in bearing, Bending- Determination of work load, Estimation of spring back. (Derivation and Numerical) (06Hrs)

Unit 5	b) Forging-Forging of Strip and Disc c) Extrusion-Determination of Work load from stress analysis and Energy consideration, Determination of Power Loss. (Derivation and Numerical) (06Hrs)				
Unit 6	Analysis of metal forming process -Wire Drawing, Sheet metal forming processes like Deep Drawing, Stretch forming. Introduction to Finite Element Analysis of Metal Forming Processes. (Derivation and Numerical) (06Hrs)				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Manufacturing Science	Ghosh and Mallik	East-West Private Limited	2nd Edition
	2.	Principal of Industrial Metal working Processes	G. W. Rowe	CBS Publisher, 2005	2nd Edition
	3.	Mechanical Metallurgy	George E. Dieter	McGraw Hill Higher Education	3rd Edition
	4.	Metal Formingmechanics and Metallurgy	W F Hosford and R M Caddel	Cambridge University Press, 2011	4th Edition
	5.	Metal Forming: Processes and Analysis	Hill, R	Claredon Press, 1998	1st Edition

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Syllabus of M. Tech (Manufacturing Engineering), Semester- II

Course Code:MFG161 Course Title: Intelligent Industrial Systems (Professional Elective-II) **Teaching Scheme:** Theory: 3 Hrs./week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02 Hrs

Course Objectives	1. Understand the importance of Artificial Intelligence in Manufacturing systems. 2. Understand the importance of Knowledge Based Systems in Manufacturing systems. 3. Developing the capability of applying Intelligent Systems in Manufacturing Systems. 4. Assess the performance of Manufacturing Systems 5. Develop a systematic approach for design and implementation of Manufacturing Systems. 6. Suggest new procedures to improve the productivity of existing manufacturing systems.
Unit 1	Computer Integrated Manufacturing Systems Structure and functional areas of CIM system – CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM. Manufacturing Communication Systems – MAP/TOP, OSI Model, Data Redundancy, Top- down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing System Components, System Architecture and Data Flow, System Operation. (06Hrs)
Unit 2	Components of Knowledge Based Systems – Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition, Clustering.

	Applications in Manufacturing Systems. (06Hrs)
Unit 3	Machine Learning – Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks – Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing. (06Hrs)
Unit 4	Automated Process Planning – Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES. (06Hrs)
Unit 5	Group Technology: Models and Algorithms Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation – Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. (06Hrs)
Unit 6	Knowledge Based Group Technology – Group Technology in Automated Manufacturing System. Structure of Knowledge based system for group technology (KBST) — Data Base, Knowledge Base, Clustering Algorithm. (06Hrs)

References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Intelligent Manufacturing Systems	Andrew Kusiak	Prentice Hall.	
	2.	Artificial Neural	Yagna	Prentice Hall.	12th Edition

		Networks	Narayana		
	3.	Automation, Production Systems and CIM	Groover M.P.	Prentice Hall.	3rd Edition
	4.	Design and Implementation of Intelligent Manufacturing Systems	Hamid R Parsaei and Mohammad Jamshidi	Prentice Hall.	1st Edition
	5.	Introduction to Artificial Neural Systems	Jacek M. Zurada	JAICO Publishing House Ed	1st Edition

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Syllabus of M. Tech (Manufacturing Engineering), Semester- II

Course Code:MFG162 Course: Mechatronics and Robotics(Professional Elective-II) **Teaching Scheme:** Theory: 3 Hrs/week Tutorial: 0 Hr/week	Credits: 3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02Hrs

Unit 1	**Introduction to Mechatronics:** Definition and Approach of Mechatronics, Measurement and Control Systems, Sensors and Transducers: Performance Terminology, Displacement, Velocity, Position, Proximity, Force, Fluid Pressure, Liquid Level, Temperature, Light Sensors, Procedure for Selection; Microprocessor Based Controllers and Mechatronics Approach; Signal Conditioning: Op Amp, Protection, Digital Signals, Multiplexes and Digital Signal Processing, Pulse Modulation. (06Hrs)
Unit 2	**Drives and Controllers:** Actuation Systems, Direction control valves , Pressure and Process Control Valve, Pneumatic and Hydraulic Systems; Electrical Actuation System: Mechanical Switches, Solid State Switches, Solenoid, DC/AC Motors, Stepper Motors; Microprocessor and its Application: Architecture of Microprocessor 8085, Instruction Set, Embedding a Microprocessor into a Mechatronics System. (06Hrs)
Unit 3	**Introduction to robotics and Kinematics**: Robotics configuration, Need and Classifications of Robots, Characteristics of robot, Robot Peripherals, Sensors, Robot Kinematics, Homogeneous Transformations, Forward & Inverse Kinematics. (06Hrs)
Unit 4	**Robot Control Units**: Motion Controls. Problems of Dynamics, Differential

	Relationships, Motion Trajectories, , Dynamics of Robot Control of Single & Multiple Link Robot, Static Force Analysis. (06Hrs)
Unit 5	**Robot Programming And Machine Vision**: Robot Programming: Different Languages Expert Systems, Teach and Pendent Method, Image Processing & Analysis, Application of Artificial Intelligence, Voice Communication. (06Hrs)
Unit 6	**Robot Applications in Manufacturing:** Material Transfer & Machine Loading/Unloading, Processing Operations, Inspection, Automation, Robot Cell Design, Control, Recent Developments and Special Applications, Micro & Bio Robotics. (06Hrs)

References

Sr. No.	Title	Author	Publication	Edition
1.	Mechatronics	Bolton, W.	Tata Mcgraw-Hill, New Delhi	1st Edition
2.	Introduction to Mechatronics	Shetty, D. and Richard, A.K.	Tata McGraw Hill, 2003	1st Edition
3.	Mechatronics System Design	Mahalik, N.	PWS Pub. Boston. 1997	2nd Edition
4.	Principles, Concept and Applications: Mechatronics	Bolton, W.	Tata McGraw. 2003	1st Edition
5.	Mechatronics: A Multidisciplinary Approach	Merzouki R., Samantaray A. K., Pathak P.M., Bouamama B.	Prentice Hall. 2009	4th Edition

			Ould		
	6.	Intelligent Mechatronic Systems: Modeling, Control and Diagnosis	Springer 2013 Mechatronics, Intl. J	Pergamon Press	
	7.	Robotics: Fundamental concepts and analysis	A. Ghosal	Oxford university press, 2006	1st Edition
	8.	Industrial Robotics	M P Groover	Pearson Edu, 2008	1st Edition
	9.	Robotics and Control	R K Mittal & I J Nagrath	Tata McGraw-Hill ,2003	
	10.	Robotics: Control, sensing, vision and intelligence	K Fu, R Gonzalez, and C S G Lee	McGraw Hill, 1987	2nd Edition
	11.	Robot Dynamics & Control	Mark W. Spong and M. Vidyasagar	John Wiley & Sons (ASIA) Pte Ltd, 1989	1st Edition
	12.	Automation, Production systems and Computer Integrated Manufacturing	M P Groover	Prentice Hall India, 1987	4th Edition

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(Faculty of Science & Technology)

Syllabus of M. Tech (Manufacturing Engineering), Semester- II

Course Code:MFG163 Course: Finite Element Method(Professional Elective-II) **Teaching Scheme:** Lecture: 3 Hrs/week	Credits:3-0-0 (3) Mid Semester Examination-I: 15 Marks Mid Semester Examination-II: 15 Marks Teacher Assessment: 20 Marks End Semester Examination: 50 Marks End Semester Examination (Duration): 02Hrs

Unit 1	Introduction to Finite Difference Method and Finite Element Method, Advantages and disadvantages, Mathematical formulation of FEM, Variational (Rayleigh-Ritz) Method, Potential Energy Method, Weighted Residual (Galerkin) Approach, Weighted Residual (Least Squares) Approach. (06Hrs)
Unit 2	Shape functions, Natural co-ordinate system, Element and global stiffness matrix, Boundary conditions Errors, Convergence and patch test, Higher order elements. (06Hrs)
Unit 3	Applications: problems of structural mechanics and solid mechanics, Plane stress and plane strain problem, 3-D problems. Torsion, bending of plates and shells, (06Hrs)
Unit 4	FE formulation for vibration, heat transfer, and fluid flow problems. (06Hrs)
Unit 5	Application of the method to materially non-linear bending of straight beams and elastic plates problems, associated flowcharts and computer programming, Data preparation and mesh generation through computer graphics, Numerical techniques, 3D problems. (06Hrs)

Unit 6	FEM an essential components of CAD, Use of commercial FEM packages, ANSYS Software and MATLAB Programs for Finite Element Analysis, Comparison with conventional analysis. (06Hrs)				
References	**Sr. No.**	**Title**	**Author**	**Publication**	**Edition**
	1.	Finite Element Analysis	C.S.Krishnamoorty	Tata McGraw-Hill	1st Edition
	2.	Computer Analysis of Framed Structures	D. Maity	I.K. International Pvt. Ltd. New Delhi	3rd Edition
	3.	Fundamentals of Finite Element Analysis,	David V. Hutton,	McGraw Hill	3rd Edition
	4.	Introduction to the Finite Element Method: Theory, Programming and Applications	Erik G. Thompson	Wiley, 2005	1st Edition
	5.	Introduction to Finite Element Analysis - Theory and Application	John Wiley H. C. Martin and G. F. Carey	NewYork, McGraw-Hill	1st Edition
	6.	Finite Element Procedures,	K. J.Bathe,	Prentice-Hall of India, New Delhi, India	2nd Edition
	7.	Matrix and Finite Element Analysis of Structure	M. Mukhopadhyay	Ane Books pvt Ltd.	2nd Edition

	8.	The Finite Element Method in Structural and Soild Mechanics,	Zienkiewicz and Y.K. Cheung,	McGraw Hill, London	5th Edition
	9.	A History of Modern Computing,	P.E. Ceruzzi,	The MIT Press, Cambridge, MA, 1998.	1st Edition
	10.	Finite Element Analysis	Wiley S.S. Rao,	Elsevier Butterworth-Heinemann	1st Edition

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Syllabus of M. Tech (Manufacturing Engineering), Semester- II

Course Code:MFG151 Course: Lab IV: Advanced Optimization Techniques **Teaching Scheme:** Practical: 2 Hrs/week	Credits: 0-0-1 (1) Term-work: 25 Marks

The lab work consists of the assignments/experiments related to

The lab experiments shall be conducted to solve the numerical on

- LPP – using software LINGO/LINDO/MS Excel/PYTHON
- Single variable and multi variables with constrained and unconstrained optimization using MATLAB/PYTHON
- Non-traditional optimization with MATLAB/PYTHON

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Syllabus of M. Tech. (Manufacturing Engineering), Semester-II

Course Code: MFG152	Credits: 0-0-1 (1)
Course: LAB-V Characterization of Materials	Term Work: 25 Marks
Teaching Scheme:	
Practical: 2 Hr./week	

Course Content:

The lab work consists of the assignments/experiments related to

1. Sample preparation techniques for microscopy.
2. Interaction volume concept of electron beam.
3. Case study on microstructure analysis by OM, SEM and TEM.
4. Case study on elemental analysis by XRD, WDS and EDS.
5. Case study on surface analysis.
6. FTIR and DSC analysis of polymers.

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Syllabus of Syllabus of M. Tech. (Manufacturing Engineering), Semester-II

Course Code:MFG153 Course: Lab-VI [Advanced MATLAB Programming] **Teaching Scheme:** Practical: 02 Hr/week	Credits: 0-0-1 (1) Term work: 25 Marks

Course Content:

The lab work consists of the assignments/experiments related to

Programming in MATLAB Software .

1. GUI Design: Introduction of Graphical User Interface, GUI Function Property, GUI Component Design, GUI Container, Writing the code of GUI Call back.
2. MATLAB Programming: Automating commands with scripts, Writing programs with logic and flow control, Writing functions, Control statement Programming, Conditional Statement Programming, Examples.
3. Loops and Conditional Statements: Control Flow Conditional Control if, else, switch
   Loop Control for, while, continue, break Program Termination return
4. Functions: Writing user defined functions, Built in Function, Function calling, Return Value, Types of Functions, Global Variables
5. MATLAB Toolbox: Optimization Toolbox, Fuzzy logic Toolbox, Global Optimization Toolbox, Neural Network Toolbox, Statistics and Machine Learning Tool Box.
6. Introduction to Simulink

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Syllabus of M. Tech. (Manufacturing Engineering), Semester-II

Course Code:MFG154 Course: Mini Project **Teaching Scheme:** Practical: 4 Hr./week	Credits: 0-0-2 (2) Practical /Oral : 50 Marks

Course Content:

A group of students or individual students are required to choose a topic of interest. To train students in identification, analysis, finding solutions and execution of live engineering and managerial problems. The course content of the mini project shall be from emerging / thrust areas, topics of current relevance having research aspects or shall be based on industrial visits.

Students can also choose live problems from manufacturing organizations as their mini project.

At the end of the semester, the students should submit a report and appear for End Semester Examination.

End Semester Examination will be assessed by Examiner appointed by University and internal guide. Mini Project will have end Semester examination of 50 marks.

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Syllabus of M. Tech.(Manufacturing Engineering), Semester-III

Course Code:MFG201 Course: MOOC Course **Teaching Scheme:** Online Course (Minimum12Weeks)	Credits:3-0-0 (3) End Semester Exam:100Marks

It is mandatory for the student to complete one MOOC course related to the program of study. The student will have to complete the MOOC course which will be available on the SWAYAM portal (Free online education portal). Registered MOOC courses should not have similar or overlapping content to that of the regular courses in the curriculum of the program. The credits can be given to the students after successful completion of the MOOC course of 12 weeks or more.

The credits will be transferred by the evaluation in terms of assignments or examinations or viva-voce. In case the student is unable to clear MOOC Course examination, the student will have to appear for an Institute-level examination for the respective MOOC course.

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Syllabus of M. Tech.(Manufacturing Engineering), Semester-III

CourseCode:MFG211 Course: Dissertation-I **Teaching Scheme:** Practical: 18Hr/week	Credits:0-0-9 (9) Term-work:50Marks Vivavoce:100Marks

The dissertation shall consist of a report on any research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and /or development work that the candidate has executed. The report must include comprehensive literature work on the topic selected for dissertation.

Term-work: The dissertation part-I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be a senior faculty member from the department.

Viva Voce: The dissertation part-I will be in the form of seminar report on the project work being carried out by the candidate and will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be an external examiner.

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Syllabus of M. Tech.(Manufacturing Engineering), Semester-V

Course Code:MFG251 Course: Dissertation-II **Teaching Scheme:** Practical: 24Hr/week	Credits:0-0-12 (12) Term-work:100Marks Vivavoce:100Marks

The dissertation part-II will be in continuation of dissertation part-I and shall consists of a report on the research work done by the candidate or a comprehensive and critical review of any recent development in the subject or detailed report of the project work consisting of a design and /or development work that the candidate has executed. The examinee shall submit the dissertation in triplicate to the head of the institution duly certified by the guide and the concerned head of the department and the Principal that the work has been satisfactorily completed.

Term-work:

The dissertation will be assessed by two examiners appointed by the university, one of whom will be the guide and other will be a senior faculty member from the department.

Viva-Voce:

It shall be consists of a defense presented by the examinee on his research work in the presence of the examiners appointed by the university, one of whom will be the guide and other will be an external examiner.